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EPA

Summary and Analysis of Comments: Control of Emissions from Unregulated Nonroad Engines

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Assessment and Standards Division
Office of Transportation and Air Quality
U.S. Environmental Protection Agency

Chapter 1: Introduction/Background

On October 5, 2001, EPA published a Notice of Proposed Rulemaking (NPRM) which put forth proposed emission standards and test procedures for large spark-ignition (SI) engines; recreational vehicles using spark-ignition engines such as off-highway motorcycles, all-terrain vehicles, and snowmobiles; and recreational marine diesel engines. For large SI engines, a two-phase program was proposed. The first phase of the standards, to go into effect in 2004, will reduce combined HC and NOx emissions by nearly 75 percent, based on a steady-state test. These standards will be supplemented in 2007 by setting limits that will require optimizing the same technologies, but emission measurements will be based on a transient test cycle, new requirements for evaporative emissions and engine diagnostics will also start during this phase. For snowmobiles, the Agency proposed adopting a first phase of standards for HC and CO emissions based on clean carburetion or 2-stroke electronic fuel injection (EFI) technology, and a second phase of emission standards that will 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, the Agency proposed standards that will reduce emissions by 50 percent, based mainly on moving these engines from 2-stroke to 4-stroke technology and a second phase of standards for all-terrain vehicles that will require some catalyst use. For recreational marine diesel engines we proposed standards similar to the existing standards for commercial marine diesel engines.

The NPRM announced that public hearings would be held on October 24, 2001 and October 30, 2001 and that the comment period would extend until December 19, 2001. On December 18, 2001 EPA published a notice extending the comment period to January 18, 2002.

On May 1, 2002, EPA published a notice reopening the comment period until May 31, 2002. The notice requested comment on whether, pursuant to previous comments, EPA should finalize emission standards regulating permeation emissions from land-based recreational vehicles.

Commenter	Abbreviation	Docket No.
ABATE of Illinois		IV-D-169
Adirondack Mountain Club		IV-D-164
Air Transport Association	ATA	IV-D-190
American Motorcyclist Association	AMA	IV-D-
Appalachian Mountain Club	AMC	IV-D-167
Association of Equipment Manufacturers	AEM	IV-D-179
(Association of Local Air Pollution Control Officials	ALAPCO	IV-D-200)
Automotive Engine Rebuilders Association	AERA	IV-D-159
Backcountry Skiers Alliance	BSA	IV-D-
Bluewater Network		IV-D-186
BlueRibbon Coalition	BRC	IV-D-175
Briggs & Stratton		IV-D-194
California Air Resources Board	CARB	IV-D-198
California Motorcycle Dealers Association	CMDA	IV-D-172
Carver Boat Corporation	Carver	IV-D-170
Caterpillar		IV-D-188
Connecticut Department of Environmental Protection	CT	IV-D-
Construction Industry Manufacturers Association*	CIMA	(*See AEM*)
Cummins Inc.	Cummins	IV-D-210
Earthjustice Legal Defense Fund		IV-D-178
Engine Manufacturers Association	EMA	IV-D-
Environmental Defense[1]		IV-D-202
Equipment Manufacturers Institute*	EMI	(*See AEM*)
Fast, Inc		IV-D-195
Ford Motor Company	Ford	IV-D-173
Gas Processors Association	GPA	IV-D-162
George Mason University- Mercatus Center	Mercatus Center	IV-D-166
GFI Control Systems, Inc.	GFI	IV-G-03
Hinckley Company (The)IV-D-177		
Honda Motor Company Ltd.	Honda	IV-D-207
International Snowmobile Manufacturers Association	ISMA	IV-D-204
Industrial Truck Association	ITA	IV-D-211
Kawasaki Motors Corp., USA	Kawasaki	IV-D-192
Mach 1 Motorsports		IV-D-160
Manufacturers of Emission Controls Association	MECA	IV-D-213
Mercury Marine		IV-D-212
Minnesota House of Representatives		IV-D-199
Mitsubishi Motors R&D of America	Mitsubishi	IV-G-04/D-193
Motorcycle Industry Council	MIC	IV-D-214
Motorcycle Riders Foundation (The)	MRF	IV-G-18

[1]Also the Grand Canton Trust, the Wasatch Clean Air Coalition, and the Wyoming Outdoor Council.

National Association of Home Builders	NAHB	IV-D-187
National Marine Manufacturers Association	NMMA	IV-G-02
National Propane Gas Association	NPGA	IV-G-16/D-197
Natural Resources Defense Council	NRDC	IV-D-183
Natural Trails and Waters Coalition	NTWC	IV-D-
New Hampshire Department of Environmental Services	DES	IV-D-191
Nissan Motor Co., Ltd.	Nissan	IV-D-161
Northeast States for Coordinated Air Use Management	NESCAUM	IV-D-196
Occupational Safety and Health Administration	OSHA	IV-D-174
Outdoor Power Equipment Institute	OPEI	IV-D-203
Ozone Transport Commission	OTC	IV-D-171
Peninsular Engines, Inc.	Peninsular	IV-D-180
Pennsylvania Department of Environmental Protection	Pennsylvania	IV-D-165
Polaris Industries	Polaris	IV-D-209
Rev! Motorcycles		IV-D-184
Sierra Club Recreation Issues Committee	RIC	IV-D-185
Sonic USA, IncIV-D-181		
Sonex Research, Inc.	Sonex	IV-D-201
South Carolina Department of Health and Environmental Control		IV-D-
Southern Rockies Forest Network[2]	SRFN	IV-D-182
State and Territorial Air Pollution Program Administrators	STAPPA	IV-D-200
Tanaka Kogyo Co., Ltd.	Tanaka	IV-D-158
Tecumseh Products	Tecumseh	IV-D-
Toro		IV-D-163
Utah Snowmobile Association	USA	IV-D-168
Westerbeke Corporation	Westerbeke	IV-D-208
Wisconsin Motors, LLC	Wisconsin	IV-D-176
Miscellaneous:		
Concerned Bikers Association		IV-D-205

* The Construction Industry Manufacturers Association (CIMA) and the Equipment Manufacturers Institute (EMI) have merged and are now know as the Association of Equipment Manufacturers (AEM).

[2] Also Aspen Wilderness Workshop, Backcountry Skiers Alliance, Biodiversity Associates, Colorado Environmental Coalition, Colorado Mountain Club, Colorado Wild High County Citizens' Alliance, Rocky Mountain Recreation Initiative, The Wilderness Society, Western Colorado Congress, and the Western Slope Environmental Resource Council.

Summary and Analysis of Comments: Common Issues

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II. Chapter 2: Common Issues

A. Engines Covered by the Rule

What We Proposed:

We proposed emission controls for new nonroad vehicles and engines that have yet to be regulated under our nonroad engine programs. They cover land-based spark-ignition recreational engines, including those used in snowmobiles, off-highway motorcycles, and all-terrain vehicles; land-based spark-ignition engines rated over 19 kW, including engines, used in forklifts, generators, airport tugs, and various farm, construction, and industrial equipment, and recreational marine diesel engines.

What Commenters Said:

Several commenters were concerned that the categories of engines that would be subject to the standards are too broad and requested that EPA reconsider the impacts on a particular sub-segments of the categories.

With regard to Large SI engines, for example, AEM and SMI commented that they are concerned that the compliance costs of the rule will cause considerable hardship to Wisconsin Motors LLC and threaten its ability to supply engines to saw manufacturers. AEM requested that EPA consider the disproportionate cost of the program in light of the minor emissions impact associated with concrete and masonry saws compared to more sophisticated industrial applications. The impact of engine and catalytic converter heat, the sensitivity to electronic controls in a harsh working environment, the small available engine package space, and the higher initial costs are all significant design and cost constraints to this segment of the industry.

NAHB also requested that EPA consider a particular segment of engines separately. They commented that EPA should consider the impacts of the costs of the regulation on engines used in the construction industry, and particularly the increased costs to homebuilders. They are concerned that the rule could seriously disrupt the cost or availability of construction equipment, which could impact the cost of housing. They also commented that EPA has not "adequately demonstrated that equipment used in various types of construction are significant sources of air pollution that warrant new federal regulations."

With regard to diesel marine engines, Cummins comments that there is a need to preserve the competitive balance between CI and SI sterndrive/inboard marine engines. CI engines tend to have lower NOx+NMHC levels than SI engines, and SI engines tend to have lower levels of PM. Cummins suggested that EPA take into account and preserve the competitive positions of each engine type, and that resultant cost increases, stringency and effective dates need to be the same for each. Cummins stated that CI engine manufacturers, especially those in the 150 to 400 hp range, cannot afford to compete if the emissions requirements are more stringent, or earlier, than those that will apply to SI engines. EMA commented that, given the fact that EPA inventory information shows that recreational marine engines only account for 0.1 percent of mobile source emissions, EPA has failed to demonstrate that emission controls are required for these engines.

Finally, with respect to recreational engines, ISMA commented that snowmobiles should not be regulated as part of the group of engines covered by this rule. As set out in more detail in Section II.C.3 below, ISMA argues inclusion in a broad category should be based on whether emission controls on a type of engine will reduce the contribution of the category as a whole and whether their usage patterns are similar. They say that EPA must follow the fundamental administrative principle that similar situations be treated similarly and that different situations be treated differently. They note that EPA exempted snowthrowers and ice augers from regulation in a previous rule because these types of equipment are not operated during the ozone season. Consequently, EPA should not continue to include snowmobiles in the group of engines to be regulated simply because they are nonroad engines.

Our Response:

After reviewing the comments, we continue to believe that it is appropriate to consider all large SI nonroad engines and vehicles together when determining emissions contribution. The legislative history of the Act indicates that we should not subdivide categories of nonroad engines into small subcategories.[3] This is because Congress did not want us to subdivide source categories into such small divisions that each subcategory by itself would have minimal contribution, despite the fact that nonroad engines as a whole contribute significantly to pollution. This is likely the reason why the final version of the Act does not require a finding of "significant contribution," but merely "contribution," for individual categories of nonroad engines. In general, we chose to group engines and equipment together based on common characteristics such as combustion cycle, fuel, usage patterns, power rating, and equipment type. By dividing nonroad engines and equipment into separate categories based on these characteristics we are able to devise the most appropriate regulatory programs for each category which take into account the specific characteristics of the engines and equipment, as well as the unique traits and needs of the affected vehicle and equipment manufacturing industries and the end users of the vehicles and equipment. In addition, it avoids the danger recognized in the legislative history of dividing nonroad engines into small categories.

Large SI nonroad engines have similar emissions characteristics. We have treated recreational vehicles as distinct from other Large SI equipment for the purposes of this regulation.

Regarding large SI engines, we do not believe it is appropriate to subdivide this category. The design and emissions characteristics of all large SI nonroad engines are sufficiently similar that they can all be reviewed as one category for the purposes of rulemaking. EPA has taken into account the particular concerns of concrete and masonry saw users in designing these regulations. Putting either saws or construction equipment in a separate category would create the problems discussed above and is unnecessary and inappropriate from a regulatory perspective. Moreover, as discussed above, the Act requires us to regulate all classes or categories of engines that contribute to ozone or CO pollution, so the reference to "minor impact" is not relevant. Finally, as discussed in Section III.A below, construction equipment, even if reviewed separately, contributes to such pollution.

With regard to Cummins' comments on competition between CI and SI marine engines, factors other than performance tend to be of primary consideration when deciding which type of engine to purchase (though these engines appear to be reasonably interchangeable in the 150 to 400 hp range). There is a large price difference between a diesel engine and a gasoline engine of the same power, with consumers already willing to pay twice as much for a diesel engine than a gasoline engine. The

[3] Senate Report 101-228, pp. 104-105.

advantages of the diesel engine include better fuel economy, safety, durability, and lower insurance costs.[4] Because of the advantages of diesel engines perceived by consumers, we do not believe that the new standards will affect the competitiveness between SI and CI recreational marine engines.

Regarding ISMA's comments on including snowmobiles in the recreational vehicles category, please see our response to Section II.C.2 below.

1. Highway Motorcycle and SI Marine Standards

What We Proposed:

We did not propose standards for highway motorcycles and SI marine engines in this proposal.

What Commenters Said:

Environmental Defense urges EPA to not delay the establishment of enhanced emission standards for highway motorcycles and to adopt NOx emission standards for these vehicles.

OTC is disappointed that highway motorcycles and marine SI engines were not included in the proposed rulemaking. They encourage EPA to address these important categories very soon. In addition, OTC believes that EPA must revisit some of the categories addressed (namely marine and recreational vehicles) and establish technology forcing standards to adequately protect public health and move towards four-stroke catalyst technology and develop an effective mandatory labeling program.

STAPPA and ALAPCO urge EPA to propose standards for highway motorcycles and gasoline-powered marine engines in a timely manner and to move forward expeditiously with final promulgation of the most rigorous standards that are technologically feasible.

Our Response:

Standards for highway motorcycles and SI marine engines were proposed in a separate rulemaking that was signed on July 25, 2002, and published in the Federal Register on August 14, 2002 (67 FR 53050). The proposed regulations and other documents associated with the proposal are available on the EPA Office of Transportation and Air Quality web site at: http://www.epa.gov/otaq/roadbike.htm.

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[4] "Competitiveness Between SI and CI Engines in Recreational Boat Market," Internal EPA memo from John Mueller to CI Marine Team, June 16, 1998.

B. Emissions Inventory

Summary of the Proposal:

To develop the exhaust emissions inventory for the categories of nonroad equipment covered by the proposed rule, we relied upon the most recent version of the draft NONROAD model publicly available with some updates that we anticipated would be included in the next draft release. Chapter 6 of the Draft RSD contained a detailed description of the information used in the NONROAD model for each of the nonroad categories.

The NONROAD model divides each category of off-highway engines into power ranges to distinguish between technology or usage differences. Each of the engine applications and power ranges covered by the proposal were modeled with distinct annual hours of operation, load factors, and average engine lives. The basic equation used in the NONROAD model for determining the exhaust emissions inventory, for a single year, from off-highway engines is shown below:

$$Emissions = \sum_{ranges} (population \times power \times load \times annual\,use \times emission\,factor)$$

This equation sums the total emissions for each of the power ranges for a given calendar year. “Population” refers to the number of engines estimated to be in the U.S. in a given year. “Power” refers to the population-weighted average rated power for a given power range. Two usage factors are included; “load” is the ratio between the average operational power output and the rated power, and “annual use” is the average hours of operation per year. Emission factors are applied on a brake-specific basis (g/kW-hr or g/hp-hr) and represent the weighted value between levels from baseline and controlled engines operating in a given calendar year. (The proposed standards for all-terrain vehicles (ATVs) and off-highway motorcycles were based on a chassis test, with the standards in grams per kilometer. For these two categories of equipment, the equation used by the NONROAD model for calculating emissions is similar to the equation noted above except that the “load factor” and “power” terms are not included in the calculation, the “annual use” is input on a miles per year basis, and the “emission factors” are entered on a gram per mile basis. Units conversion from kilometers to miles as appropriate is also included.)

Summary of the Comments:

<u>Recreational Vehicles</u>

MIC commented that EPA has overestimated the annual mileage rates for ATVs and off-highway motorcycles. MIC states that a more accurate estimate of average annual usage for ATVs and off-highway motorcycles is 350 miles, not the 7,000 miles estimated by EPA for ATVs or 2,400 miles estimated by EPA for off-highway motorcycles. MIC submitted a number of items to support its 350 miles per year estimate for ATVs and off-highway motorcycles. MIC included hour and mileage data from one ATV manufacturer’s warranty claims information and hours and miles data from a phone survey performed by another ATV manufacturer of ATV owners. MIC also submitted several state surveys that estimated the usage of recreational vehicle owners in those states, and information on ATVs for sale on the internet. (Based on the manufacturer information, MIC commented that ATV usage declines with age. The 350 miles estimate is an average annual mileage rate over the lifetime of an ATV.) MIC estimates that the baseline emissions inventory for ATVs would drop by 95% if the annual mileage is reduced from 7,000 miles to 350 miles.

In addition to the comments on miles per year noted above, MIC provided additional comments on the approach EPA used to develop the 7,000 miles per year estimate for ATVs. (The 7,000 miles per year estimate for ATVs was determined based on EPA's analysis of hours per year information from a study performed by the Consumer Product Safety Commission (CPSC) which yielded an average use of 350 hours per year, multiplied by an estimated average ATV speed of 20 mph.) MIC commented that a number of outliers (i.e., users with very high usage rates) are included in EPA's estimate of hours per year and should be excluded from the analysis. MIC commented that ATVs users which do not ride at all in a given year need to be included in the average hours per year estimate. By eliminating the outliers and including riders that have no use in a given year, MIC estimated that the per hour estimate would be reduced significantly (by about 36 percent).

MIC also provided comments on the statistical method used by EPA to develop mileage estimates from the CPSC study results. They state that the product of variables (e.g., trips per year multiplied by hours per trip, which would yield hours per year) produces accurate estimates only if the calculation is based on the average of the products for the individual vehicles rather than the product of the averages. (An example of the different statistical approaches is provided on page 7 of the MIC comments.)

Furthermore, MIC commented that EPA's average speed of an ATV (20 mph) is overestimated. MIC states that in an attempt to determine the proper value, they sought to determine how the 20 mph estimate compares with to average speeds achieved during sanctioned races. Data was collected from the Grand National Cross Country racing, and is located in Table 3 of its comments. They found that only riders in the top professional category ("Pro") were able to achieve speeds of 20 mph, the lower category ("Novice") had average speeds of about 16 mph. MIC also submitted data from surveys performed by a number of states and two ATV manufacturers that report the average speed for ATVs and off-highway motorcycles ranges from 5 to 7 mph. MIC also presented odometer and hour meter data from four used ATVs which result in average speeds of 4.1 to 6.6 mph. MIC also commented that the ATV speed data from the State of California is not representative of the national population of riders as a whole because it was gathered at recreational parks on groomed trails (compared to ungroomed trail riding) and is biased toward those ATV operators who ride most. Based on the above data, MIC believes there is no credible basis for EPA to use an average speed of 20 mph for ATVs.

The CMDA believes that the emissions inventories for off-highway motorcycles and ATVs are grossly exaggerated. The CMDA cites industry estimates that emissions of off-highway motorcycles had been overstated by 20 times and for ATVs by 5,000% (which is consistent with MIC's comments noted above).

BRC commented that the foundation of the proposal for ATVs and off-highway motorcycles is based on inaccurate usage data. They submitted a copy of a study prepared by the California Department of State Parks and Recreation which states that off-highway vehicle riders go on 7.4 trips per year. (Attachment A- "1993-1994 Report: Off-Highway Vehicle (OHV) Recreation's $3 Billion Economic Impact in California & A Profile of OHV Users: A Family Affair"). Based on its description of typical trips (i.e., "the family campout" and "the so-called Guy's Ride") and estimates of typical speeds, BRC provided estimates of off-highway motorcycle usage of about 400-525 miles per year.

We received comments from hundreds of individuals stating that we grossly overstated the effects of recreational vehicles on air quality. However, most of the individuals provided no data to document their claims. A very small number of individuals did provide estimates of their own use, or typical use by others, ranging up to 2,500 miles/year for ATVs and up to 1,000 miles/year for off-highway motorcycles. One individual from California cited the same California report noted above by BRC to support an off-highway vehicle mileage estimate of 900 miles/year.

One off-highway motorcycle user from Colorado provided comments that the annual mileage estimates for ATVs and off-highway motorcycles were too high by at least a factor of two. This individual cited a study prepared by Oak Ridge National Laboratory and two studies performed by the Colorado Off-Highway Vehicle Coalition to support their comments that EPA's mileage estimates were too high. Another off-highway motorcycle user from California submitted comments on the inputs used for predicting emissions from off-highway motorcycles. The commenter provided his recommendations in four areas as follows: 1) Because of the impracticality of carrying large amounts of fuel, the commenter recommends assigning 50% greater lifetime mileage to 4-stroke motorcycles compared to 2-stroke motorcycles. 2) Due to the greater reliability of 4-stroke engines, the commenter recommends using a longer average life for 4-stroke compared to 2-strokes (which would lower the 2-stroke population estimates). 3) The commenter suspects there is a correlation between engine displacement and annual mileage (since children and other young riders that operate <125 cc bikes) and recommends using a mileage estimate that is 25% of the bikes >125 cc. 4) The commenter notes that many motorcycle enthusiasts own more than one off-highway motorcycle which would lower the annual usage rates since only one bike can be ridden at a time. The commenter recommends that EPA account for this fact by lowering the mileage estimate downward. Finally, many individual off-highway motorcycle enthusiasts and concerned citizens submitted comments either questioning or citing a comparison of emissions from off-highway motorcycles compared to cars. The estimate in question was actually made by the California Air Resources Board and noted that operating an off-highway motorcycle for 7 hours emitted the same amount of smog-forming pollutants as driving a modern car for 100,000 miles.

Our Response:

Development of inventories for these categories is indeed challenging. Despite the fact that EPA went through the processes of a "finding of contribution" and an ANPRM, it was not until the NPRM that significant comment was received on our methodology and data. In fact, most of the data we received was generated after the NPRM . (All of the studies we considered and data we received are listed in the memos identified below which are in the Final Regulatory Support Document.).

Based on information submitted by commenters as well as additional information obtained by EPA since the publication of the proposal, we agree with the commenters that the estimates of annual mileage used in the proposal for ATVs and off-highway motorcycles were too high. Using all of the information we could find on ATV and off-highway motorcycle usage, we have revised our estimates of annual mileage significantly downward. For the final rule analysis, we have estimated that both ATVs and off-highway motorcycles are used on average approximately 1,600 miles per year over their lifetime. A copy of the memos that detail the derivation of the mileage estimates for ATVs and off-highway motorcycles and the data considered in the analysis is contained in an appendix to Chapter 6 of the Final Regulatory Support Document for this final rule. As a result of the lower mileage estimates, the emissions inventories presented in the final rulemaking are significantly lower than those presented in the proposal. Likewise, the emission benefits that will be achieved over the lifetime of a typical ATV or off-highway motorcycle from the final rule standards being adopted (which are used in the cost-per-ton calculations) are also significantly lower than our estimates in the proposal.

The revised mileage rate is the estimate of the average mileage accumulated over the lifetime of an ATV or off-highway motorcycle. Of the data we used in developing the estimates, only the two data sources provided by ATV manufacturers had information that would allow an analysis of how mileage might decline with age. However, the warranty data from one ATV manufacturer was heavily weighted toward ATVs that were less than one year old (approximately 90 percent were less than one year old). The results from the phone survey performed by the other ATV manufacturer did not include any information from ATVs less than 1.25 years old. The two other studies included in our analysis (the Consumer Products Safety Commission study and an industry-sponsored panel study) did not contain information that would allow us to analyze use by age. However, both of these studies included ATVs chosen at random from the general population and should therefore represent usage rates for the fleet as a whole.

With regard to the inclusion of ATV users with extremely high rates of usage (i.e., outliers) and ATVs users who do not drive any hours, we have made some adjustments to our analysis. In the CPSC study and the industry panel, there were a small number of respondents that claimed their hours of operation on an average day of riding was greater than 10 hours (about two percent of the respondents in the surveys). While we believe there may be users that ride ATVs significant amounts, we find it implausible that on average someone would ride that many hours. Therefore, instead of throwing the high users out of the survey, where a survey respondent claimed more than 10 hours of operation on an average day of riding, we limited the daily usage to 10 hours. We have also kept in our analysis all riders who stated that they have zero hours of use because we agree that there are likely to be some ATV owners who do not ride their vehicle in a given year for some reason. Finally, in our analysis of the CPSC and industry panel studies, we have based our analysis of annual use on the average of the products as recommended by MIC. (In other words, we first calculated the average hours of use per respondent from their response to the various questions and then averaged those results.) We agree that this approach is the appropriate manner in which to analyze the survey results.

With regard to the average speed of ATVs used in the analysis, we agree with the commenters that based on the data submitted by MIC, an average speed of 20 mph is too high for ATVs. For our revised analysis, we have estimated the average speed of two different types of ATV operation - utility and recreation. Based on the data provided by MIC from the two ATV manufacturers, we have estimated the average speed of utility ATVs to be 8 mph. (The data provided by both manufacturers are from utility type ATVs only and do not include recreational type ATV which are not equipped with odometers or hour meters.) Based on data from the State of California, we have estimated the average speed of recreational ATVs to be 13 mph. We agree with MIC that the speed data gathered by the State of California is not representative of the ATV population as a whole. However, we do believe that it is most representative of recreational use of ATVs. While it is true that not all trail riding is done on groomed trails in parks, there are many places where recreational riding conditions would be similar. Lacking any other information on the average speed of recreational ATVs, we have used the data from the State of California to represent the average speed of recreational ATV use. The derivation of the average speeds for utility and recreational ATVs is detailed in a memo contained in an appendix to Chapter 6 of the Final Regulatory Support Document for this final rule.

With regard to BRC's estimates of mileage for off-highway motorcycles, we believe that the information used in our analysis is representative of typical operation of off-highway motorcycles. While their estimates may be appropriate for the trips described in their comments, BRC has not provided any information to demonstrate that the trips they describe are representative of the entire off-highway motorcycle fleet. Our analysis of the mileage estimate for off-highway motorcycles is contained in an appendix to Chapter 6 of the Final Regulatory Support Document for this final rule.

In response to the comments from the individuals that estimated their own recreational vehicle use, we believe our revised mileage estimates for ATVs and off-highway motorcycles are consistent with individual estimates since they claim mileages both higher and lower than our revised estimates. Furthermore, we have considered the Oak Ridge National Lab study, the Colorado studies, and the California study cited in the comments in our analysis of ATV and off-highway motorcycle mileage estimates. Our analyses of annual mileage for ATVs and off-highway motorcycles is contained in an appendix to Chapter 6 of the Final Regulatory Support Document for this final rule. We have not made any adjustments to our modeling inputs to adjust for differences in 2-stroke and 4-stroke lifetime or operation, usage for off-highway motorcycles <125 cc, or multiple bike ownership. While the commenter has raised some interesting points, there was no data provided to support the adjustment recommended to our analysis. Furthermore, we are not aware of any other information that would allow us to account for such differences if they were indeed appropriate. Finally, we have also made estimates of the amount of pollution emitted by off-highway motorcycles compared to current cars. While not as high as the numbers cited from California, we have estimated that operating a current 2-stroke off-highway motorcycle for one hour produces the same amount of HC emissions as driving a current car (meeting EPA's National Low Emission Vehicle, or NLEV, standards) for 9,600 miles. Incredible as it may seem, an unregulated 2-stroke engine used in an off-highway motorcycle emits extremely high levels of HC emissions especially when compared to a car equipped with the latest emission control technologies.

C. Air Quality Need

1. General Need for Emission Controls For These Engines

What We Proposed:

The engines and vehicles that are 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. These pollutants cause a range of adverse health effects, especially in terms of respiratory impairment and related illnesses. Elevated emissions from those recreational vehicles that operate in national parks (e.g., snowmobiles) also contribute to visibility impairment. The proposed standards will help states achieve air quality standards and 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.

Commenters Support the Proposal

We received many comments from organizations expressing support for the proposed regulatory program. For example, the Connecticut Department of Environmental Protection noted that the engines covered by this rule are a significant and growing sources of mobile source emissions, and that the standards “are of immediate importance to Connecticut’s strategy to attain and maintain the national ambient air quality standards (“NAAQS”) for ozone.” Connecticut is currently looking for emission reductions in addition to those contained in its 1998 attainment demonstration and the proposed standards, along with EPA’s Tier 2 standards for on-highway vehicles, “would contribute significantly to this effort.”

The Pennsylvania Department of Environmental Protection commented that the proposed standards “are a critical component of a comprehensive national, nonroad regulatory program.” They noted that these engines are sources of CO, air toxics, and PM emissions, as well as “approximately 5 percent of the total of all ozone precursors emitted in Pennsylvania.” Pennsylvania notes that “States are relying primarily on EPA to exercise strong leadership in setting sufficiently stringent and protective national standards for new mobile sources,” and that they “require this level of stringency in order to achieve [their] obligations required by the Clean Air Act to reduce ozone levels in some of our more problematic ozone nonattainment areas.” Pennsylvania urged EPA to finalize these standards “not only because it is a statutory mandate, but also because it is the right thing to do.”

STAPPA/ALAPCO noted that “an effective control program for nonroad SI engines and marine and land-based recreational engines will help reduce the harmful health effects of ozone, CO, PM and toxic air pollution, and also address such environmental problems as visibility impairment” and that “the benefits of regulating emissions from [these engines] far outweigh the costs.” STAPPA/ALAPCO notes that “more than 160 million tons of pollution are still emitted into the air each year and approximately 121 million people still reside in areas that exceed at least one of the six health-based National Ambient Air Quality Standards.” Progress for controlling ozone has been slow, especially in the southern and northern regions of the country, where “ozone levels have actually become worse over the past 10 years.” They further note that “ozone levels in 29 of our national parts have increased by more than 4 percent in the last decade.”

Bluewater Network called EPA’s attention to the exposure and public health dangers associated with benzene, PM, and CO emissions, and urged EPA to revisit the studies that describe these effects.

The South Carolina Department of Health ane Environmental Control notes that although the State is in attainment, “several of the State’s major metropolitan areas may face the tough challenge of meeting the contested 8-hour ozone standard.” Recreational activities are an important of the state’s economy: there are currently over 56,000 motorcycles and 304,000 recreational watercraft registered in the state, and more are brought in by tourists and travelers. “Emissions from nonroad engines, recreational gasoline engines, and recreational marine engines are a significant source of ozone precursors” and “a national plan to control these sources would aid the state’s efforts in meeting new and more stringent air quality standards.”

The Ozone Transport Commission commented that their member states need nonroad emission controls to help them attain and maintain the one-hour and eight-hour ozone NAAQS. They also noted that these engines contribute to hotspot of toxic emissions, particularly for benzene and 1-3 butadiene. Personal exposure is also of concern as “studies have indicated that the exhaust from large spark ignition engines contains 10,000 to 90,000 parts per million (ppm) of benzene, whereas the federal ambient occupational health standard for benzene is 200 ppm.”

NESCAUM supported EPA’s analysis of the health and environmental effects of emissions from these engines. They noted that "VOC and NOx are primary ozone precursors and ozone nonattainment remains a widespread air quality problem in the NESCAUM region." They also noted that NOx emissions from these engines is not just a summertime ozone problem. NOx emissions also contribute to acidification of lakes and streams and contributes to secondary PM formation.

The California Air Resources Board noted that despite their regulations for nonroad sources, "many regions of the State still achieve unhealthy levels of air pollution" and that "continued efforts, in the form of emission control of engines and equipment, are needed to bring these areas into attainment with the air quality standards." They are particularly interested in EPA's finalizing standards for sources they are preempted from controlling.

The Sierra Club Recreation Issues Committee noted that recreational vehicles "are a larger source of air pollution today than 10 years ago" and that "on public lands, off-road vehicles can be the largest single source of air pollution." They call EPA's attention to "many well-documented cases of the adverse health effects" associated with these engines. They also note that HC emissions from these engines impair air quality and visibility not only in National Parks and other public lands, but also in National Forests and regions under the jurisdiction of the Bureau of Land Management where the use of ATVs, dirt bikes, and snowmobiles is growing.

The Appalachian Mountain Club called attention to the adverse effects that air pollution can have on hikers, as evidenced by a study performed by the Brigham and Women's Hospital, Harvard School of Public Health and the Appalachian Mountain Club. This study "demonstrated that ozone, and to a lesser extent fine particulate matter, result in acute respiratory impacts to healthy, active adults hiking a higher elevation Eastern parklands. These impacts occurred at levels below the 1997 NAAQS for ozone and particulate matter. In addition, the number of hours hiked was an independent predictor of declines in measures of pulmonary function."

The Natural Resources Defense Council commented on the health effects associated with PM emissions from the regulated engines. They note than an NRDC study of 239 cities estimated the annual death toll from fine particulate pollution at 50,000 per year, and a study of the Greater Boston area found these emissions are associated with an increase in heart attacks up to 62 percent on high pollution days. These risks may be higher in cities with more air pollution.

The Natural Trails and Waters Coalition called attention to the high emission rates from these engines, and to the exposure and public health concerns caused by these emissions. They call EPA's attention to the high PM emissions from these engines, and the health and visibility effects associated with those emissions. They commented that EPA's authority to set emission standards for these engines is clear, both under section 213 of the Clean Air Act, pursuant to the Agency's determination that emissions from these engines "contribute to the failure of one or more regions of the country to achieve attainment standards," and section 169(A) and (B) of the Act. They note that "based on the plain language of the law, the EPA has the authority to regulate highly localized sources of pollution when they clearly contribute to degradation of air quality on protected public lands." They commented that "the connection between recreational vehicles and visibility impairment is clear and direct" due to the high levels of HC emissions from these engines, which are a major constituent of organic carbon and thus a source of fine PM. They are concerned that "the impact of these machines on visibility is much broader across public lands" than current analysis indicates. Comments by Mr. Althouse repeated many of these concerns.

Environmental Defense commented that the general adverse health and environmental effects of emissions from these vehicles and engines are exacerbated in microenvironments. They note that people who operate, work, recreate, or are in the vicinity of these engines for significant periods of time are exposed to high levels of harmful pollutants.

Our Response

After consideration of all the comments, we are finalizing an emission control program that will help address the environmental concerns raised by these commenters. While the standards may not be as stringent as some of them requested, they will achieve significant emission reductions and help reduce personal exposure concerns for people who reside or who work or recreate in the vicinity of these vehicles and engines.

Commenters Oppose the Proposal

Some commenters called into question the need for standards for these engines. The Mercatus Center commented that EPA has not shown that national standards are needed for these engines. They note "most areas of the country now meet health-based air quality standards" and "unless the estimated emission reductions happen to occur in the relatively few areas that fail to meet air quality standards, U.S. citizens will gain few health or environmental benefits." They further note that "EPA makes no attempt to show why the same emission standards should apply to every forklift, recreational marine engine, offroad motorcycle or snowmobile regardless of whether that vehicle is used in the wilderness if northern Minnesota, the outskirts of Boston, downtown Los Angeles or Hoboken, New Jersey."

MIC called into question EPA's findings for ozone and CO non-attainment. For example, they note that of the 17 designated CO non-attainment areas, only one recorded a violation of the standard last year. They also note that no significant recreational vehicle use occurs in the vicinity of monitors showing elevated levels of CO, nor have any recreational vehicles contributed in any measurable way to CO non-attainment. ISMA made similar comments about the contribution of snowmobiles to ozone and CO nonattainment (see below).

MIC commented that EPA lacks statutory authority to establish CO standards based on Section 213(a)(3), stating that ATV and offroad vehicles and their engines are not making, and in the future cannot be predicted to make, measurable contributions to ambient CO concentrations in any CO non-attainment area. They state that they have identified significant errors in the modeling data used by EPA to estimate emissions- the errors tended to significantly overstate the emissions from this engine segment and therefore project large emissions reductions under the proposed standards (and low cost estimates are generated per ton of projected emission reduction). Reliance on flawed data cannot legally be used to demonstrate compliance with Section 213's requirement to take cost into account.

The California Motorcycle Dealers Association commented that the comparison between offroad vehicles and other motor vehicle emission categories in urban areas is flawed, as offroad vehicles are mostly used in non-urban areas and that the emissions inventories for off-highway motorcycles and ATVs are grossly exaggerated. Mr. Ciotti, an off-highway motorcycle rider, also noted concern about the contribution of off-highway motorcycles to nonattainment, noting that "nonattainment largely occurs in areas that don't support off-road recreational motorcycle riding" and that it "occurs in months that off-road recreational motorcycling emissions are at a minimum" because people prefer to not ride when conditions are hot and dusty. He advocated program based on the California program that prohibits using certain motorcycles in nonattainment areas during certain periods. He also notes that "emissions from off-highway motorcycles occur disproportionately in rural areas." Glen Akins had similar concerns, noting that the NONROAD model does not take into account "geographical use patterns of off-highway vehicles," which are not used near urban areas "simply because there are no places to ride near urban areas." He also noted that "emissions are completely absorbed by the surrounding environment with no impacts to air quality or human health" in the rural areas where they are used.

Our Response

Please see our answer to comments in Section II.A.(bis), regarding application of standards to these engines generally.

Regarding the assertion that emissions from recreational vehicles occur most often in rural areas, this assertion is not relevant for our finding. The test under the statute is whether a category of engines contributes to ozone or CO contributions in more than one nonattainment area, not whether or not it contributes even more pollution in rural areas. Moreover, though there is a correlation between nonattainment areas and urban areas, particularly for ozone, there are many counties that are part of nonattainment areas that may be considered rural or suburban in character - in fact, there is not much correlation between PM nonattainment areas and urban areas. In any case, the evidence, including the particular site information provided by AMA, shows that recreational vehicles are used in numerous nonattainment areas around the country and in fact contribute sizable emissions in such areas. Our local modeling information, with geographical distribution of recreational vehicles based on the presence of areas to ride them in (such as recreational vehicle parks), indicates considerable usage of these vehicles in nonattainment areas[5]. The inventories provided for the 1991 Nonroad Study (Docket No. A-91-24, Document No. II-B-4) contain numerous examples of nonattainment areas with populations of recreational vehicles. For example, ATVs and off-highway motorcycles are also used in counties and cities within CO-nonattainment areas, and are operated on private land and in and around non-attainment areas. This is illustrated by information about ATV use provided by Honda in public comments, which included recent warranty claims for ATVs in three serious CO non-attainment areas: Fairbanks, AK, in 1998 and 2001, in Phoenix, AZ in 2001, and in Las Vegas, NV in 2000.

Regarding MIC's comment that EPA's initial modeling overestimated the emissions from recreational vehicles, we have revised our emissions estimates in response to these comments, but the reduction in total emissions has no bearing on the issue of whether recreational vehicles contribute at all to ozone or CO concentrations in nonattainment areas. As discussed above, there is no question that recreational vehicle do contribute in these areas. MIC attempts to read the word "significant" into section 213(a)(3), but Congress clearly intended that the significance finding only apply to review of nonroad engines as a whole, not individual categories of nonroad engines. See also Engine Manufacturers Ass'n v EPA, 88 F. 2d 1075, 1098.

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[5] Further details of the growth and geographical allocation methodologies are covered in the paper, "Geographic Allocation and Growth in EPA's NONROAD Emission Inventory Model," by Gary Dolce, Greg Janssen, and Richard Wilcox, presented at the 1998 Air and Waste Management Association Conference.

MIC is also incorrect in discounting contribution in CO nonattainment areas that have recently had levels below CO NAAQS levels. These areas are still CO nonattainment areas and contribution to CO concentrations in such areas should be considered in our determination under section 213(a)(3), regardless of recent air quality data. An area cannot be redesignated to attainment until it can show EPA that it has had air quality levels within the level required for attainment and that it has a plan in place to maintain such levels. Until areas have been redesignated, they remain nonattainment areas. There are important reasons to focus on redesignation status, as compared to just current air quality. Areas with a few years of attainment data can and often do have exceedances following such years of attainment because of several factors including different climatic events during the later years, increases in inventories, etc. For example, a recent National Academy of Sciences report concludes that "Fairbanks will be susceptible to violating the CO health standards for many years because of its severe meteorological conditions. That point is underscored by a December 2001 exceedance of the standard in Anchorage which had no violations over the last 3 years."[1] Thus, a plan to maintain attainment with the NAAQS is critical to being redesignated as an attainment area, and measures such as control of emissions from nonroad engines can help to avoid potential future air quality problems. In addition, MIC seems to rely on the assumption that recreational vehicles are ridden only on established trails, whereas the evidence indicates that a substantial amount of riding occurs off such trails. See discussion in chapter 1 of the RSD.

Regarding Mr. Ciotti's comments, he provides only speculation no data to indicate that recreational vehicles are not ever ridden on days when nonattainment may occur. Nonattainment can occur during many months of the year and need not be on only hottest of days. Also, pollutants can remain in the air and contribute to ozone nonattainment well after the time that the pollutant was initially emitted.

Regarding comments from the Mercatus Center, EPA disagrees with the statement that there are only a relatively few places around the country with any air quality problems. As discussed in Chapter 1 of the RSD, nonattainment areas for ozone, CO and PM include numerous areas around the country that contain much of the country's population. Moreover, exceedances of the eight hour ozone standard and the fine PM standard have been found in numerous other areas of the country. Visibility impairment occurs in still other areas of the country. Other air pollution problems like acid deposition or air toxic emissions are more regional or site-specific, and are thus not linked to confined areas. Areas with air pollution problems include the nation's largest cities, their surrounding areas, smaller cities, rural towns and pristine natural areas. These regulations will reduce emissions that affect all of these areas. Moreover, attempting to regulate only in areas that have discreet air pollution concerns, possibly regulating only those pollutants of concern in those areas, will create a patchwork of regulation that has traditionally been strongly objected to by the manufacturers, dealers, and users affected by such a patchwork. Finally, Mercatus's idea is completely antithetical to regulation of mobile sources. As the term indicates, these are <u>mobile</u> sources of emissions that may be in an attainment areas one day (or minute) and a nonattainment area the next. A program that only attempts to regulate mobile sources when they are in areas of concern will either be impossible to enforce or easily circumvented, or both, and may create considerable burden on users.

2. Need for Emission Controls for Snowmobiles

What We Proposed

In addition to the need for emission controls for snowmobiles based on their contribution to ozone and CO nonattainment, we also discussed the regional and local-scale public health and welfare effects associated with emissions from these engines, including regional haze, visibility impairment, and personal exposure to air toxics and CO. 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.

Commenters Support the Proposal

Several states supported the snowmobile controls, noting that snowmobile use is high in their areas. For example, the New Hampshire Department of Environmental Services noted that "New Hampshire will be impacted more than many states due to the per capita snowmobile population and over 6,000 miles of snowmobile trails." NESCAUM disputes the manufacturers' argument that the impact of snowmobiles is small because they are used for only small periods of time in remote areas. According to NESCAUM, "in the Northeast, snowmobiles are a common sight in downtown areas, at gas stations and along main roads. They are driven in large numbers along streets and recreational paths for many more than 12 weeks of the year. Snowmobiles come in close proximity to pedestrians, motorists, and those using public parts such as cross country skiers."

Other commenters noted that snowmobile emissions are problematic even if they are not just a summertime problem. STAPPA/ALAPCO noted that "snowmobiles pose other serious public health and welfare problems even if they don't contribute to summertime ozone problems." STAPPA/ALAPCO, the Appalachian Mountain Club, and NESCAUM each noted that snowmobile NOx emissions contribute to acidification of lakes and streams and lead to secondary formation of PM. Environmental Defense Fund noted that "the adverse public health and environmental impacts associated with NOx are not confined to the Summer months," and that wintertime emissions or cumulative emissions loadings are problematic as well. Specifically, they note the contribution of nitrates to fine particulate concentrations in the East, "*especially in the Winter*" (emphasis in original), to "*wintertime* light extinction in national parks and wilderness areas across the West" (emphasis in original), and to acid deposition, especially through accumulation in the winter snowpack which is released in the spring thaw. These problems are expected to increase as snowmobile use grows. Bluewater commented that they note adverse effects from these vehicles is a year-round problem, and that "a considerable body of scientific research documents the effects of NOx and its byproducts that result either from wintertime emissions or cumulative emission loadings."

Several commenters noted the personal exposure effects from snowmobiles. Bluewater, STAPPA/ALAPCO and NESCAUM commented that snowmobile HC emissions contain elevated levels of several dangerous toxic air pollutants, such as benzene, 1,3-butadiene and formaldehyde. The Sierra Club Recreation Issues Committee called EPA's attention to the impacts of snowmobile emissions, especially on "public employees (such as Park Rangers) and others directly in the path of these machines."

Environmental Defense called EPA's attention to a recent study that suggests "CO may plan a significant role in causing some birth defects." They also call attention to the body of research on the health effects of particulate matter emissions, and note the observations of the National Park Service that these effects are exacerbated in the case of snowmobiles because the conditions in which they are operated (cold, stable atmospheric conditions) "which hinder the dispersion of air pollutants and allow pollutants to accumulate in the immediate area of their release."

The Appalachian Mountain Club has concerns with the fact that no NOx standard was proposed for snowmobiles, since NOx is also a precursor to nitric acids that form fine particles which impair visibility and cause acid rain.

Our Response

Regarding these comments, we generally agree that snowmobile emissions can contribute to significant air pollution problems and are finalizing standards for these vehicles. Regarding the comments that EPA should have regulated NOx from snowmobiles, we note that all commenters appeared to agree that NOx emissions from snowmobiles are not a concern for summertime ozone nonattainment. Nevertheless, they suggest that EPA may regulate NOx because of its other deleterious effects, like contribution to acid deposition and visibility impairment.

We agree that NOx emissions from recreational vehicles, and snowmobiles in particular, contribute to such pollution, including increased PM, and resulting visibility impairment. As a result, we are including a NOx standard for snowmobiles. This standard will essentially cap NOx emissions from these engines, to prevent backsliding. As the use of four-stroke technology becomes more prevalent with our Phase 3 standards, it makes sense to set a NOx standard, since four-stroke engines emit NOx levels many times higher than two-stroke engines. Since our Phase 1 and Phase 2 standards will have fewer four-stroke snowmobiles, especially Phase 1, it does not make sense to set NOx standards for these phases. Therefore, we are finalizing a HC+NOx standard for our Phase 3 program that begins in the 2012 model year.

We are not promulgating standards that would require substantial reductions in NOx because we believe that standards which force substantial NOx reductions would likely not lead to reductions in PM and may in fact increase levels of PM, HC and CO. NOx emissions from two-stroke snowmobiles are very small, particularly compared to levels of HC. Technologies that reduce HC and CO are likely to increase levels of NOx and vice versa, because technologies to reduce HC and CO emissions would result in leaner operation. A lean air and fuel mixture causes NOx emissions to increase. These increases are minor, however, compared to the reductions of CO and HC (and therefore PM) that result from these techniques. On the other hand, substantial control of NOx emissions may have the counter-effect of increasing CO, direct PM and HC emissions and cause greater PM emissions associated with those HC emissions. The only way to reduce NOx emissions from four-stroke engines (at the same time as reducing HC and CO levels) would be to use a three-way catalytic converter. We don't have enough information at this time on the durability or safety implications of using a three-way catalyst with a four-stroke engine in snowmobile applications. Three-way catalyst technology is well beyond the technology reviewed for this rule and would need substantial additional review before being contemplated for snowmobiles. Thus, given the overwhelming level of HC, CO and PM compared to NOx, and the secondary PM expected to result from these HC levels, we believe it would be premature and possibly counterproductive to promulgate NOx standards that require significant NOx reductions from snowmobiles at this time. EPA therefore does not believe more stringent regulation of NOx is appropriate under section 213(a)(4) at this time.

Commenters Oppose the Proposal

The International Snowmobile Manufacturers Association called into question EPA's authority to set standards for snowmobiles, based on empirical and statutory concerns. Empirically, ISMA contends that EPA "has no basis for regulating HC and CO emissions from snowmobiles under section 213(a)(3) [because] snowmobiles are not making, and in the future cannot credibly be predicted to make, contributions to ambient concentrations of HC, and CO in any nonattainment area that would present more than a *de minimis* contribution to the ambient levels of regulated pollutants." ISMA bases their statements on analysis performed by Sierra Research which concludes that snowmobiles do not contribute to ozone nonattainment due to their use in winter months when ozone is not a problem, and they do not contribute to CO nonattainment outside of one CO nonattainment area (Fairbanks, Alaska). In addition, use of snowmobiles is prohibited on public highways in Fairbanks "which amounts to a practical ban on snowmobile use in the Fairbanks nonattainment area). Even if they were used in the Fairbanks area, worst-case analysis suggests that their contribution, 0.03 ppm, " is less than the level of precision required by EPA when determining compliance with the CO standards (0.1 ppm). Finally, CO levels are expected to decline without the snowmobile standards.

Based on the above, ISMA questions EPA's statutory authority to set standards for snowmobiles, on four grounds.

- Snowmobiles cannot rationally be included within any group of sources that would warrant regulation under section 213(a)(2) and (3) based on contribution to ozone concentrations. Inclusion in a broad category should be based on whether emission controls on a type of engine will reduce the contribution of the category as a whole, whether their usage patterns are similar. EPA must follow the fundamental administrative principle that similar situations be treated similarly and that different situations be treated differently. EPA exempted snowthrowers and ice augers from regulation in a previous rule because these type of equipment are not operated during the ozone season. For these reasons, EPA should not continue to include snowmobiles in the group of engines to be regulated simply because they are nonroad engines.
- EPA cannot regulate CO emissions from snowmobiles because they contribute to CO nonattainment in only one CO nonattainment area. Section 213(a)(2) and (3) require them to contribute to nonattainment in more than one nonattainment area. The only way to achieve that goal would be to lump snowmobiles into a larger group and then set national standards to address conditions in one wintertime CO area, neither of which can be supported under the Act.
- The relevant emissions must occur in the nonattainment area, so EPA must take into account the use restrictions on snowmobiles in Fairbanks, the lack of significant snowfall in Spokane, and the distances between the snowmobile paths and the relevant CO nonattainment areas. Arbitrary allocations of emissions to specific CO nonattainment areas should not be the basis for a rulemaking
- The Act requires not only that the emissions occur in a nonattainment area, but they are also non-*de minims*. Yet, snowmobiles make no significant contribution because regulating their emissions will not measurably reduce CO concentrations in any CO nonattainment area. In

> addition, in determining “significant contribution,” recent case law indicates costs must be considered as well.

ISMA also comments that EPA cannot rely on regional haze or toxics emissions to set standards for snowmobiles. The Act specifies that EPA set standards to reduce ambient levels of ozone and CO. Whether CO, NOx, and VOC emissions from these engines contribute to regional haze is irrelevant. While the Act permits EPA to set standards for other pollutants, that provision applies to pollutants other than CO, NOx, or VOCs. It cannot be used as alternative statutory authority to regulate those same pollutant.

With regard to air toxics, ISMA reminds EPA that EPA stated in the 2001 mobile source air toxics rule that there is insufficient information to determine the contribution of nonroad engines to mobile sources. Thus, “the use of air toxics as a justification for the proposed emissions standards is technically and legally suspect.”

Finally, ISMA questions EPA’s authority to set standards for snowmobiles based on visibility issues and regional haze. They note that “there is no independent authority in the Clean Air Act to promulgate mobile source emission standards based on regional haze or visibility concerns.” Sections 169A and 169B of the Act “contain specific requirements for states and regional commissions to address regional haze and visibility issues.”

In their hearing comments, the International Snowmobile Manufacturers Association called EPA’s attention to a study prepared by Sierra Research and submitted by Polaris, which “demonstrated the absence of any significant air quality impacts from snowmobiles – and therefore the absence of any legal authority for regulating snowmobiles.” According to ISMA, “there is no other air quality justification” to set standards for these vehicles. They also question the contribution of these engines to ozone formation, given that they “are used exclusively in the winter and primarily in rural areas.”

The Utah Snowmobile Association commented that “snowmobiles are not used in non-attainment areas, which mostly consist of metropolitan areas having large concentrations of populations.” They note that the snowmobile riding season in Utah last about 4 months, 5 months if there is good snow and that the trailheads are widely dispersed, so “there is no way we can contribute significant emission impacts under these circumstances.”

Polaris Industries contends that “EPA has not demonstrated that the statutory conditions required for promulgating emission standards for snowmobiles have been met.” They cite a study by Sierra Research which “demonstrated that snowmobile emissions do not have any effect on the attainment status for carbon monoxide or ozone in any non-attainment areas where snowmobiles are operated [due to] the time of the year snowmobiles are operated (wintertime), the restrictions placed on snowmobile operation in urban areas, and the small numbers of snowmobiles used.” Polaris noted that none of the analysis supplied by EPA in the proposed rule address Sierra Research’s findings. Since the proposal, Sierra Research has performed additional research, and that information has been submitted to EPA. Polaris also noted that they requested EPA to reconsider its December 7, 2000 finding that snowmobiles contribute to nonattainment in more than one nonattainment area, but that EPA has not responded to that request. In their written comments, they again request EPA to reconsider its finding.

Our Response

We believe that it is completely appropriate to treat snowmobiles as part of the larger category of recreational vehicles. Snowmobiles share many design and use characteristics with other recreational vehicles. However, we agree that for the purposes of regulating exhaust VOC emissions from snowmobiles, it is appropriate to look at them separately from other recreational vehicles because their usage patterns (i.e. wintertime use) do not appear to be consistent with contribution to ozone concentrations during the period of time when ozone nonattainment is likely to occur. We have in the past taken such concerns into account when exempting ice augers and snowthrowers from HC standards. We believe this is a rational interpretation of section 213(a)(3). As discussed below, however, we believe HC standards (as well as NOx standards) are justified for snowmobiles under section 213(a)(4).

On the other hand, regulation of CO and permeation emissions from snowmobiles is justified under section 213(a)(3). Regarding permeation emissions, as we noted in the May 1, 2002 Federal Register notice, these generally occur when a snowmobile is not in use, in the hotter times of the year. No commenter objected to regulation of permeation emissions from snowmobiles.

Regarding CO emissions, there is no reason not to treat snowmobiles as part of the broader recreational vehicle category. CO exceedances often (though not exclusively) occur during the wintertime, when snowmobiles are more likely to be used. Thus, given the otherwise similar nature of snowmobile use and design to other recreational vehicles, there is no reason to look at their emissions separately. However, even if we did review snowmobile contribution separately, there is no question that they contribute to CO concentrations in CO nonattainment areas. As discussed in more detail in the RSD, snowmobiles are identifiable contributors in at least three current CO nonattainment areas: Spokane, Anchorage and Fairbanks, and are used in or around counties containing other nonattainment areas. As noted in the previous section, the fact that some current nonattainment areas may have recent air quality data with no exceedances does not mean that we should not treat them as nonattainment areas. Until an area has been reclassified as being in attainment and has a plan in place to assure maintenance, the area must be treated as a nonattainment area. Furthermore, a recent National Academy of Sciences report concludes that "Fairbanks will be susceptible to violating the CO health standards for many years because of its severe meteorological conditions. That point is underscored by a December 2001 exceedance of the standard in Anchorage which had no violations over the last 3 years."[2] The National Academy of Sciences panel took into account the form of the CO NAAQS in reaching this conclusion.

In addition to the CO nonattainment areas, there are 6 areas that have not been classified as non-attainment where air quality monitoring indicated a need for CO control. For example, CO monitors in northern locations such as Des Moines, IA, and Weirton, WV/Steubenville, OH, registered levels above the level of the CO standards in 1998.[3]

Moreover, though ISMA attempts to read the term "significant contribution" into section 213(a)(3), that section requires regulation for any class or category that "contributes" to CO concentrations in nonattainment areas. Congress clearly designed this provision (in contrast to the provision in section 213(a)(2) requiring "significant contribution" from nonroad engines as a whole) to prevent EPA from dividing equipment or engine types into small categories and then declaring that these categories do not contribute "significantly" to concentrations. Given that ozone and CO nonattainment are brought about through emissions from numerous different types of sources, and given the especially numerous types of sources fall into the definition of nonroad engine, it is rational to assure that EPA regulate any nonroad engines that contribute to such pollution.

Regarding the analysis by Sierra Research, we are unconvinced. EPA made its finding of contribution based on the Clean Air Act criterion of more than one CO nonattainment area and that fact remains unchanged.(see 65 FR76790, December 7, 2000). Despite progress toward improved progress towards improved CO from other sources, emissions from nonroad engines and in particular snowmobiles contribute to CO nonattainment in at least 3 areas: Spokane, WA, Fairbanks, AK, and Anchorage, AK.

First, Sierra Research's comments acknowledge that a snowmobile trail exists within the Spokane, WA, nonattainment area, and they do not present evidence that snowmobiles are not operated there. Sierra Research's comments also agree that snowmobiles are operated in Fairbanks, but in their comments they argue that the contribution is small. As mentioned above, Congress clearly designed this provision (in contrast to the provision in section 213(a)(2) requiring "significant contribution" from nonroad engines as a whole) to prevent EPA from dividing equipment or engine types into small categories and then declaring that these categories do not contribute "significantly" to concentrations. Given that ozone and CO nonattainment are brought about through emissions from numerous different types of sources, and given the especially numerous types of sources fall into the definition of nonroad engine, it is rational to assure that EPA regulate any nonroad engines that contribute to such pollution.

Sierra Research claimed that snowmobiles are being used for maintenance and that a different load factor should be applied. However, they present no information regarding the terrain or road surface conditions or weight carried by the snowmobiles that would lead us to believe that any factor other than the average should be applied. In fact, high emissions can occur if the snowmobiles are accelerated during these operations or encounter poor road surfaces or carry significant weight while performing "maintenance" activities. Thus, the average load is an appropriate estimate for Fairbanks to use in their CO emissions inventories. Anchorage reports a similar contribution from snowmobiles. Anchorage, AK, reports a similar contribution of snowmobiles to their emissions inventories (0.34 tons per day in 2000).[4]

Sierra Research, furthermore, assumes that snowmobiles are only operated on trails and has performed an analysis examining the distance between the trails and nonattainment boundaries. They note that Spokane contains a snowmobile trail within their boundaries, and that based on their reading of the maps, many of the trails are 5 to 30 miles from the nonattainment area boundaries. Most trails are 10 to 15 miles away, according to their comments. Sierra Research assumes that snowmobiles are only operated on trails. On the contrary, snowmobiles are used in urban areas within nonattainment areas. In some northeast cities, "snowmobiles are a common sight in downtown areas [and] are driven in large numbers along streets and recreational paths ... in close proximity to pedestrians, motorists, and those using public parks such as cross-country skiers."[5] A search of the available literature indicates that snowmobiles are ridden in areas other than trails. For example, a report by the Michigan Department of Natural Resources indicates that from 1993 to 1997, of the 146 snowmobile fatalities studied, 46 percent occurred on a state or county roadway (another 2 percent on roadway shoulders) and 27 percent occurred on private lands.[6] The use on private land is also confirmed by other Western States (e.g., CO and UT). Thus, the existence of a trail a relatively short rid on a snowmobile away from a CO nonattainment area does not preclude a snowmobile being operated off-trail and in nearby areas. We also show the registered snowmobiles by state with CO nonattainment areas in the RSD.

Regarding ISMA's comments on regulating visibility, we disagree with the assertion that we cannot set HC standards in order to regulate visibility impairment. ISMA's argument that section 213(a)(4) applies to emissions other than CO, NOx and VOCs, and that this prevents HC standards regulating visibility is incorrect both on its specific reading of the statute and also on the intent of section 213(a)(4). First, ISMA's interpretation of the statute is incorrect for two reasons: 1) as ISMA admits, section 213(a)(2) applies only to VOCs, NOx and CO. VOCs and HC are distinct. For example, HC includes compounds that are not included in VOCs, because they are not considered volatile. We often have used HC as a surrogate for VOCs, not because they are identical, but because HCs are comparatively easy to measure and are a good surrogate for VOCs. However, our snowmobile standards regulate HC not as a surrogate for VOCs, but as a surrogate for PM. Thus, our regulation do not regulate any of the three pollutants in 213(a)(2) specifically, nor do we regulate any other pollutant as a surrogate for VOCs. The legislative history of this section indicates that Congress meant for this exclusion to apply only to VOCs, NOx and CO specifically. See House Report 101-490, at 309 ("Paragraph (4) of revised section 213(a) provides that if the Administrator determines that emissions from nonroad engines not <u>specifically mentioned in paragraph (2) (which lists CO, VOCs and NOx)</u> significantly contribute...") ISMA has itself stated that PM emissions would be difficult to measure, so it is surprising for ISMA to object to our using HC as a surrogate; 2) moreover, the reference in section 213(a)(4) to emissions "referred to in paragraph (2)" could easily be interpreted to mean "emissions of carbon monoxide, oxides of nitrogen, and volatile organic compounds from ... nonroad engines ... [that] are significant contributors to ozone or carbon monoxide concentrations in more than one [ozone or CO nonattainment area]." ISMA argues that emissions of VOCs from snowmobiles do not contribute to ozone concentrations in ozone nonattainment areas, so the exclusion in section 213(a)(4) would not apply.

In any case, ISMA's reading of section 213(a)(4) flies in the face of the section's intent. The purpose of section 213(a)(4) is to allow EPA to regulate pollution not covered by the relatively narrow structure section 213(a)(2) and (3), which covers only ozone and CO nonattainment. ISMA's broad reading of the exclusion in section 213(a)(4) could potentially prevent EPA from regulating numerous types of pollution that are distinct from ozone and CO nonattainment but still may reasonably be anticipated to endanger public health or welfare, like visibility, acid deposition, hazardous air pollutants, etc. There is absolutely no indication that Congress intended this result.

Similarly, there is no indication that Congress intended to prevent EPA from regulating NOx for purposes other than ozone reduction. NOx emissions cause or contribute to several types of pollution (e.g., nitrification, acid deposition, and visibility impairment) that can reasonably be anticipated to endanger public health or welfare. There is no indication that Congress intended to limit EPA's ability to reduce such pollution. Additionally, in recent discussions, ISMA has indicated that NOx standards for snowmobiles are appropriate.[6]

EPA has found that nonroad engines contribute significantly to visibility impairment and that snowmobiles contribute to such impairment, particularly in class I areas. As ISMA seems to accept, the regional haze and visibility programs explicitly recognize that title II of the Act, including section 213, is the appropriate basis for regulating mobile source standards aimed at reducing visibility impairment.

Sierra Research claims that EPA did not conduct modeling for visibility. This is in error, and as we

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[6]See Memo to Docket from G. Passavant, Nonroad Director, Assessment & Standards Division (ASD), National Vehicle & Fuel Emissions Laboratory (NVFEL) Office of Transportation Air Quality (OTAQ), Office of Air & Radiation (OAR), U.S. EPA re Teleconference with ISMA Regarding Snowmobile NPRM Issues on 8/6/02 & 8/7/02.

explain in the RSD and amplify upon since the proposal, we relied on the PM air quality modeling performed in conjunction with EPA's on-highway Heavy Duty Engine/Diesel Fuel (HD07) final rule. This modeling was performed using EPA's Regulatory Model System for Aerosols and Deposition (REMSAD) model.[7] We used the REMSAD modeling to examine visibility impairment and population exposures related to the PM health effects we would anticipate would occur without the emissions reductions from this rulemaking. Furthermore, emissions from the engines subject to this rule (as well as other categories) were inputs to the modeling. Nonroad engines and vehicles that are subject these standards contribute to ambient fine PM levels in two ways. First, they contribute through direct emissions of fine PM. As shown in Table 1.1-1 of the RSD, these engines emitted 14,600 tons of PM (about 2.1 percent of all mobile source PM) in 2000. As shown in Table 1.1-3, they are modeled to emit 36,500 tons of PM (about 4.8 percent of all mobile source PM) in 2030. Second, these engines contribute to indirect formation of PM through their emissions of gaseous precursors which are then transformed in the atmosphere into particles. For example, these engines emitted about 1,411,000 tons of HC or 23.5 percent of the HC emitted from mobile sources in 2030.

Thus, the modeling results show the visibility and PM levels in the future that include the contribution from the engines subject to this rule. As described in detail in the RSD, the visibility modeling, reported in units of deciview (a visibility unit similar to a decibel for sound), shows widespread visibility impairment in places across the country where Americans live, work, and recreate as well as in the 156 national parks, forests and wilderness areas labeled as Class I areas.

The monitored data and air quality modeling presented in the RSD confirm that the visibility situation identified during the NAAQS review in 1997 is still likely to exist. Specifically, there will still likely be a broad number of areas that are above the annual PM2.5 NAAQS in the Northeast, Midwest, Southeast and California , such that the determination in the NAAQS rulemaking about broad visibility impairment and related benefits from NAAQS compliance are still relevant. Thus, levels above the annaul fine PM NAAQS cause adverse welfare impacts, such as visibility impairment (both regional and localized impairment). Snowmobiles are operated in and around areas with PM2.5 levels above the level of the secondary NAAQS. For 20 counties across nine states, snowmobile trails are found within or near counties that registered ambient $PM_{2.5}$ concentrations at or above 15 µg/m^3, the level of the $PM_{2.5}$ NAAQS.[7]

Achieving the annual $PM_{2.5}$ NAAQS will help improve visibility across the country, but it will not be sufficient (64 FR 35722 July 1, 1999 and 62 FR July 18, 1997 PM NAAQS). In setting the NAAQS, EPA discussed how the NAAQS in combination with the regional haze program, is deemed to improve visibility consistent with the goals of the CAA. In the East, there are wide areas above 15 ug/m^3 and light extinction is significantly above natural background. Thus, large areas of the Eastern United States have air pollution that is causing unacceptable visibility problems. In the West, scenic vistas are especially important to public welfare. Although the annual $PM_{2.5}$ NAAQS is met in most areas outside of California, virtually the entire West is in close proximity to a scenic Class I area protected by 169A and 169B of the CAA.

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[7] 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.

As described in detail in the RSD, the results of the REMSAD visibility modeling (that included emissions from engines subject to this final rule) also showed that visibility is impaired in most Class I areas and additional reductions from vehicles subject to this rule are needed to achieve the goals of the Clean Air Act of preserving natural conditions in Class I areas.

Recreational vehicles, such as snowmobiles, contribute to visibility impairment in Class I areas, based on current monitored PM levels as discussed in the RSD. Visibility and particulate monitoring data are available for 8 Class I areas where snowmobiles are commonly used. These are Acadia, Boundary Waters, Denali, Mount Ranier, Rocky Mountain, Sequoia and Kings Ganyon, Voyager, and Yellowstone. The information presented in Table 1.5-6 of the RSD shows that visibility data supports a conclusion that there are at least 8 Class I areas frequented by snowmobiles with one or more wintertime days within the 20-percent worst visibility days of the year.

In these areas, snowmobiles represent a significant part of wintertime visibility-impairing emissions. In fact, as discussed in the RSD, snowmobile emissions can even be a sizable percentage of annual emissions in some Class I areas. The snowmobiles thus are a significant contributor to visibility impairment in these areas during the winter. As indicated, winter days can often be among the worst visibility impairment. In addition, as the CAA specifically states a goal of prevention and of remedying of <u>any</u> impairment of visibility in Class I areas, the contribution of snowmobiles to visibility impairment even on winter days that are not among the days of greatest impairment is a contribution to pollution that may reasonably be anticipated to endanger public welfare and is properly regulated in this rule.

Based on the Sierra Research report, ISMA claims that snowmobiles do not contribute to visibility impairment in national parks, by stating that:

> …the NPRM and RSD contain no air quality modeling results demonstrating that significant visibility impairment is actually caused by snowmobiles...[An] independent analysis conducted by Sierra showed that snowmobiles do not significantly degrade visibility and have substantially lower impacts than other vehicles…operating in the parks. (Memorandum to IV-D-204 at 3)

As described above, we conducted visibility modeling (see the discussion of the REMSAD modeling). Although in the proposal, we emphasized the modeling in the PM health effects section, we have clarified its applicability to visibility in the final rule. Further, we note the relevant question is not whether snowmobiles contribute more or less than other sources, but whether they contribute. Even ISMA's own modeling (although we disagree with the modelling approach selected) makes the case that snowmobiles do contribute to visibility impairment in Class I areas.

Specifically, Sierra Research conducted modeling for ISMA, to demonstrate ISMA's claim, using the SCREEN3 Model Version 96043:

> …a single source Gaussian plume model, which provides maximum ground-level concentrations for point, area, flare, and volume sources, as well as concentrations in the cavity zone and concentrations due to

> inversion break-up and shoreline fumigation. (U.S. EPA, Dispersion Models).

The modeling demonstrated that there is up to an 8 percent contribution to visibility impairment from snowmobile exhaust based on what ISMA describes as “worst case” conditions. It should be noted that SCREEN3 is not an agency-approved model for conducting visibility modeling nor is it appropriate for mobile sources. In fact, the original guidance for the SCREEN model is called “Screening Procedures for Estimating the Air Quality Impact of Stationary Sources” (emphasis added). (See US EPA SCREEN3 Guidance. Document No. EPA-454/B-95-004. September 1995). In that stationary source modeling guidance, with respect to the section “What the model cannot do,” the report states,” SCREEN cannot explicitly determine the maximum impacts from multiple sources.” Readers are directed to other models to capture the impacts from multiple stationary sources. SCREEN3 is not designed to model visibility or mobile sources or multiple sources.

ISMA noted that the conversion factors used by SCREEN3 are “conservatively high” and meant for “worst case” conditions, where there is a “pronounced [wind] polarity…such as where a sea breeze exists” (Memorandum to IV-D-204 at 13). Consequently, ISMA believes that data gathered away from a coastline would actually have a lower demonstrated visual impact than the impact determined by the model (Memorandum to IV-D-204 at 13). ISMA reasons that by using the same model for automobiles, the impairment contribution is double of what was expected, and therefore, the 8 percent is most likely double of what it should be. As a result, ISMA arbitrarily cuts this number in half and concludes an up to 4 percent contribution to visibility impairment from snowmobile emissions in national parks “on best visibility days” (Memorandum to IV-D-204 at 14). A more appropriate conclusion from the puzzling results from the automobile modeling should be that this model was not well-specified for mobile source applications. Although the contribution levels in this industry-sponsored study are lower than our results, and although we have some concerns with this study, they still confirm that snowmobiles are indeed a significant contributor to visibility degradation in Yellowstone.

Our conclusion is supported by the National Park Service’s conclusion that “visibility assessment indicates that under this alternative [of no action for restricting snowmobile use, or current conditions], vehicular emissions would cause localized, perceptible visibility impairment near the West Entrance, and in the area around Old Faithful and Flagg Ranch. The emissions along heavily used roadway segments would also lead to localized, perceptibly visibility impairments under certain viewing conditions” (NPS 2000 at 207-208, 225). Furthermore, in a focus group held by EPA regarding public perceptions of visibility, respondents indicated that there were a number of dimensions to visibility in addition to visual range, such as color and crispness or clarity (ABT Associates, 2001).

In addition to the national REMSAD modeling, we also conducted local-scale modeling using an EPA-approved visibility model, VISCREEN Version 1.01, to evaluate whether current emissions from recreational vehicles, such as snowmobiles, contribute to localized visibility impairment in Class I areas. This analysis focused on localized visibility impairments in Yellowstone National Park.[8] The VISCREEN model is a visibility screening level-I and -II model that characterizes point source plumes and visibility effects at 34 lines of sight. Thus, in this modeling, EPA treated snowmobiles as a synthetic point source in order to determine plume perceptibility effects in a national park.

Using VISCREEN Version 1.01, we determined plume perceptibility from snowmobile usage at four entrances (North, South, East, and West) in Yellowstone National Park as a case study of visibility impairment from recreational vehicles. We conclude that plume perceptibility would be noticeable at all entrances, even at the North entrance where the smallest numbers of snowmobiles enter. Variations in the parameters concluded that perceptibility increased as the observer neared the plume and at smaller plume-offset angles. As well, a sensitivity analysis was conducted in order to demonstrate visibility impairment when the source is located within the Class I boundaries and concluded that visibility impairment increases if the source is located within the boundary. This provides further proof that snowmobile usage can lead to visibility impairment at Yellowstone. These results all indicate that snowmobiles contribute to visibility impairment concerns in Yellowstone National Park, a Class I area.

3. Personal Exposure and Snowmobiles

What We Proposed

In our discussion of personal exposure to emissions for snowmobiles, we used an empirical model for CO from a Grand Teton exposure study to estimate benzene exposure.[8] We used benzene emission rates from a State of Montana emission study.[9] Our results suggest that benzene exposures for riders driving behind a single snowmobile were predicted to range from 1.2E+02 to 1.4E+03 $\mu g/m^3$. Using the same model to predict exposures when riding at the end of a line of six snowmobiles spaced 25 feet apart yielded exposure predictions of 3.5E+03, 1.9E+03, 1.3E+03, and 1.2E+03 µg/m3 benzene. at 10, 20, 30, and 40 mph, respectively.

What Commenters Said

Sierra Research noted that the model developed by Snook is incorrectly formulated, as it estimates rider exposure as a function of the size of the snowmobile wake. An equation describing wake size was derived based on concentrations of CO measured at the breathing-zone of a rider in addition to emission rates measured on a snowmobile in the field: "In particular, the running emission rate of the lead snowmobile was used to estimate the cross-section (or radius) of the wake of the lead snowmobile... as a function fo the distance behind the lead snowmobile." The comment notes that emission rates estimated by snook were substantially lower than those used by EPA in representing typical emission rates from snowmobiles. Noting that the emission rates appear unrealisticallly low, the comment concludes that the exposure model developed by Snook (1996) must overestimate rider exposures for a given emission rate.

Our Response

The emission rates were developed by Snook (1996) by multiplying exhaust concentrations of CO by the rate of air flow from the exhaust. Snook measured exhaust concentrations using standard methods. However, the exhaust air flow was estimated based on balancing a set of chemical equations that estimated exhaust flow as a function of air intake flow on the measured snowmobile. It appears that the air intake flow measurements taken by Snook (1996) were erroneous and appear to be biased low. As a result, the mass emission rates used to calibrate the exposure model also appear to be low. Consequently, it is likely that Snook's model, as it is currently formulated, will overestimate exposures if correct emission rates are employed in it. While rider exposures may be high, the model developed by Snook does not currently estimate them accurately.

What Commenters Said

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[8] 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. Also, Snook, 1996, "An Investigation of Driver Exposure to Carbon Monoxide while Traveling in the Wake of a Snowmobile." (Dissertation) University of Tennessee, Knoxville.

[9] 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.

The Sierra Research comments also noted that “Snook and Davis estimated that the wake radius at 100 feet behind the lead snowmobile would be about 1 meter. On the other hand, using a point source model, Sierra estimated a wake (or plume) radius of about 4.2 meters 100 feet downwind of the source assuming a wind speed of 20 mph.”

Our Response

Of particular note in Snook and Davis’ work is the lack of concordance between observed wake values and traditional point-source dispersion algorithms, like Gaussian models. Snook and Davis note this result, and accordingly attribute the growth of the wake to turbulence induced in the wake of the vehicle, and not atmospheric dispersion as would be the case if snowmobiles were point sources. Snook (1996) reviews prior literature describing plume growth in the wake of motor vehicles. Due to vehicle-induced turbulence, vehicle wakes do not grow as predicted by Gaussian models. As a result, Sierra’s estimate of the wake radius using a point source model will not be correct.

What Commenters Said

Sierra Research conducted an “alternative analysis” of benzene concentrations using the CAL3QHC dispersion model (Version95221). In accordance with CAL3QHC modeling guidance, Sierra estimated concentrations of benzene at receptors16 feet from the centerline of the roadway.

Our Response

CAL3QHC is EPA’s model for estimating pollutant concentrations around transportation facilities. It makes use of a Gaussian plume algorithm for pollutant concentrations. CAL3QHC’s user’s guide states:

> A receptor should be located outside the "mixing zone" of the free flow links (i.e., total width of travel lanes plus 3 meters (10 feet) on each of the outside travel lanes) (See Figure 2). The mixing zone is considered to be the area of uniform emissions and turbulence. (www.epa.gov/scram001)

In other words, CAL3QHC is intended to model concentrations at locations away from roadways. Thus, CAL3QHC, while appropriate for assessing transportation air quality impacts at roadside receptors, is not appropriate for calculation of concentrations on the roadway itself.

As a means of evaluating this modeling approach, CO concentration data collected by Snook (1996) and presented by Snook and Davis (1997)[1] have been analyzed to determine whether measurements of CO in the centerline of a snowmobile plume are of similar magnitude as measurements of CO 15-feet off the centerline of a snowmobile plume. Snook collected personal exposure data on a snowmobile riding at 10, 20, 30, and 40 mph at distances of 25, 50, 75, 100, and 125 feet behind a lead snowmobile. Snook corrected the data to account for CO concentrations that arise from riding one’s own snowmobile. Throughout this data set, centerline concentrations are substantially (and significantly) higher than off-centerline concentrations for every between-snowmobile distance measured by Snook (1996). These results indicate that predictions of concentrations of CO, benzene, or any pollutant modeled using CAL3QHC will substantially underestimate actual rider exposures.

What Commenters Said

An OSHA survey of benzene and CO exposures of employees in Yellowstone National Park indicated that no exposures were above any OSHA-determined permissible exposure limits for occupational safety. Only two individuals in the study experienced benzene concentrations in excess of the NIOSH recommended exposure level, a snowmobile mechanic and a kiosk attendant who spent substantial fractions of their work shift outdoors. They note that workplace practices, rather than emission standards, are a better remedy for high exposures.

Our Response

Very few measurements have been taken to quantify exposures to snowmobile exhaust constituents. While only two individuals were exposed to high concentrations of benzene in this study, their exposures measurements may provide information on exposures that may occur in similar scenarios. The mechanic and kiosk attendant in the study were continuously exposed to direct emissions from snowmobiles. In other exposure situations in which individuals are in close proximity to a large number of snowmobiles, these data indicate the potential for high exposure to benzene and other exhaust constituents. Such exposure scenarios might include snowmobile riders continuously in the plume of other snowmobiles for several hours. Because limited data is available for exposure characterization, these few exposure measurements provide important information into high-end exposures. While emission reductions will reduce exposures in these scenarios, the reductions in emissions from this rule are designed to address nonattainment of the National Ambient Air Quality Standards and other health and welfare effects. While OSHA remains the primary regulatory agency for workplace exposure, cleaner vehicles can aid reductions in worker exposure.

4. Personal Exposure - Large SI Engines

What We Proposed

In addition to the need for emission controls for Large SI engines based on their contribution to ozone and CO nonattainment, we also discussed the regional and local-scale public health and welfare effects associated with emissions from these engines, particularly personal exposure to air toxics and CO. Exhaust emissions from Large SI engine applications with significant indoor use can expose individual operators or bystanders to dangerous levels of pollution. Indoor use may include extensive operation in a temperature-controlled environment where ventilation is kept to a minimum. The main pollutant of concern is CO, although HC high emissions can lead to increased exposure to harmful pollutants, particularly air toxics.

Commenters Support the Proposal

NESCAUM noted that emissions from Large SI Engines “aggravate both local and regional ozone problems” and affect the health and safety of workers who operate equipment with these engines, due to their toxics emissions as well as their HC and CO emissions.

Commenters Oppose the Proposal

Briggs & Stratton commented that setting standards for Large SI Engines based on personal exposure is not appropriate. They note that “elevated personal exposure levels will always be possible when operating an internal (sic) engine in an enclosed space,” that personal exposure is best addressed through local workplace controls, and that OSHA standards can address personal exposure more efficiently. They also call EPA’s attention to the Clean Air Act requirement that standards for these engines be based on their effect on the National Ambient Air Quality Standard (NAAQS) and not on personal exposure issues.

The Industrial Truck Association also questions EPA’s reliance on personal exposure to CO emissions from these engines as a justification for setting CO standards. According to ITA, indoor concentrations of pollutants is not just a function of equipment emission rates; “they are to a much greater extent a function of (i) the facility itself, including its size, configuration, and air-exchange capabilities, and (ii) the number and size of the engine-powered pieces of equipment in operation and their location, including (for mobile equipment) schedules of operation and traffic patterns. Thus, the room size and layout, the air-exchange rate, the number of engines, the usage rates of the engines, the horsepower and load factors of the engines, the times and areas of use of the engines, and a number of other factors will overwhelm the emission rate of a particular engine in influencing the ambient pollutant levels in a facility.” If EPA had considered these factors, it may have chosen different emission limits. ITA also notes that OSHA has already set exposure limits for CO, based on all factors that contribute to those levels. ITA further comments that “EPA cannot quantify the alleged benefits of its approach in terms of individual exposure to CO or other pollutants” or “show any need for further reductions from the standpoint of individual exposures. Finally, ITA is concerned that the emphasis on personal exposure “creates a presumption that only LPG engines can safely be used in enclosed or partially enclosed areas.” They request that EPA refrain from characterizing LPG and low-CO engines as the only engines that can be used safely indoor or partially-enclosed applications.

Our Response

Please see our response in Section III.3.b of this Summary and Analysis of Comments.

5. Personal Exposure - Recreational Marine Engines

What We Proposed

In addition to the need for emission controls for recreational marine diesel engines based on their contribution to ozone and CO nonattainment, we also discussed the regional and local-scale public health and welfare effects associated with emissions from these engines, particularly personal exposure to CO. As with snowmobiles, the usage patterns of recreational marine engine can lead to high personal exposure levels, particularly for CO emissions.

Commenters Support the Proposal

NESCAUM notes that there is a need to reduce "ozone precursors, PM, toxics, and water pollution caused by marine engines," and that several members of their organization are pursuing programs to introduce cleaner marine engines in their states.

Commenters Oppose the Proposal

The National Marine Manufacturers Association questioned the need for CO control from marine engines. They commented that recent injuries and deaths associated with CO poisoning are "not a valid basis for requiring CO emission reductions from recreational marine engines." These deaths and injuries are due to reckless behavior by individuals and are "completely unrelated to any level of CO control that can be achieved under EPA rules" (emphasis in original). They further note that EPA is constrained by the Act to focus on pollutants that are "significant contributors to the nonattainment status of any area."

Our Response

While CO emissions from recreational marine engines are a serious problem, we are not relying on a personal exposure rationale for our authority to regulate recreational marine diesel engines. As we noted in Section II.A. of the proposal, we established that the engines covered cause or contribute to ozone or carbon monoxide pollution in more than one nonattainment area. We did this in three actions in 1996, 1999, and 2000, in which we made separate determinations that each category of nonroad engines covered contributes to ozone and CO nonattainment, and to the adverse health effects associated with ambient concentrations of PM. A list of these findings is contained in Table II.A-1 of the proposal. At the same time, CO emissions from marine engines can be a serious personal exposure. While we intend for the CO emission standard to serve as a cap on uncontrolled emission levels, they will prevent manufactures from increasing CO emission levels as they control other emission constituents, and thus prevent them from exacerbating this problem.

6. Noise Controls

What We Proposed

As we noted in the preamble for our proposed rule, we established noise emission standards for motorcycles and three-wheeled ATVs in 40 CFR Part 205 (45 FR 86708, December 31, 1980). Prior to proposal, we received public comments requesting that we consider setting new noise standards for recreational vehicles. Noise from these vehicles in public parks or other public lands can adversely impact other activities. In response to those comments, we noted that we do not have funding to pursue noise standards for nonroad equipment that does not have an existing noise requirement.

What Commenters Said

The Sierra Club Recreation Issue Committee and Environmental Defense group note the contribution of these engines to noise levels. They note that "noise from dirt bikes, snowmobiles and ATVs is frequently in the range of between 81 and 111 decibels, equivalent to a busy street or a rock concert," and these vehicles "are one of the single largest sources of noise pollution on public lands." This is of particular concern because the areas in which they are operated "are naturally quiet," and because even areas that are off-limits to these vehicles experience high noise levels from them. They note that noise abatement would be helped by the move to 4-stroke engines on these vehicles. These groups, as well as the Natural Resources Defense Council, Bluewater Network, and Mr. Althouse, requested EPA to consider noise standards for these engines because, in the words of NRDC, "these machines are often used on public lands, where many people value natural quiet and solitude." Bluewater Network suggested that EPA can address noise from snowmobiles by requiring 4-stroke technology for these vehicles. Bluewater noted that although a rider was attached to an Appropriations bill several years ago preventing EPA from setting noise standards, their understanding is that the prohibition applied only to that session of Congress. The Natural Trails and Waters Coalition noted that the Public Health and Welfare Act (42 USC 4901) gives EPA authority to set these standards.

The Appalachian Mountain Club requested that EPA set noise standards for recreational vehicles, based on the Vermont state law of 73 maximum dBs for snowmobiles at 50 feet. They also suggests that the Transportation Noise Emission Provision (40 CFR 205.1) be expanded to include ATVs and the standard should be tightened to reflect current available technology.

Our Response

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

We are aware of the impacts of recreational vehicles on noise levels in public parks and public lands, and we may choose in the future to explore further regulation under the Noise Control Act. However, noise control standards were not the subject of this rulemaking and would need further review under the Noise Control Act prior to engaging in any rulemaking, including whether funding has been allocated by Congress for such a rulemaking. See also our response at Section II.I.1 of this document.

D. Certification and Compliance

This Section II.D addresses the major comments that we received regarding certification and compliance issues. Both MIC and ISMA submitted detailed comments on specific regulatory language. Many, but not all of these comments are addressed in this section. The comments that are not addressed in this section are those that are much less significant from a policy perspective, especially those that dealt with the structure, format, and clarity of the regulatory language. These other comments have been considered fully, and are addressed in separate documents that have been placed in the docket for this rulemaking.

1. Useful Life Policy and Warranty

What We Proposed:

In EPA's nonroad engine and vehicle programs, manufacturers are generally responsible to build their engines to meet the emission standards for the full useful life of the vehicle. The useful life is specified by regulation and is generally intended to reflect the typical life of the engine (without being remanufactured). Useful life values, which are expressed in terms of years or amount of operation (in hours and/or kilometers), vary by engine category. Consistent with other recent EPA programs, we proposed useful life values to be 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. We also specified that the actual useful life would be the period during which the vehicle is designed to properly function in terms of reliability and fuel consumption, without being remanufactured. We proposed that the useful life would be set during certification, and would not be varied for production within the model year.

We proposed to apply our conventional emission-related warranty requirements to the engines and vehicles being regulated in this rulemaking. The general requirement for warranties is specified by §207(a) of the CAA. For this rulemaking, we specified that the warranty period must be at least as long as one half of the useful life. Consistent with our other warranty programs, we also specified that manufacturers that provide longer non-emission-related warranties must also include emission-related components.

What Commenters Said:

MIC and ISMA both commented that we should not specify the useful life based on design life. They argued that the nature of the recreational vehicle market is such that manufacturers must design their vehicles to last much longer (in terms of hours or kilometers) than the average service life. They also commented that we should set a constant useful life instead of using the variable approach that we proposed.

MIC and ISMA both commented that we should not require warranty periods longer than half of useful life.

Our Response:

We agree with MIC and ISMA that recreational vehicles are unusual in the respect that they are designed to last much longer than the typical owner would actually use them. Therefore, we are modifying the proposed definition of "useful life" for recreational vehicles to be "the expected average service life before the vehicle is remanufactured or retired from service . . ." We are not using this approach, however, for commercial engines such as Large SI engines, which have much higher usage rates. For commercial engines, we believe that there is not a significant discrepancy between average service life and design life, since owners of these engines are not likely to scrap a functional engine. For this reason, and because the concept of design life is generally more readily understood by manufacturers of these engines than actual in-use service life, we are finalizing a definition of "useful life" for Large SI engines that is based on design life.

We disagree with the comments opposed to the concept of minimum rather than fixed useful life values for three reasons. First, both average service life and design life vary widely within the categories being regulated. For example, high-speed sport ATVs may be used for twice as many miles in their lives as the average ATV, while some utility vehicles may be used less than the average. Similarly, some Large SI engines are used in continuous operation where they can accumulate enough hours within a single year to exceed the minimum useful life value. Given this wide variety of applications, and usage patterns, we do not believe that we can set a single fixed value for each regulated category that would accurately reflect the in-use operation of the engines and vehicles of that category.

The second reason is that we have observed that market forces tend to drive manufacturers to make longer lasting products over time. Thus, useful life values that are appropriate now may be too short in the future. By setting minimum rather than fixed useful lives we enable the regulatory program to evolve with the technology.

Finally, as is described in the RSD, we have determined that the standards being adopted are feasible with variable useful life values. For example, the standards for offroad motorcycles are expected to met by virtually all properly functioning four-stroke motorcycles. Thus, since our useful life definition would not be expected to ever result in useful life period that was longer than the period that a motorcycle was designed to be properly functioning with respect to non-emission related performance (even in cases where the actual useful life is much longer than the minimum), the variable specification of useful life would not make the standards infeasible.

With respect to warranty, we do not believe that the requirement to include emission-related components in all extended warranties will be burdensome to manufacturers. Manufacturers should be building their products to have durable emission controls, so that emission-related warranty claims should be infrequent, even during extended warranty periods.

2. Exemptions

What We Proposed:

We proposed that we may require manufacturers (or importers) to add a permanent label describing that an engine is exempt from emission standards for a specific purpose. In addition to helping us enforce emission standards, this would help ensure that imported engines clear Customs without difficulty.

We discussed in the proposal the Customs Service's policy of allowing foreign nationals traveling with their personal vehicles (including automobiles, trailers, aircraft, motorcycles, and boats) to import such vehicles without having to pay a tariff as long as the vehicle is used in the U.S. solely for the transportation of such person.

What Commenters Said:

EMA supports this proposal provided that the level of information required on the label is not too burdensome. They comment that it would be helpful to facilitate the importation of exempt engines. Recreational vehicle manufacturers commented in opposition to some of the administrative requirements of the proposed exemption provisions.

NTWC and SRFN question the emissions exemption for foreign nationals bringing personal recreational vehicles into the U.S. They stated that Customs allows unlimited temporal use of such vehicles. NTWC and SRFN request clarification on whether or not the grounds for this exemption is that EPA has determined that the harm of prolonged use outweighs other actual benefits of longer exemptions.

Our Response:

We are finalizing the labeling provision as proposed. We do not believe that the information required on the label (heading, corporate name/trademark, engine displacement and power, statement of exemption) is burdensome. For recreational vehicles, and other engines covered by part 1068, we have included a provision that would allow us to waive unnecessary administrative requirements.

We are not finalizing any special exemptions for the personal vehicles of foreign nationals. We will continue to defer to the Customs Service for determinations of when an engine or vehicle is imported into the U.S.

3. Rebuilding/Recordkeeping

What We Proposed:

We proposed to apply rebuilding provisions to nonroad engines and vehicles that are similar to those that apply for highway engines (see §1068.120). In general, this would require that rebuilders return the engine to its certified configuration and maintain records. We stated in the proposed regulations that:

> *The term "rebuilding" refers to a partial or complete rebuild of an engine or engine system, including a major overhaul in which you replace the engine's power assemblies or make other changes that significantly increase the service life of the engine.   It also includes replacing or rebuilding an engine's turbocharger or aftercooler or its systems for fuel metering or electronic control. For these provisions, rebuilding may or may not involve removing the engine from the equipment.*

What Commenters Said:

OTC expressed concerned that improperly rebuilt or maintained engines used beyond their useful life would result in greater emissions, and urged EPA to examine and take steps to ensure that rebuilt engines are maintained and operated to their fullest potential and efficiencies.

EMA commented that they generally support requirements designed to ensure that engines are rebuilt to their original configuration.

AERA commented in support of our general provisions for rebuilding certified engines, but expressed concern about the details of the regulations, and differences between our proposal for nonroad engines and the existing program for highway engines. Their two specific concerns were with the definition of "rebuilding", and with the language requiring rebuilders to use parts that would "control emissions to the same degree as with the original parts". With respect to the definition of "rebuilding", AERA was concerned that the proposed definition could expand the scope of the rebuild requirements. They preferred the definition specified for diesel marine engines in 40 CFR 94.11. They also stated that we should not use the term "partial rebuild" since it does not have any meaning in the rebuild industry.

With respect to the parts that are used during rebuild, AERA stated that it is concerned that requiring rebuilders to use parts that would "control emissions to the same degree as with the original parts" could impose additional requirements on rebuilders.

Our Response:

We share OTC's concern about improperly rebuilt nonroad engines. That is why we are finalizing rebuilding provisions for nonroad engines and vehicles that are similar to the provisions that apply to highway engines.

We agree with AERA that nonroad engine rebuilding provisions should be consistent with the provisions that apply to highway engines. The proposed regulations in part 1068 were intended to be a plain-language equivalent of the existing regulations for highway engines. These provisions are intended to include complete engine overhauls and major repairs of engine systems. They generally do not include minor repairs and other routine maintenance. In response to the concerns raised by AERA, we have added regulatory language to clarify the scope of these rebuild provisions. It is important to note, however, that there would still be regulatory language that applies to maintenance that does not qualify as rebuilding. The regulations prohibit any maintenance that would have the effect of disabling or reducing the effectiveness of emission controls. It is only the recordkeeping requirements that are dependent on whether or not the maintenance qualifies as rebuilding.

We recognize the concern raised by AERA about the language requiring rebuilders to use parts that would "control emissions to the same degree as with the original parts" could impose additional requirements on rebuilders. However, we do not believe that the proposed language would impose a greater burden on rebuilders. Nevertheless, we have incorporated into the final regulations additional clarifying language.

With respect to the rebuilding provisions of part 94, we are finalizing the proposed rebuilding requirements. Note that this includes out-of-frame rebuilding which is commonly referred to as remanufacturing. Also note that if the rebuilt marine engine is installed in another existing vessel, our replacement engine provisions would apply. If it is used to provide power to a new vessel, we would treat the rebuilt engine as a new engine.

4. Defect Reporting

What We Proposed:

For recreational marine diesel engines, we proposed to adopt the requirements that already apply to Category 1 commercial marine diesel engines, which generally requires reporting based on a finding that 25 or more defects exist over several years.

The proposed requirements for Large SI engines and recreational vehicles were that manufacturers must notify EPA when there are occurrences of 25 or more defects for engine families with annual sales of up to 10,000 units; this threshold would increase proportionally for larger engine families. These provisions are based on engine family sales, however the counting and reporting of defects is not limited to a single engine family. In addition, for catalyst-related defects, we proposed a threshold of approximately half the frequency of noncatalyst problems to trigger a defect report to EPA. Information on defects can come from many sources—including warranty claims, customer complaints, and product performance surveys. We proposed similar thresholds for potential or unconfirmed defects that would trigger a requirement to conduct an investigation, which may or may not result in a defect report.

What Commenters Said:

EMA generally supported the proposed defect reporting requirements for recreational marine engines and equipment in the proposal.

Several manufacturers commented that requirements in part 1068 for defect reporting should be the same as the current on-highway requirements. Manufacturers also commented that the count of defect occurrences should be limited to a single engine family and a single model year. Manufacturers opposed the requirement to count defects even if the defect is corrected before it reaches the ultimate buyer. These manufacturers generally opposed the defect investigation requirements.

Ford commented that there should no difference for the catalyst defect requirement. In addition, Ford recommended that EPA be consistent with CARB vehicle regulations by requiring defect reporting when emission-related defects exist in at least 4.0% of the total engines population. Ford also recommended that a five year defect counting period be adopted for all engines to be in line with the on-highway vehicle regulations.

One commenter complained about the lack of clarity of the requirement that appeared in the proposal requiring an investigation if information from dealers or elsewhere indicated a “higher than normal” occurrence of potential defects.

Our Response:

We have developed a new plain language defect reporting requirement for part 1068. The existing defect on-highway defect reporting regulations in subpart T of part 86 were originally drafted in 1977. We have learned a great deal since then about how to track defects. We believe that the requirement to investigate unconfirmed defects is important tool to prevent manufacturers from ignoring such potential defects.

We agree with the commenters that the investigation and reporting thresholds should be limited to a single engine family and a single model year to simplify the defect tracking program. However, the final regulations will still require that all equivalent defects be reported, without regard to model year or family, once a report is required.

We also agree that defects corrected before the engine reaches the ultimate buyer should not be counted for the reporting threshold. However, we are requiring that they be counted in the investigation threshold. We think that if a manufacturer finds a large number of defects before they reach the customer, it is reasonable to require an investigation to ensure that there is not also a large number of defects that were not corrected.

We believe that it would be inappropriate to allow a defect that occurs in nearly 4 percent of the engines in an engine family to go unreported. This is a significant percentage, and we need to be aware of such defects. It is also appropriate to set lower thresholds for catalysts, since defective catalysts can lead to very high emissions.

Finally, we believe that the defect tracking requirements should generally last for the useful life of the engines. A single value would not properly reflect the differences in usage rates on different types of engines.

Regarding the concern for clarity in counting defects, it was our belief and intent that manufacturers would utilize information about replacement part sales or shipments for indications of such a "higher than normal" occurrence. We have therefore revised the regulation language to note that parts shipments, along with warranty claims, must be counted towards the threshold for starting an investigation.

5. Recall

What We Proposed:

We proposed new regulations in part 1068 to clarify the Act's requirements related to recall. However, these proposed regulations would not apply to marine CI engines. We proposed to apply the existing recall regulations for commercial marine engines to recreational marine engines without any changes.

What Commenters Said:

Several manufacturers supported allowing manufacturers to use alternatives to recall. Ford believes that nonroad large SI engine requirements for recall should be the same as the current highway requirements.

Our Response:

We are finalizing the proposed recall regulations. Based on our experience in the motor vehicle program, we view recalls as an extremely effective tool to induce manufacturers to produce emission durable products. We recognize that the actual recall and repair of engines may prove to be burdensome and impose financial hardship on a manufacturer in some cases. Thus, we expect to consider alternatives to recall in the event of in-use emissions exceedances, prior to a finding of nonconformity. However, we do not need to adopt specific regulatory provisions to allow this, as long as the Administrator had not yet rendered a determination of nonconformity, in order to consider alternatives to traditional recall. It is after a determination of nonconformity with the requirements of section 207(c) of the Act is made, that the manufacturer no longer has the option of an alternate remedial action, and an actual recall is required. Of course all alternatives would be required to have the same or greater environmental benefit as conventional recall and to provide equivalent incentives to manufacturers to produce durable control emissions.

6. **Emission Data Submission** (Including DF)

What We Proposed:

We proposed the requirement that manufacturers estimate the rate of deterioration for each engine family over its useful life (the period during which engines are designed to properly function without being remanufactured). Using the deterioration factor, manufacturers would then show that each engine family meets the emission standards by incorporating this in emission control.

For certification testing, we proposed that manufacturers must select the emission-data engine, the engine to be used for testing, that is most likely to exceed emission standards in a given family; or, the "worst-case" engine. Use of the worst-case engine for testing ensures that all engines within a given family are compliant with the emission standards. We proposed that manufacturers include the results of all emission tests performed on their emission-data engines in their application for certification.

What Commenters Said:

Nissan believes that DFs should be allowed based on engineering judgment. (Nissan 5) Further, they believe that we should provide for assigned DFs for very small engine families (e.g., < 100 units). (Nissan 4)

Our Response:

The Clean Air Act calls for emission certification to be based on emission measurements. To implement this for Large SI engines, we have established a simplified process for establishing deterioration factors for all engine families. To a large degree, this is possible due to the fact that manufacturers will be testing their engines under the in-use testing program, which provides the most accurate possible measure of deterioration. Under the proposed certification program, manufacturers would have wide latitude to establish deterioration factors for individual engine families. For example, if manufacturers can show that other engine families using similar emission-control components would have similar emission-control characteristics, they may simply apply the same deterioration factor to both families. We generally refer to this as carry-across for two engines in the same model year or carry-over for an engine family that remains unchanged for a later model year. Manufacturers may also use their discretion to collect test data from laboratory or field measurements on either whole engine systems or on individual components separately. We therefore believe that assigning deterioration factors or allowing manufacturers to develop deterioration factors only on engineering judgment is neither necessary nor appropriate. We have applied somewhat different thinking with respect to small businesses, as described in Section G.

7. **Need for Production-Line Testing**

What We Proposed:

We proposed production-line testing (PLT) for all of the engines covered by this rulemaking. PLT requirements involve routine testing of production-line engines to help ensure that newly assembled engines control emissions at least as well as the emission-data engines tested for certification. The purpose of PLT is to provide information to allow early detection of problems with the design or assembly of freshly manufactured engines.

If an engine fails to meet an emission standard, the manufacturer must modify it to bring that specific engine into compliance. In the case of many engines failing to meet the standard, the entire engine family may be determined to fail the production line testing requirements and the manufacturer will need to correct the problem for future production. Further, sufficient testing must be performed to show that the engines in the engine family comply with emission standards.

The proposed PLT program for Large SI engines and recreational vehicles specified the Cumulative Sum (CumSum) statistical process for determining the number of engines a manufacturer needs to test. (We proposed a one-percent sampling rate for recreational marine diesel engines.) Each manufacturer selects engines randomly at the beginning of a new sampling period, which may be defined based on the size of the engine family. Under the CumSum approach, individual engines can exceed the standards without causing the engine family to fail the production line testing requirements. However, we have also proposed the requirement that manufacturers adjust or repair every failing engine and retest it to show that it meets the emission standards. All production-line emission measurements must be included in the periodic reports to us.

We also proposed the reduction of testing requirements for engine families whose engines consistently meet emission standards. This would entail applying for a reduced testing rate for engine families with no production-line tests exceeding emission standards for two consecutive years. The reduced testing rate approval would apply only for a single model year with a minimum testing rate of one test per engine family per year. In addition, we proposed an allowance for manufacturers with unique engine compliance circumstances to suggest an alternate plan for testing production-line engines, as long as the alternate program effectively ensures that the engines will comply. This allowance is a flexibility, and will not affect the stringency of the standards or the PLT program. (*See the category-specific chapters that follow for discussions on PLT for the specific programs*.)

What Commenters Said:

EMA believes that the requirement of Production Line Testing (PLT) for recreational marine engines is burdensome and unjustified. MIC and ISMA commented that we should not finalize PLT for recreational vehicles. ISMA also commented that if EPA does finalize PLT that it should a allow manufacturers to combine engine families for PLT and only test the new technologies.

Our Response:

We believe that some testing of production engines is generally required to ensure that engines are being produced consistent with the certificate of conformity. It does no good to require a manufacturer to certify an engine design for an engine family, if the engines do not conform to that certificate when they are produced. In the past, we have relied on selective enforcement audits (SEAs) to ensure production quality. In the SEA program, EPA audits the emissions of new production engines by requiring manufacturers to test engines pulled off the production line on short notice. This spot checking approach relies largely on a deterrence strategy. We now believe that a PLT program is generally more effective, and less burdensome than frequent SEAs.   Manufacturers already design into their production processes steps necessary to make sure their engines are properly produced. Emission testing can generally be designed into that process with limited burdens. However, we recognize that there are special situations that should be considered separately:

> 1) There are technologies that would be expected to not be subject to emission-related production problems. This is especially true where manufacturers make fundamental changes to noncomplying products, rather than making marginal changes. The most obvious example of this is the switch to a four-stroke engine design from a two-stroke engine design. In this case, the chance of production mistakes causing vehicles to be produced to not comply with the standards would be very small. An engine certified as a four-stroke engine could not be accidentally produced as a two-stroke engine.
>
> 2) There are cases in which a manufacturer certifies an engine design with a large compliance margin. That is a manufacturer designs an engine to be well below the emission standard, but does not use that margin to generate emission credits. The need for PLT in that case is less than in other cases, since production engines would need to have larger emission increases during production to exceed the standards.
>
> 3) PLT becomes less critical once production quality has been demonstrated. With mature engine designs and production practices, it is less likely that production quality will suddenly drop.

We have included flexibilities to address these special cases. In addition, we have included specific authority to allow manufacturers to develop their own methods of ensuring that the engines are being produced to comply with the emission standards.

Thus, we disagree with the comments suggesting that PLT is not necessary or that it is excessively burdensome. We also disagree with the ISMA suggestion to only test the new technologies. This suggestion is actually contrary to the logic of the first special case mentioned here, since the engines that ISMA wants to exclude will generally rely solely on calibration changes and other marginal improvements, rather than fundamental technology upgrades.

It is worth noting that the regulations would allow manufacturers to request (as an alternative) combining engine families for production-line testing, provided they could develop an alternate program that would show their production compliance just as well as program that we are specifying in the regulations. We believe that the kind of program proposed by ISMA (for new technologies) could potentially be used as an alternative program, with appropriate modifications. For example, it would be essential that such a program included testing of all technologies, rather than just those new low emission technologies.

8. Running a Production Line Test Program or a Selective Enforcement Audit

What We Proposed:

EPA proposed manufacturer production line testing requirements. EPA is also given the discretion under Clean Air Act section 206(b) to perform a selective enforcement audit (SEA), in which EPA selects an engine family gives the manufacturer a test order detailing a testing program to demonstrate that their production-line engines comply with emission standards. In general, we intend to use on manufacturers' testing of production-line engines to demonstrate compliance with emission standards for production vehicles. In the proposed regulations, we reserved the right to conduct SEA if we have reason to question the emission testing conducted by a manufacturer.

What Commenters Said:

Caterpillar believes that being required to test 1% of one's production is excessive and that EPA can assure compliance of new engines by utilizing an SEA approach. They believe that self-audits should be encouraged and that the risk of non-compliance automatically ensures full compliance. They state that the program could be voluntary if the manufacturer chooses or it could be done on demand under a specified SEA program. (Cat 6)

EMA believes that the requirement of Production Line Testing (PLT) for recreational marine engines should be capped at a maximum of five engines per family.

EMA believes that EPA must propose for comment what would be involved in an SEA, the specifics of how it is to be conducted, what would constitute a pass or fail, and how a fail would be addressed.

Nissan believes that CARB testing should satisfy EPA requirements for the proposed standards and that we should allow for the approval of a sampling plan, instead of being completely random (like for CARB). Further, Nissan supports the omission of transient tests and NTE from PLT. (Nissan 3, 6,6)

Ford believes that manufacturers should be able to repair or delete a test engine without EPA pre-approval; documentation would be provided by the manufacturer in a quarterly report. They also believe that the regulation should state that manufacturers may set adjustable parameters anywhere within the adjustable range. (Ford 7) The current proposal requires EPA approval to waive the initial emission test before adjusting or repairing an engine after transport, Ford believes that manufacturers should be able to waive initial test without EPA approval. (Ford 8)

Our Response:

We agree that manufacturers testing Large SI engines to meet the requirements of California ARB's production-line testing program should have to do no additional testing under EPA's program. We designed the federal program to differ from that in California only in ways that would allow greater flexibility for the manufacturer. EPA approval of a sampling plan is one example of this greater flexibility.

It is important to note that we are not requiring routine testing for transient or off-cycle emissions during production-line testing of Large SI engines. As we pointed out in the proposal, we recommend that manufacturers with such testing capabilities do such testing as needed to ensure that production engines are meeting all applicable standards. This would serve as additional protection for the manufacturer under any testing of in-use engines. Also, if we have specific concerns, we may direct the manufacturer to do additional transient or off-cycle testing with production engines to show that these engines meet emission standards.

Caterpillar misstated the proposed sampling rate for production-line testing. The one-percent figure for Large SI engines represents a maximum testing rate, beyond which a manufacturer no longer needs to show that engines meet emission standards. For most situations, a manufacturer would test far fewer engines. In fact, with the potential for alternative procedures and reduced testing rates, manufacturers may be able to reduce their testing either to a very simple procedure or a very small number of engines. We believe that the production-line testing requirements impose very little incremental burden beyond the amount of self-auditing emission measurements recommended by Caterpillar.

With respect to the issues raised by Ford, we believe that the proposed provisions are appropriate to allow us to ensure the validity of emission test measurements. At the same time, we are aware that these provisions may in some cases add considerable unnecessary burden. We therefore intend to work with manufacturers on a case-by-case basis, eventually adopting guidance that allows for simplified approval or pre-approval in the circumstances described by the Ford comments.

9. Maintenance Intervals

What We Proposed:

We proposed limits on the amount of scheduled maintenance that manufacturers may prescribe for their customers to ensure that engines continue to meet applicable emission standards. The proposed limits are to prevent a manufacturer from specifying maintenance intervals so frequent that there is little assurance that in-use engines are continuing to operate at certified emission levels. We also proposed that these minimum maintenance intervals would be applied to engines that the manufacturer operates for service accumulation before performing emissions testing.

What Commenters Said:

ITA believes that minimum maintenance intervals should be deleted since the standards only allow scheduled maintenance on critical emission-related components with clear assurance that it will be done. They believe that the proposal has conflicting minimum intervals of 4500 and 5000 hours and that EPA should clarify whether “maintenance” includes replacement or just general servicing. (ITA 32)

GFI believes that the standards should allow fuel-system component cleaning (without disassembly) to allow re-tuning of adjustable parameters. (GFI)

Recreational vehicle manufacturers opposed restrictions on maintenance.

Our Response:

The maintenance requirements allow manufacturers to specify maintenance on critical emission-related components with the clear assurance that it will be done most of the time. This falls considerably short of being sure that such maintenance will always be done. To close this gap, we generally adopt minimum maintenance intervals for emission-related components, further ensuring that scheduled maintenance does not exceed a reasonable expectation for operators to keep emission-control systems functioning properly.

We have modified our approach to these minimum intervals for Large SI engines by connecting different intervals for different systems or components. The most critical components that should generally be low-maintenance we believe should function throughout the engine’s useful life. Manufacturers may therefore not specify maintenance on catalysts, turbochargers, or emission-control units more frequently than every 5,000 hours. Fuel injectors do not require frequent maintenance, but may need more frequent attention. We are therefore setting the minimum maintenance interval for fuel injectors at 3,500 hours. Oxygen sensors and fuel system cleaning are relatively straightforward maintenance steps that may be needed twice over the engine's useful life, so we are setting the minimum scheduled maintenance intervals for these items at 2,500 hours. These intervals are generally consistent with the requirements adopted by California ARB, with some adjustment to align with requirements for automotive emission-control systems. The maintenance referred to in the regulations applies to either servicing or replacing engine components. Note that diagnostic systems may indicate to the operator that any of these maintenance items are necessary sooner than would be done under the manufacturer's prescribed maintenance intervals. If an operator fails to do the maintenance called for by the diagnostic system, we would probably consider the engine to be one that is not properly maintained.

We have also modified the maintenance restrictions for recreational vehicles to clarify that routine maintenance is allowed.

10. Certification Process

What We Proposed:

For certification we proposed a process similar to those already adopted for other engines. We proposed that manufacturers would have to certify their engine models by grouping them, by similarity in emission characteristics, into engine families. This would play a part in determining the amount of testing required for certification. Broader or narrower categories may be approved to address a manufacturer's unique product mix. We also proposed that for certification testing, manufacturers would have to choose the worst-case engine as its emission-data engine (*see II.D.7. Emission Data Submission*).

What Commenters Said:

Caterpillar believes that the test engine should be specified rather than letting manufacturer select worst-case engine. Further, they believe that EPA should not be able to deny certification because the manufacturer has selected the "wrong" test engine. (Cat 7)

For Large SI engines, Ford believes that EPA should completely harmonize with California ARB to avoid adding cost without environmental benefit and adopt an identical certification application as that used by CARB. (Ford 1, 4) Further, they strongly support installation instructions. (Ford 6)

Nissan believes that certification should be aligned to eliminate any redundancy with CARB and production engines should be allowed in anticipation of certification approval. They also believe that C2-certified engines should be allowed to be used in D2 applications. (Nissan 3,4)

Our Response:

We agree that it is an important objective to align certification requirements with those already in place for California ARB. We adopted certification requirements that rely heavily on California ARB's protocol for Large SI engines. To the extent that there are inherent differences in certifying engines to state vs. federal requirements, we will work to prevent those differences from causing any significant additional burden for manufacturers. Also, we intend to cooperate with California ARB staff to be able to use common templates and forms for certifying engines as much as possible.

The Clean Air Act relies on "introduction into commerce" as the key point at which manufacturers must have certified engines. Manufacturers may therefore produce engines in anticipation of gaining approval for a pending application for certification. Manufacturers may only sell those engines, however, after they are appropriately labeled, showing that they are in a certified engine family at the point of sale.

We agree that the prescribed approach to installation instructions is a helpful assurance that people will correctly install engines in nonroad equipment, including diagnostic and aftertreatment systems and components that must be carefully integrated into the overall design of the equipment.

As described in the preamble to the proposed rule, we rely on the manufacturer using good engineering judgment to select the worst-case engine to represent an engine family. Since manufacturers are responsible for all the engines in the family, regardless of the choice of the test engine, it would be inappropriate for EPA to select the test engine. We have added the reference to good engineering judgment to the regulation text. As a result, we will generally not overturn a manufacturer's choice of the test engine, except for fraud or other situations we specify in part 1068.

In the proposal, we described our reasons for requiring manufacturers to test engines with both the C2 and the D2 duty cycles, unless engine families were restricted to being used only in variable-speed or constant-speed applications, respectively. This involves a very small additional test burden and should involve little or no additional design effort beyond that needed to make the engine commercially available for the different applications. Since Nissan did not address any of the reasons given for this testing arrangement, we have adopted the testing provisions as proposed.

11. Defining Spark-Ignition Engines

What We Proposed:

We proposed to add a definition for "spark-ignition" consistent with the existing definition for "compression-ignition." The proposed definition is: "spark-ignition means relating to a type of engine with a spark plug (or other sparking device) and with operating characteristics significantly similar to the theoretical Otto combustion cycle. Spark-ignition engines usually use a throttle to regulate intake air flow to control power during normal operation." This allowed us to define a compression-ignition engine as any engine that is not spark-ignition which helps ensure that emission standards for the different types of nonroad engines fit together appropriately.

What Commenters Said:

EMA commented that this definition would result in most engines fueled with natural gas being considered spark-ignition engines. They stated that the convention for land-based engines is to certify natural gas engines derived from compression-ignition engines as compression-ignition engines even though they make use of a throttle and spark plug. They say that this convention is logical because CI derived natural gas engines are marketed as a replacement for CI engines, and that this convention should be applied to recreational marine engines. (EMA p.36-37)

Our Response:

We disagree with EMA's assertion that it is the convention to certify natural gas engines derived from compression-ignition engines (even those that use a throttle and spark plug) as compression-ignition engines. There are diesel-derived natural gas nonroad engines being produced and sold today that are not included in the 40 CFR part 89 certification program for nonroad diesel engines because they are not considered to be compression-ignition engines. While EMA was concerned that we were narrowing the definition of what we considered compression-ignition engines, the changes we proposed actually served to add a new condition for engines to qualify as a spark-ignition engine (the spark plug). The final definition includes one additional change to include gasoline-fueled engines as spark-ignition, regardless of whether they met the other criteria. This prevents any possible confusion in terminology or technology variations with gasoline-fueled engines. EMA did not provide any other reasons why our proposed definitions would not be appropriate. Therefore, we are finalizing these definitions largely as proposed.

12. Noxious Emissions

What We Proposed:

In 40 CFR Part 94, language exists intended to prevent the use of emission controls that increase unregulated pollutants. It reads: “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.” We requested comment on amending this language to focus on preventing emissions that would endanger public welfare, rather than setting a standard that allows no tradeoff between pollutants. Specifically, we requested comment on the following language as an alternative: “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.”

What Commenters Said:

EMA comments that the amended language discussed in the preamble is directionally consistent with their prior comments, but it still remains deficient. They comment that the terms “noxious and toxic” and “unreasonable risk” must be clearly defined and specified, that the language would be unreasonably vague and should be removed. They are concerned that the broad language would allow interpretations that could prohibit the use of existing emission control technologies such as exhaust gas recirculation, timing retard, or aftertreatment.

Our Response:

The amended language places fundamental emphasis on the risk to public health, welfare, or safety. The secondary reference to noxious or toxic substances adds an explanatory note and therefore does not call for more precise terminology. Moreover, these terms are specifically mentioned in the Clean Air Act. “Unreasonable risk” is commonly used in legal terminology, so we believe there is ample case history to provide an accepted meaning to the term. In practice, issues of risk will generally be resolved well in advance of the certification process. EPA generally discusses all available technology options in rulemakings that set new emission standards. We expect that in most cases, technologies that may cause an unreasonable risk will be identified during that process. We would not base new standards on a technology that we believed would cause an unreasonable risk to public health or safety. In the event of the emergence of a new technology after the rulemaking, manufacturers would have the opportunity to resolve issues of risk during the development process. With respect to technologies that are currently being used in mobile source applications, such as exhaust gas recirculation, fuel-injection technologies, and aftertreatment, we do not believe that they cause or contribute to an unreasonable risk under this language. We are adopting amended language consistent with that discussed in the proposal for all the engines subject to this final rule. We believe this would appropriately require future development of new technologies would include consideration of the possibility of increasing emission levels of problematic pollutants for which no emission standard applies.

E. Cost Analysis

What We Proposed:

We developed a full set of estimated costs to assess the burden associated with the proposed emission standards, as described in the Draft Regulatory Support Document.

1. Recreational Vehicles

a. Snowmobiles

What Commenters Said:

ISMA offers data from a NERA study, elasticities for new sales are about -1.0 in short term and -5.0 in the long term (1% price increase would decrease sales by 1% and 5% over a short and long term time period, respectively. Snowmobile sales lack sales volume to achieve economies of scale similar to other on and off-road industries, and are therefore more price sensitive (R&D for new technology is therefore limited as well).

Preliminary results from ISMA's study with NERA indicates that the long-term demand for snowmobiles is highly elastic- price increases will have significant effects on long-term sales and these increases in sales imply reduction in consumers' surplus. ISMA urges EPA to consider the factors that distinguish snowmobiles from other nonroad vehicles: "the discretionary nature of the purchase, the infrequency of use, the sensitivity of sales to snowfall, the relatively small volume of sales, the potentially high ratio of regulatory costs to product price, the need for sufficient lead time...in striking an appropriate balance in regulatory requirements."

Our Response::

Comments regarding elasticity and impacts on sales are addressed in Section F of this chapter. While manufacturers commented that increased costs would negatively impact sales (see Section F below), we did not receive any comments on the costs we projected for various emissions control technologies for snowmobiles. We reviewed our costs for 4-stroke engines and compared them, where possible, to cost differences between currently available 2-stroke and 4-stroke models. Where models were directly comparable, we found price differences in the $500 to $600 range, which compares reasonably to our projected costs which are somewhat higher. For these reasons, we did not revise our cost estimates for snowmobiles.

What Commenters Said:

The Mercatus Center provided comments on the cost analysis for snowmobiles. The Center comments that the cost estimates do not mesh with the time line of the standards in that the fixed costs for Phase 1 are amortized over the first five years of production while the Phase 2 standards begin four years after Phase 1. The Center comments that if the fixed costs were amortized over four years the per unit fixed costs would be higher and that this raises questions about the accuracy of cost estimates and, therefore, the feasibility of the Phase 1 standards.

The Center comments that if the fuel savings estimated for Phase 2 represent a true economic benefit - that consumers would actually prefer the fuel savings over lower purchase price, better styling, and faster acceleration, - that EPA can consider less coercive and less risky ways of getting comparable results. For instance, EPA could use mileage labeling to enable consumers to choose sleds. This approach, the Center comments, would avoid the risk that the consumer would be harmed because of the loss of more highly-valued attributes. The Center argues that the approach would also avoid bankrupting firms that only offer low end machines and are unable to diversify into more expensive, high end, machines. The commenter argues that the rule would prompt fewer bankruptcies thereby encouraging greater supply and lowering costs to consumers. The lower costs would translate into older sleds being turned over at a faster rate. The commenter also suggests that dropping the Phase 2 standards would also eliminate one of the most expensive proposals, in terms of cost per ton of CO reduced. Mercatus supports this comment by noting that CO cost per ton of $670/ton for Phase 2 snowmobiles is more than four times that of the Large SI standards for LPG engines.

Mercatus Center comments that the estimated $216 incremental costs for Phase 2 may be too low. They comment that the advance technologies for 2-strokes (direct injection and 4-stroke engines) range in cost from $262 to $770 and that adding electronic controls costs range from $119 to $174. The commenter fails to understand how these costs could translate into average total incremental costs of $216.

On the subject of fuel economy improvements, Environmental Defense et al notes that Bombardier has stated that its 4-stroke snowmobile engine provides a 30 percent fuel economy savings and Yamaha has stated that its 4-stroke snowmobile engine provides up to 30 percent fuel economy improvement.

Our Response:

We believe that it is appropriate to amortize the fixed costs over five years for Phase 1. The Phase 1 and Phase 2 standards are additive and the Phase 2 costs presented are incremental to the Phase 1 costs. In our analysis, we do not retire Phase 1 costs when Phase 2 begins. In any event, a small increase in unit costs for Phase 1 if a manufacturer chose to amortize fixed costs over four rather than five years would not be a basis for challenging the feasibility of the Phase 1 standards. We have considered comments on the feasibility of the Phase 1 standards in Section V.B.

The Center suggests that the Phase 2 standards should be voluntary and that if it turns out that consumers value fuel savings over initial costs or other 2-stroke attributes, they could choose to purchase advanced technology sleds. We do not believe this approach is consistent with the requirements of the CAA section 213. We must set standards that achieve the greatest degree of emissions reduction achievable through the application of technology. Our Response: to comments regarding the feasibility of the Phase 2 standards is in Section V.B. In addition, we disagree with the view that , because full-life economic benefits exceed costs, these regulations should be voluntary. Our primary intent is to ensure emissions reductions. As past practice has confirmed the availability of fuel savings does not ensure that manufacturers will build , or consumers buy, environmentally beneficial machinery. Thus voluntary standards will most certainly not provide the environmental benefits provided by mandatory standards. We are therefore finalizing mandatory standards. We believe the Phase 2 standards we are finalizing are feasible and appropriate and consistent with the Act.

The comments from Mercatus seem to be that if the fuel savings are real, consumers would voluntarily purchase the cleaner sleds and that the public should not be made to run the risk that the savings have been seriously overestimated. As discussed above, we do not believe voluntary standards are appropriate. With regard to fuel savings, the difference in fuel consumption between conventional two stroke and direct injection two-strokes and 4-strokes is generally well understood and accepted. Conventional 2-stroke engines allow about one-third of the fuel mixture to pass through the engine unburned. This is also why 2-stroke engines have very high HC emissions levels. The advanced technologies capture and use that part of the air fuel mixture that passes through a conventional 2-stroke engine unburned. Therefore, fuel consumption and HC emissions are improved. We have used a 25 percent fuel consumption benefit for our analysis, which we believe is reasonably conservative. Data often shows savings in the 30 to 40 percent range. We did not receive comments that we have overestimated fuel savings or snowmobile usage. In any event, we have considered energy impacts of the rule and it is clear that replacing conventional two-stroke engines with more advanced technologies has a positive impact on fuel consumption. Even if lesser fuel savings were realized, we believe the standards we are finalizing would be feasible and in keeping with the primary CAA requirements of achieving emissions reductions.

The commenter suggests that manufacturers that only offer low end products would be disadvantaged by the Phase 2 standards. We have not considered this an issue because all large manufacturers, which sell 99 percent of snowmobiles, currently offer full product lines. We did not receive comments from any manufacturers suggesting they sell fewer higher end products than their competitors or that their product line differs significantly from their competitors in a way that creates a unique issue for them. It also stands to reason that manufacturers would offer high end products along with entry level products due to the potential for higher profits from selling high end machines and the desire to keep customers that want to move from entry level to higher level products. Small manufacturers also focus on high end machines and did not comment on this issue. Mercatus implies the rule will cause bankruptcies within the industry. We have worked carefully with manufacturers and have included flexibilities in the Final Rule to help manufacturers transition to more stringent standards. These flexibilities include considerable lead time, early credits programs, and averaging. We have also considered the needs of small manufacturers and provide additional flexibility for them. There are always risks that must be managed as companies face new emissions standards, and we believe we have designed the program in a way that will allow manufacturers to meet the requirements.

In response to comments regarding CO cost per ton estimates, we did not present CO cost per ton estimates for Large SI engines. Mercatus appears to mistake the HC+NOx cost per ton estimate for Large SI LPG engines as a CO cost per ton estimate. The two numbers are not comparable and we do not believe our cost per ton estimates for snowmobiles are a cause for concern.

Mercatus commented that they did not understand how the average total costs for Phase 2 could be less than the costs of the direct injection and 4-stroke technologies. As presented in Chapters 4 and 5 of the RSD, we are anticipating a mix of technologies to be used to meet the snowmobile standards. Chapter 4 presents the emissions reductions expected from each technology and how a certain mix of technologies can achieve the emissions standards. The mix will differ among manufacturers depending on the technology paths they choose, as would be expected in an averaging program. For purposes of the cost analysis, we select a likely mix of technologies that would meet standards. The costs for those technologies are weighted by their projected use within the sales mix both for the baseline and control cases to estimate an average cost for the standards. The total costs for Phase 2 are incremental to Phase 1. Because the higher cost technologies are not likely to be needed in 100 percent of sales, average costs are lower than the costs of those individual technologies. For the Final Rule cost analysis, we project that the use of direct injection will increase from 10 to 35 percent and that the use of 4-stroke will increase from 10 to 15 percent. The total incremental cost for Phase 2 is estimated to be $131. The weighting of the costs for purposes of the cost analysis are provided in Chapter 5, Table 5.2.3-21.

b. ATVs and Off-highway Motorcycles

What Commenters Said:

MIC raised several issues with the cost analysis. First, they comment that the contractor report used of the cost analysis does not provide data supporting the effectiveness of the various emissions controls included in the analysis. MIC comments that it is inappropriate for the contractor to rely on confidential information to substantiate the benefits claimed in the report and that none of the benefits are substantiated by test data..

Our Response::

Arthur D. Little - Acurex Environmental, under contract with EPA, provided EPA with a cost analysis for various technologies that could potentially be used to reduce emissions from recreational vehicles. The estimated costs were incorporated into EPA's analysis of costs. As stated on page 3-3 of the contractor's report, the contractor report was aimed at cost issues and was not a feasibility study. The contractor notes that the estimated emissions reduction percentages are provided to give the reader a general sense of emissions control potential but do not represent definitive research or testing. Our technological feasibility assessment for the proposal was presented in the RSD and did not rely on the cost report. Similarly, the feasibility assessment for the Final Rule also does not rely on the cost report.

What Commenters Said:

MIC believes that reliance on confidential information that is not available to the potentially regulated entities denies these parties an opportunity to comment on the basis for the proposed rule. They believe that this is inconsistent with EPA's duty to provide for meaningful public participation in the standards development process.

Our Response::

The contractor report and the RSD provide substantial detail in estimating the costs for emissions controls. Component cost estimates are provided and the methodology used to estimate costs for R&D is explained. The contractor contacted several different potential sources of information including vehicle manufacturer and component suppliers. The contractor estimated costs based on the information they were able to find and engineering judgement. The contractor also reviewed cost studies conducted for other emissions control programs where similar technologies were cost out for other applications. While the sources of some of the information was considered confidential, the cost estimates are provided in detail. Manufacturers were able to compare our cost estimates with their own costs and experiences to provide meaningful comments. MIC themselves provide comment on what parts of the cost analysis they believe are accurate and where they believe EPA should make adjustments.

What Commenters Said:

MIC comments that EPA underestimates 4-stroke engine fixed costs for R&D, especially the tooling cost estimates, are unrealistic. MIC notes that there are extreme differences in the split between variable and fixed costs in the industry depending on the degree of manufacturer integration. MIC goes on to provide results of a modeling exercise conducted by Sierra Research, under contract from MIC. This exercise uses a model previously created to analyze costs for the automotive industry. MIC notes that the relationship between engine variable and fixed costs varies significantly depending on if a manufacturer is highly integrated (for example, makes the engine and vehicle) or is less integrated (e.g., buys engines from a supplier). The model was modified by the contractor to better reflect ATVs. MIC then used the model to estimate costs for a highly integrated manufacturer. They also estimate that 2-stroke engines should cost about one-third less than 4-stroke engines. They provided results for a single engine size, 400 cc.

Based on the results of the modeling, MIC commented that EPA underestimated fixed costs and overestimated variable costs. The results in terms of overall costs, as noted by MIC are reasonably consistent with EPA's estimates. They also believe that EPA made an incorrect assumption that sufficient manufacturing capacity exists to increase the production of existing four-stroke engines by an amount sufficient to replace the current two-stroke engines. MIC states that an appropriate analysis of the cost of replacing two-stroke engines with four-stroke engines requires an estimate of the cost of developing and building new four-stroke engines specifically designed to replace the two-stroke engines being discontinued.

An individual user of off-highway motorcycles commented that EPA underestimated the cost of 4-stroke engines for off-highway motorcycles. The commenter compares the purchase price of a KTM EXC 250 cc 2-stroke off-highway motorcycle (less than $5,800) with a KTM 4-stroke EXC 400 cc off-highway motorcycle (around $7,000). They comment also that a Yamaha 426 cc 4-stroke off-highway motorcycle, they believe, is priced at about $6,700 and the Cannondale E440 is priced at about $7,500. The commenter also comments that EPA should consider the cost of riders having to buy two machines, one for competition and one for trail riding. Currently, riders can modify their competition models to make them compliant with Forest Service requirements and sound requirements.

An individual user commented that 4-stroke racing off-highway motorcycle cost an order of magnitude more than comparable 2-stroke motorcycles which have engines with one-half the displacement. They were also concerned that requiring the development of a competition and noncompetition platform would cause manufacturers to drop one of them.

Our Response::

MIC commented that we overestimated variable costs and underestimated fixed costs for 4-stroke engines. As noted by MIC, the fixed cost and variable cost portions of the estimate of total costs will be different for each manufacturer depending on their level of integration. A company that produces their own engines will attribute a larger portion of the cost to fixed costs due to the tooling and R&D involved compared to a company that purchases engines from a supplier. We estimated costs based on a nonintegrated manufacturer rather than trying to estimate the cost of building an engine from the ground up. As noted in the contractor's cost report (p.4-8), the cost analysis is based on repowering with off-the-shelf 4-stroke engines. As explained in the report (p.3-6), the contractor took this approach to the cost analysis because many ATVs and off-highway motorcycles currently use 4-stroke engines and it was reasonable to expect manufacturers to use existing engines rather than creating new powerplants. In addition, because 4-stroke engines have already been produced and used in these applications, it was believed that it would be more accurate to investigate the costs of those existing engines rather than the costs of ground-up engine designs.

MIC notes that they believe EPA has overestimated variable costs. However, because we investigated the costs of a nonintegrated manufacturing process, the variable cost (which is essentially the cost of the engine) are high compared to the findings of MIC. As noted by MIC, the total costs for the engines estimated by EPA and by MIC compare reasonably. We believe this is especially encouraging considering that MIC used a automotive-based model and a different (ground-up engine production vs. off-the-shelf) methodology to generate their cost estimates. Also, we continue to believe manufacturers will largely rely on existing engines rather than new engine designs due to the prevalence of 4-stroke engines in the market today. For these reasons, we did not change our cost analysis.

MIC comments that EPA underestimates fixed costs and does not include costs for chassis modifications. As noted above, the ratio of fixed costs and variable costs are different for different levels of integration within the industry. Because we cost out off-the-shelf engines, the fixed costs are already part of the engine cost. The cost estimates include fixed costs associated with chassis modifications as noted on p.3-6 of the contractor's report. The fixed cost estimates provided in the analysis are for chassis modifications.

In response to comments on purchase price, we examined prices on two manufacturer web sites where we could find what could be considered comparable 2-stroke and 4-stroke 2003 model year models in the same engine size range as that considered by the commenter. We found that the manufacturer suggested retail price (MSRP) between for a Honda CRF 450R 4-stroke was listed as $6,299 and the MSRP of the CR250R 2-stroke was $5,899, a difference of $400. For Yamaha, we also found that the difference in MSRP between the YZ450F 4-stroke and the YZ250 2-stroke was $400. These are competition machines, where both 2-stroke and 4-stroke models are sold, and MSRP comparisons can more easily be made. Differences in cost for typical nonracing machines may be somewhat lower because the engines may be less powerful or sophisticated.

We looked at the KTM 2003 model year line-up (www.ktm.usa) and found that the line-up includes EXC 250 and EXC 450 4-strokes, both designated as racing models. KTM also includes an EXC 250 two stroke model that is not designated as a racing model. The EXC 400 was not listed as available for the 2003 model year. We were unable to verify the prices estimated by the commenter. MSRP information was not provided by the manufacturer on the web site. However, it would be difficult to compare the 2-stroke nonracing model with the two 4-strokes that are designated as for racing. There may be other differences in the models and the designation as a racing model may influence pricing. It would also be difficult to compare prices of models from different manufacturers because each manufacturer has different vehicle attributes, pricing system, and place in the market. Based on our cost analysis, the comments of manufacturers regarding cost differences, and the MSRP information on the Honda and Yamaha models that we found, we believe our projected cost differences between 2-strokes and 4-strokes are reasonable.

We do not believe the rule will result in a significant number of riders purchasing two motorcycles where they would have only purchased one before. Manufacturers have the option of certifying competition motorcycles under the primary program and the Final Rule also contains an optional set of standards to encourage the certification of motorcycles that would otherwise qualify as competition models. To the extent there is market demand for certified competition vehicles, we believe manufacturers will have avenues to meet those demands. Manufacturers will have incentive to certify as many of their products as possible in order to market them to as wide a consumer base as possible. It will be to the manufacturer's advantage to certify competition models and market them for use recreationally as well as for competition. Consumers wanting to purchase a model that is suitable for competition and certified by EPA is very likely to be able to do so after the program begins. Also, given the cost of these products, it is unlikely that many consumers would purchase two machines due to the EPA requirements.

We estimate costs on a per unit and aggregate basis. Consumers purchasing two motorcycles rather than one would affect these estimates only if overall sales were projected to increase substantially. Per unit costs would decrease somewhat if sales increased because fixed costs would be spread over additional sales. Aggregate costs would increase by an amount consistent with the sales increase. However, we have no basis for projecting significant sales increases due to the standards.

With regard to concerns that manufacturers will not offer both off-road and closed course machines due to the costs of developing two platforms, we believe a variety of machines will remain available. Currently, manufacturers offer a large variety of off-road and closed course competition machines. Competition machines will continue to be sold under the program, and some may be exempt from requirements. We have designed a program, with two options, that offers manufacturers flexibility to develop new technology and bring certified products to market. While it is true that manufacturers may streamline their product lines in response to standards, manufacturers will also continue to strive to meet consumer demand.

What Commenters Said:

MIC commented that EPA underestimated costs for pulse air systems and catalysts. For catalysts, MIC comments that EPA's variable cost estimate seems reasonable but that additional elements have been ignored including improved exhaust system to handle higher temperatures, additional brackets, and heat shields. MIC comments that a more reasonable cost for R&D would be about $1 million per family to cover costs of recalibrating engines and running durability testing. MIC comments that revised tooling costs for exhaust system components would be about $500,000 per family. These modifications would result in a total cost of about $130 for a catalyst.

Similarly for secondary air systems, MIC comments that upgraded exhaust systems and shielding would raise the variable costs to $27. R&D and tooling would be similar to that for a catalyst system, $1.5 million per family. This would result in a total cost of about $62. MIC further comments that EPA must legally ensure that its cost estimates are supported by substantial evidence. Because MIC has provided more detailed analysis, and the NPRM cost analysis is not well supported, EPA should adjust its estimates.

They offer that motorcycle emission control programs in countries that have experience with them has ranged from $5 to $100 depending on a variety of factors specific to each system. (*Attachment 1 to MECA comments- summary of worldwide current and proposed motorcycle emission regulations*).

Our Response::

In response to the comments, we have adjusted our cost estimates for incorporating the above technologies into ATV designs. We have increased our variable cost estimates by $10 to cover the costs of improved materials for exhaust systems. We do not believe significant additional heat shielding would be needed because the systems are integrated into the improved exhaust systems which are not placed on ATVs in a manner that exposes to rider to potential contact during operation. Also, the systems will be designed and calibrated with heat management in mind.

MIC states that we have underestimated R&D and tooling costs for secondary air and catalysts but does not provide any information to support their cost estimates. While our R&D costs included engineering development work and testing for each component, we may have underestimated the amount of effort needed to meet the standards overall. In order to ensure that costs have been accounted for, we have adjusted our fixed cost estimates in a manner we believe is reasonable.

In response to comments, we have increased our estimate of the R&D costs involved with incorporating these emissions control technologies into ATV designs. We have not taken the approach suggested by MIC incorporating $1 million of R&D for each family and for each technology. Although no basis is provided for the estimate, it suggests over one year of R&D each technology is needed for each family to incorporate both a catalyst and pulse air system into an ATV exhaust system.[10] Although these technologies have not been used significantly on ATVs, the technologies have been used in other applications and are well understood. We believe it would be logical for manufacturers to start with existing components and optimize them for ATV applications. Once this basic R&D has been done, the systems would then be tailored for individual models. In our work with secondary air systems, we were able to modify a system from a BMW motorcycle application and effectively apply it to two different ATV models in a few months. We understand that the systems must be thoroughly tested, but at the same time, manufacturers are unlikely to need to spend millions of dollars on each model.

For our R&D estimates for the final standards, we adjusted the R&D costs by estimating that manufacturers would conduct 12 months of base R&D, followed by 6 months of R&D on each engine family. The base R&D would involve designing emissions controls and a strategy for meeting the standards and the individual R&D would involve applying the technology to the various models. The R&D effort would primarily involve recalibration the incorporation of secondary air systems on some models. The averaging program helps manufacturers in this effort by allowing manufacturers to optimize each model. We are not expecting manufacturers to use catalysts to meet the final standards. We believe based on our experience that this level of R&D would be more than sufficient, and if anything, is an overestimate of the effort involved given that pulse air systems are not likely to be used on all models.

We have also adjusted our tooling costs in response to MIC comments. MIC commented that the tooling involved with both secondary air and catalysts would be about $500,000 each per engine family. In response, we believe it is unlikely that each engine family would need completely unique systems. As noted above, we were able to apply the same secondary air system to two different models. Manufacturers would likely design systems that would function on different models and may be able to

[10] Arthur D Little - Acurex estimates a monthly R&D cost of $60,333. "Nonroad Recreational Vehicle Technologies and Costs", Arthur D. Little - Acurex Environmental, Draft Final Report, July 2001 (Docket A-2000-01, document II-A-31), p. 4-2.

use systems or components originally designed for other applications with few modifications. However, each manufacturer may need to design a unique system for which they would require new tooling. We have used the $500,000 estimate from MIC for the system tooling cost and have spread the cost of the system over 50 percent of the families, the number of families anticipated to be equipped with secondary air systems.

We are not finalizing standards at this time that would require the use of catalysts on ATVs. In consideration of future standards, we would reassess the costs involved with applying catalysts to ATVs.

2. Large SI engines

What Commenters Said:

The NAHB believes that the benefits of the proposed rule are overstated, referring to the improved fuel economy. MECA agrees that catalysts improve engine performance and fuel consumption while reducing emissions. And Environmental Defense believes that the fuel economy benefits offset Tier 2 costs.

The Mercatus Center noted that estimated fixed costs for Large SI engines appeared small in spite of the concern expressed in the proposal that companies would be limited in achieving emission reductions by R&D and other capital constraints. The Center also suggested that fixed costs should be amortized for the Tier 1 standards in the same way that fixed costs were amortized for Tier 2 standards and found that the methodology in the analysis made three presumptions: (1) all engine producers can meet the California standards, (2) all companies sell engines in California and will continue to sell after emission standards apply there, and (3) that R&D costs would be unaffected if applied to 100 percent of a firm's engine production, rather than applying the costs only to the California models.

The Mercatus Center thought we used the wrong sales volume (2000 units annually) to amortize fixed costs, since our estimated average production for each manufacturer was 15,000 annual units. They then proceeded to revise the cost estimates with their amortization scheme to show that they could rent a movie more cheaply than their estimated per-engine cost for upgrading emission-control technologies ($3.47). In either case, they note that amortization of fixed costs necessarily disadvantages small businesses with lower sales volumes.

The Mercatus Center questioned the validity of the learning curve in the cost analysis, citing the lack of empirical evidence supporting this approach for the companies affected by this regulation. They also suggested that Large SI engine manufacturers would be using established technologies that have already undergone learning from other companies. Finally, the Center failed to comprehend how we could project long-term cost changes for Tier 1 engines after the Tier 2 standards would start.

The Mercatus Center challenged the assumption in the cost analysis that manufacturers would not be making technological changes to incorporate the anticipated engine changes, especially because of the projected improvements in fuel efficiency and performance.

The Mercatus Center thought they found a typographical error, pointing out that costs for CNG and LPG engines were identical and that costs for these engines did not change when using a 3 percent or a 7 percent discount rate.

MECA believes that the lifetime savings in fuel consumption improvements, lower maintenance, and reliable performance offset the cost of applying advanced technology. However, MECA states that member companies raised the issue that EPA cost estimates for advanced emission control systems appear to be too high. Further, MECA states that they anticipate that as the sales volume of these control systems increase, costs will almost certainly be reduced.

Our Response:

It is not clear how the NAHB believes that we have overstated the benefits associated with the Large SI emission standards. The proposal presented a detailed analysis of emission rates and usage parameters to calculate the estimated emissions impact of the new standards. Absent any specific critique of the analysis, we are unable to make improvements to address this comment. In contrast, MECA supports our position that emission-control technologies for Large SI engines carry benefits that go beyond the anticipated emission reductions. The Environmental Defense Fund makes a somewhat different point by associating fuel-economy gains with the 2007 standards. In fact, the expected fuel-economy improvements are attributed to the new technologies, which we expect to be fully deployed in 2004. We expect only a small further improvement in fuel economy as manufacturers optimize their systems to control emissions as needed to meet the 2007 standards.

Generally speaking, since Large SI engine manufacturers will be engaged in developing engine technologies to meet California ARB standards, this rule is not resulting in additional R&D costs for Phase 1 of the regulation. EPA anticipates these costs will have already been borne due to the R&D efforts taken by engine manufacturers to meet California's 2004 emissions standards. Certification records in California verify that manufacturers are continuing to produce engines for the California market. It is clear that manufacturers have been producing the California engines with the full expectation that the same engines would be produced nationwide in the same time frame; it is therefore appropriate to assume the same R&D costs for California and nationwide sales. Also, manufacturers are conducting this R&D effort whether we set emission standards or not, so it is not appropriate to include these as fixed costs associated with the Tier 1 standards.

This approach makes the fixed costs seem very small. Also, amortizing the costs over five years of production further reduces the apparent burden associated with capital costs. Nevertheless, we believe it is appropriate to consider the actual total expenditures before amortizing, including those costs associated with meeting the California ARB standards. The engineers tasked with meeting emission standards are generally part of a small group that already has full-time responsibility for overall engine quality and performance. While economic swings come and go, it is true that companies are responding to the current economic slowdown by laying off engineering staff, rather than hiring to meet the new demands. Moreover, Large SI manufacturers are facing federal emission standards for the first time and must quickly learn to operate under some of the most advanced regulatory requirements ever adopted.[11] As a result, we believe it is fully appropriate to consider the physical and capital constraints of these companies.

With respect to the amortization methodology, the Mercatus Center overlooked the fact our cost

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[11]For example, this is the first nonroad program including engine diagnostics, evaporative controls, emission standards based on transient duty cycles, or field-testing standards and procedures.

analysis based the estimated fixed costs on certifying each engine model, rather than applying a single R&D figure to a manufacturer's total production. We agree that this projected sales volume is an important factor in determining the per-unit costs. While there is clearly significant variation for different manufacturers and, indeed, for different product lines for individual manufacturers, we believe that the analysis appropriately presents the costs of a typical scenario. For this category of engines, market share is distributed quite evenly among the several manufacturers, so we don't believe the assumed values unfairly characterize the costs for any single manufacturer. Moreover, any reasonable degree of variation in assumed sales volumes would only slightly affect the overall cost estimates and would not at all affect our conclusions that the standards are appropriate and cost-effective. We note also that if these commenters are not getting some popcorn with their video rental, they are paying too much. Small manufacturers would only be disadvantaged relative to bigger companies under this analysis if their per-model sales would be significantly less than for other companies. We are aware that this sometimes occurs.

As described in earlier rulemakings, the learning-curve assumptions incorporated into the cost analysis reflect average values observed from a wide range of manufacturing sectors. More careful study of individual sectors could lead us to justify a greater or lesser degree of learning for each of the regulated engine categories. However, this would require a very extensive effort. We rather believe it is reasonable to rely on broadly established average values and accept this degree of uncertainty. In addition, we note that no commenter has ever provided specific information suggesting that we rely on different parameters to incorporate the effects of learning. The analysis presents costs based on manufacturers producing components specifically for nonroad engines, including low-volume production with more labor-intensive processes. We therefore believe it is not appropriate to believe that companies producing and assembling these components for the first time will be able to start producing these things at the same level of efficiency as that achieved by automotive production.

Since the Tier 2 standards don't involve additional hardware beyond Tier 1, the costs for the two tiers apply in a simple additive form. As a result, it is no problem or inconsistency to consider decreasing Tier 1 costs well beyond the time that the Tier 2 standards begin to apply.

Large SI engines are generally car and truck engines adapted for nonroad use. "Rapid technological change" is an appropriate description of car and truck engines from the last 25 years, but these developments have been carried over into the comparable nonroad engines only to the extent that it would have been more expensive to produce the old-technology engines. For example, if car makers change their castings to improve the engine block in some way, production of the older engine block is discontinued completely. This allows for ongoing, implicit improvement in nonroad engines, yet even this poses a problem for nonroad engine manufacturers, who must respond to these changes with (usually) little time to integrate the modified engines into their equipment. Market dynamics have so successfully stifled innovation in Large SI engine technology that we believe it is appropriate to assume this for the future as well.

After double-checking, we confirmed that the suggested typographical errors were in fact accurately presented. The analysis made the explicit assumption that a single set of costs applied to both CNG and LPG engines based on their very similar hardware configurations. Also, since there are no costs after the units are sold, the discounting method does not affect the calculated cost of producing engines that meet the standards.

MECA's concerns that we over-estimated costs underscore the appropriateness of incorporating the learning curve for long-term reductions in estimated costs. The initial costs likely seem relatively high when compared with automotive systems, where high sales volumes and established production practices have substantially reduced costs. The long-term projected costs for Large SI engines come closer to the values expected by MECA.

F. Economic Analysis

1. Need for Economic Impact Analysis for this Rulemaking

What We Proposed:

To assess the impacts of our proposed emission control program, we estimated the compliance costs associated with meeting the proposed standards and the inventory benefits that will results when the standards are fully phased-in. The resulting estimate of the cost effectiveness of the rule are contained in Section IX.C of the preamble. These estimates range from \$80 to \$670 per ton of HC+NOx control, and \$40 to \$670 for CO control.

What Commenters Said:

The Mercatus Center at George Mason University commented that EPA has not estimated the economic benefits nor the economic costs of the proposed rule. The Center claims that EPA instead measures nationwide reductions in emissions and estimates lifetime fuel/maintenance savings from the rule as substitutes for a dollar estimate of economic benefits related to health and environmental improvements. It also states that the Agency relies upon engineering costs related to the development of new technologies to meet the standard as the estimate of the rule's economic costs. EPA cites cost-effectiveness as its measure of net benefits in support the proposed rulemaking.

Our Response:

As part of the analysis for this final rule, we updated our estimated compliance costs and inventory benefits. We also conducted a benefit-cost analysis of the rule and estimated the quantitative net benefit of the regulation. The economic benefits analysis values in monetary terms the health effects from reduced exposure to the controlled pollutants. The economic costs are estimated using a market model for each of the various vehicle categories. The market model takes into account the effect of consumer and producer behavior on market price, quantity, and welfare changes when regulatory costs are imposed. From this analysis, EPA can calculate the net benefits of the rule and not solely rely upon cost effectiveness measures to demonstrate the net benefits. A description of the methodology used can be found in Chapter 9 of the Final Regulatory Support Document prepared for this rulemaking.

Based on the estimated regulatory costs associated with this rule and the predicted changes in prices and quantity produced in the affected industries, the total estimated annual social gains of the rule in the year 2030 is projected to be \$553.3 million (in 2000 and 2001 dollars). Social gains are equal to the surplus losses net fuel efficiency gains and do not account for the social benefits (the monetized health and environmental effects of the rule). The net present value of the social gains for the 2002 to 2030 time frame is equal to \$4.9 billion. The social gains are equal to the fuel savings minus the combined loss in consumer and producer surplus, taking into account producers' and consumers' changes in behavior resulting from the costs associated with the rule. These results are contained in Table IX.D-1 of the preamble.

For most of the engine categories contained in this rule, we expect there will be a fuel savings as manufacturers redesign their engines to comply with emission standards. For ATVs and off-highway motorcycles, the fuel savings will be realized as manufacturers switch from 2-stroke to 4-stroke technologies. For snowmobiles, the fuel savings will be realized as manufacturers switch some of their engines to more fuel efficient 2-stroke technologies and some of their engines to 4-stroke technologies. For Large SI engines, the fuel savings will be realized as manufacturers adopt more sophisticated and more efficient fuel systems; this is true for all fuels used by Large SI engines. Overall, we project the fuel savings associated with the anticipated changes in technology to be about 730 million gallons per year once the program is fully phased in. These savings are factored into the calculated costs and costs per ton of reduced emissions, as described above. The controls in this rule are a cost-effective means of obtaining reductions in NOx, NMHC and CO emissions.

2. Elasticity Estimates - Snowmobiles

What Commenters Said:

ISMA submitted a study prepared by National Economic Research Associates titled *Economic Assessments of Alternative Emission Standards for Snowmobile Engines*. That study presents the industry's economic impact analysis of the proposed snowmobile standards and several alternative scenarios. In this study, ISMA estimates the short run price elasticity of demand to be -1.054 and the long run price elasticity of demand to be –4.63. The demand equation is estimated using ordinary least square and hypothesizes that the following functional relationship:

> *current snowmobile sales per household = f (current real price of all goods sold in SIC 3799# 9 defined to include snowmobiles, ATVs, and other products.), snowfall in the previous year, and the snowmobiles sales per household in the previous year)*

The estimation is conducted using natural log transformations of the variables such that the coefficient for the real price variable is the short run price elasticity of demand and the long run price elasticity of demand is a function of the coefficient of the price variable and the lagged dependent variable (snowmobile sales per household in the previous year).

Our Response:

Demand and supply elasticities are crucial components of the partial equilibrium model used to quantify the economic impacts of the emission standards. The price elasticity of demand is a measure of the sensitivity of buyers of a product to a change in price of the product. The price elasticity of demand represents the percentage change in the quantity demanded resulting from each 1 percent change in the price of the product. The price elasticity of supply is a measure of the responsiveness of producers to changes in the price of a product. The price elasticity of supply indicates the percentage change in the quantity supplied of a product resulting from each 1 percent change in the price of the product.

Demand and supply elasticity estimates can be estimated, assumed, or retrieved from previous studies that have carried out these estimations. We used a combination of techniques for our analysis. In the case of recreational diesel marine vessels, a demand elasticity measure was available from a previous study, but the supply elasticity was estimated. For forklifts, both supply and demand elasticities were estimated. For the snowmobile, ATV, and OHM markets, we used the price elasticity of demand for recreational boats. This value is assumed to be a reasonable estimate of the price elasticity of demand for snowmobiles, ATV and OHM markets. The price elasticity of supply is estimated for the snowmobile and OHM markets. Attempts to estimate this value for the ATV market were unsuccessful, and so the price elasticity of supply estimate generated for the OHM market was used. We also performed sensitivity analyses to evaluate the uncertainties involved in these estimates.

The price elasticity of demand estimated by NERA for snowmobiles is very different than the one we used (-2.0). However, we have four concerns about using it in our analysis. These are explained in greater detail in a Memorandum from Linda Chappell to Linc Wehrly, et al., dated August 15, 2002. First, the quantity and price data used in the estimation do not directly match: the sales data is for snowmobiles but the price data is a compilation of snowmobiles and other recreational vehicles. The price variable reflects prices for ATVs, snowmobiles, and other transportation equipment, and snowmobiles are a small segment of sales in these product categories. Since the price variable is critical to the elasticity estimation, this approach is problematic. Second, NERA treats price as predetermined rather than exogenous. While this is an accepted method, it is not technically the most correct method. Third, the results for the short-run price elasticity of demand are not statistically significant. The statistical significance of the long-run price elasticity of demand is not presented. Finally, the statistical method used is problematic. They used Ordinary Least Squares estimation and a lagged dependent variable in the estimation process. This approach may lead to estimation errors associated with serial correlation. While NERA indicates that they tested for serial correlation using a technique that is consistent even in the case of equations that include lagged dependent variables, no statistical information (such as a Durbin-Watson statistic) is presented.

3. Elasticity Estimates - Forklifts

What Commenters Said:

Mercatus comments that EPA is inconsistent in how it describes the price elasticity of the forklift market. On one hand, EPA claims that forklift users are “very sensitive to capital expenditures” and that “it is unclear whether purchasers will tolerate any increase in the cost of the product” (which would suggest a price elastic good). On the other hand, specifically in Table 5.2.2-1, EPA assumes forklifts have a price elasticity of zero and that forklift users are not sensitive to price. Table 5.2.2-1 presents the incremental costs per Large SI LPG engine where the costs are derived assuming the same number of engines are sold annually under the baseline and control situations. Additionally, EPA states that forklift users “appear willing to spend additional money to obtain forklifts that possess desired characteristics” such as lower emission engines.

Our Response:

We responded to these comments about price elasticity in the economic impact analysis prepared for this rule. Our analysis for forklifts is based on the demand forklifts as price elastic. In the economic analysis, EPA does project a decrease in sales for forklifts. The small cost increases relative to total forklift prices are small, so the expected decrease in sales is expected to be less than one percent. With respect to selecting engines for indoor application, we believe that manufacturers are generally not choosing the more expensive option. Costs for different engine types are comparable. Forklift purchasers must also consider very important factors related to refueling infrastructure that are much more prominent than any small differential prices between competing forklift models. Those who have paid extra for exhaust aftertreatment, who are in a tiny minority, have needed to pursue products from aftermarket suppliers, since engine and forklift manufacturers have apparently not found it profitable even to make these products available.

It is correct that Table 5.2.2-1 presents the estimated costs per engine under the base and control cases and is not making assumptions regarding the changes in consumer and producer behavior here. The purpose of this engineering cost comparison is to derive an incremental total cost per engine. In the economic analysis, however, the change in the equilibrium quantity of forklifts is addressed and it is not assumed that the demand elasticity of forklifts is equal to zero.

4. Fuel Savings Analysis, Especially Forklifts

What Commenters Said:

Mercatus also commented about EPA's claim of fuel cost savings generated from the adoption of the rule and its presumption of market failure. The Agency believes that the implementation of the regulation will lead to cost savings associated with the decreased consumption of fuel over the lifetime operation of the affected engines. The public comment document states that, "EPA offers virtually no evidence to support its claim of market failure; and therefore does not adequately support its claim that the proposed rule will provide consumers with a net financial gain."

According to the Mercatus Center, forklifts is the only vehicle category for which any support is provided for the failure of markets to adopt fuel savings technology absent regulation. The evidence provided by EPA, "unspecified observations of forklift user behavior and a single outside engineering estimate," is considered weak by the Center which claims this is "insufficient evidence" of a general market failure. The Center states that no supporting evidence of market failure is provided for the other Large SI engine applications nor the snowmobile, ATV, and off-highway motorcycle categories.

The Mercatus Center also takes an alternative view of the fuel cost savings. It claims that the energy/maintenance savings may represent what consumers are willing to pay for other vehicle attributes (such as safety, acceleration, and durability) and should therefore be treated as a loss in consumer welfare as opposed to a benefit. The Center finds fault with the estimate of the fuel/maintenance savings, hence states that there are no reliable benefits estimates provided in support of the regulation.

The Center further comments that if fuel savings exist, manufacturers of forklifts would have an incentive to demonstrate to potential customers these benefits in an attempt to increase market share. It states, "according to EPA, a more efficient engine would extend the average operating life of a forklift by 15 percent...A net present value of $4,544...over the useful life of 9.5 years means annual fuel/maintenance savings of $627. Hence, the "payback" period for the additional cost of a more efficient large SI LPG engine would be less than a year...Surely, even if such a short payback period cannot overcome the (alleged) myopia of forklift users, each forklift producer-seeking greater profits-would have ample incentives to educate users about the overwhelming cost advantages of its more efficient large SI LPG engine."

Our Response:

EPA's economic analysis is also addressing the issue of market failure to explain why the markets in question have not adopted engine technologies to enhance fuel efficiency absent regulation. Producers manufacture the engines they believe consumers demand. Consumers may not demand higher priced fuel-efficient vehicles because they are uncertain how large the fuel cost savings might be, it is costly to be informed of the gains from fuel cost savings, and/or they heavily discount the future fuel cost savings because of time preferences for money. Because of information costs and uncertainty pertaining to the magnitude of fuel cost savings, the marketplace may not have evolved towards offering fuel-efficient vehicles absent regulation. With the regulation, enhanced fuel-efficient engines are expected to be offered and with these engines, consumers will save on fuel costs over the lifetime operation of the affected vehicles. EPA believes its discussion on market failure in the economic analysis is applicable not only to each of the vehicle categories affected, but also to the various applications of large SI engines.

The Mercatus Center stated that the fuel cost savings generated by the rule should not be viewed as a benefit but rather as a loss in consumer welfare because consumers may not prefer fuel efficiency to other attributes (acceleration, range, durability, etc.). While consumers may prefer other vehicle attributes and would therefore rather pay higher fuel costs as a tradeoff, it does not mean that the fuel cost savings should be viewed as a loss in consumer welfare rather than a benefit. The fuel cost savings would only be viewed as a loss in welfare if consumers placed a negative value on fuel efficiency or the fuel cost savings they reap in the future and this equates to irrational behavior. EPA believes consumers are rational and would prefer fuel efficient vehicles and equipment all other factors held constant. The Center's claim to view the fuel cost savings as a loss in welfare is equivalent to saying the additional dollars saved over time are providing disutility to the consumer. Over the lifetime operation of these vehicles, consumers will receive savings in fuel costs. While consumers may prefer other vehicle attributes that are now unavailable due to the required changes in engine technology, it does not necessarily equate the lifetime fuel cost savings with a loss in welfare. Whether or not these savings are preferred to other attributes, they are still received and do provide benefits to the consumer.

To further address the issue of how consumers might react to changes in attributes of snowmobiles, EPA is conducting a hedonic analysis. This analysis will provide information regarding the consumers' willingness to pay for vehicle attributes by statistically analyzing the price differential for specific snowmobile attributes.

The Mercatus Center notes that if consumers value fuel efficiency, then producers of forklifts (and recreational vehicles) would have an incentive to educate consumers in an effort to increase their market share by providing products with this attribute. EPA notes however that it is costly for manufacturers to provide information to consumers. Producers would bear the costs of educating the consumers, but may not feel certain they could convince forklift users that fuel cost savings exist. Even if they did receive information from producers, the forklift users may be uncertain of the magnitude of the savings or whether in fact they will really occur. On the other hand, forklift users may acknowledge the fuel cost savings but may heavily discount them since these savings occur over the lifetime of the vehicle. In the case of the forklift market, EPA finds that forklift users do not tolerate increases in the purchase price of these products since they do not view forklifts as having value added to their products. Producers may therefore feel that even though consumers will reap fuel cost savings, they may not be willing to pay up front the higher price for fuel efficient forklifts.

5. Economic Impact Analysis - Marine Diesel Engines

What We Proposed:

As noted in the above discussion, the analysis performed for our proposal focused on engineering costs and inventory benefits. However, we performed economic impact and benefit analyses for the final rule. These are contained in Chapter 9 and 10 of our Regulatory Support Document.

What Commenters Said:

Several commenters noted that EPA should perform an economic impact analysis to determine the social benefits and costs of the rule. Hatteras commented that recreational boat builders are concerned that the cost of this proposal will far outweigh the environmental benefit. Mercury was also concerned that the benefits of this rule do not outweigh the costs. They commented that they understand that EPA is under a court order to regulate CI marine engines. But they note that recreational marine diesel engines constitute only about 3 percent of all diesel marine engines; the rest are for commercial applications. In addition, most recreational marine diesel engines already are equipped with emission control technology. "Consequently, a regulation for recreational CI marine engines would only provide for a financial burden on the engine manufacturers with no environmental benefit. Further justification to not regulate recreational CI marine engines is the predictable technology transfer from other diesel applications including commercial CI marine engines. This transfer will ensure emission reductions without additional financial impact due to the unnecessary certification and compliance burden."

NMMA urged that the Administration, prior to allowing this rule to proceed, conduct an independent analysis of the cost and benefit of imposing the EPA proposed standards vs. the IMO and EU standards. In addition, NMMA strongly urges that the Administration conduct an independent analysis, which examines the cost to manufacturers and the actual additional emission reduction of a rule with the NTE zone vs. without the NTE zone. NMMA does not believe that there is sufficient need and benefit that can support the cost of NTE testing. "Without such analysis," they argue, "the impacts on the boating industry could be devastating."

EMA commented that "EPA needs to account properly for the fact that, as a result of the proposed NTE standards, development and certification costs will increase exponentially for each marine engine rating. Those costs necessarily will be passed on to the customer to avoid selling engines at a loss. At the same time, because the marine engine business is not a high volume business, there are very few engines among which to divide the increased costs, which makes the resultant cost increase even more severe. Recent experience with the federal luxury tax has confirmed just how sensitive the recreational marine market is to regulatory increases in engine and vessel prices. That seemingly small tax increase effectively crippled the recreational craft business and forced many boat builders out the market. Because of this, it is utterly unreasonable and improper for EPA to propose NTE requirements for recreational marine vessels without first conducting detailed studies on the costs and market implications of those requirements.

Our Response:

We conducted an economic analysis to examine the market implications of the rule's effect on the recreational diesel marine vessel market, assuming an elastic demand for marine vessels. That analysis examined how the incremental costs per engine resulting from the standard affect market price and quantity sold of recreational marine vessels. Changes in economic social costs were also estimated. The comment states that the marine engine business is not a high volume business, hence there are few engines among which to divide the increased costs. These engines are inputs to marine vessels and the overall cost of these engines does not lead to an extremely large percentage increase in marine vessel price. Even assuming an elastic market for marine vessels, the change in the quantity purchased may not be very large because engine price makes up a relatively small proportion of the final marine vessel price.

Our analysis shows that the relative increases in price due to the regulatory costs are expected to be less than two-tenths of a percent while the reductions in output are less than one-quarter of a percent. These impacts are considered minimal. Also notable is that the percent changes in price and quantity peak in the years 2009 and 2010 but then are smaller further out into the future. The percent reduction in quantity is the same for both domestic and foreign output because it has been assumed that domestic and foreign supply have the same price elasticity.

We also report the loss in consumer surplus, the loss in producer surplus, and the loss in surplus (equal to the sum of the changes in consumer and producer surplus). These results show that the losses in consumer and producer surplus are approximately equal in size, though the loss in producer surplus is slightly less than the loss in consumer surplus. Consumer surplus losses range from a high of just under $4 million to a low of $1.9 million, while the losses in producer surplus vary from $3.6 million to $1.7 million. Like the price and quantity changes, these measures are largest in the years 2009 and 2010. They then decline to their lowest value in 2014 and beyond.

In our analysis of alternatives, we examined application of the draft European Commission recreational marine emission standards. We believe that these standards may not result in a decrease in emissions, and may even allow an increase in emissions from engines operated in the U.S. because current engines are already performing better than the proposed EC limits. Setting a standard equal to the draft EC standards would likely result in costs with few or no benefits. Therefore, we did not perform an economic impact assessment of these standards.

We also did not perform a separate economic impact assessment for application of the proposed standards without the NTE zone. This is because the purpose of the NTE is not to achieve additional emission reductions. Rather, its purpose is to ensure that emission reductions are occurring during actual vessel operation. We do not believe the NTE concept results in a large amount of additional testing, because these engines should be designed to perform as well in use as they do over the steady-state five-mode certification test. Our cost analysis accounts for some additional testing, especially in the early years, to provide manufacturers with assurance that their engines will meet the NTE requirements. However, these costs are small in comparison to the total compliance costs for the marine standards. Consequently, it does not make sense to do a separate economic impact assessment with and without these additional testing costs.

G. Small Business Provisions/Hardships

What We Proposed:

We proposed additional provisions for small manufacturers of the engines and vehicles covered in the proposal per the amended Regulatory Flexibility Act, 5 U.S.C. 601-612 by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996. The proposed regulations apply to many manufacturers that have not been subject to EPA regulations in the past, and many of these are small businesses for which a typical regulatory program may cause hardship.

What Commenters Said:

Sonex Research, Inc. recommends that small business provisions be retained in the final rulemaking.

NAHB supports the inclusion of hardship provisions for manufacturers in the proposed rule.

Our Response:

EPA conducted two separate Small Business Advocacy Review (SBAR) Panels prior to issuing the NPRM. Most of the panels' recommendations for minimizing the impact of the rule on small entities were included in the proposal and public comments were taken on them. With a few exceptions, we have finalized the small business provisions contained in the proposal, and have modified a number of them in response to the comments we received. A fuller discussion of the provisions, including those that were not finalized and the reasons for rejecting them, can be found in Section X of the preamble and Chapter 8 of the Regulatory Support Document.

1. Large SI

What We Proposed:

We proposed a variety of hardship provisions for small entities that manufacture Large SI engines. We proposed a provision to allow manufacturers to certify Large SI engines to emissions standards for engines below 19 kW if they have a displacement below 1 liter and rated power between 19 and 30 kW. We proposed expanding the provision that Large SI engine manufacturers may certify engine with a displacement below 1 liter and rated power between 19 and 30 kW (Section IV.B.4 of the proposal) to include a limited number of engines up to 2.5 liters for manufacturers producing 300 or less engines annually. This flexibility would be available for the 2004 through 2006 model years. We requested comment on this flexibility in regards to: 1) the possible need to adjust the 30 kW cap for these engines to ensure that the appropriate engines are included; 2) the sales threshold and whether a greater allowance would be necessary to accommodate the sales level of small-volume manufacturers; and 3) adopting an intermediate CO standard of 130 kW for these engines.

Beginning with 2007, we proposed discontinuing the provisions for engines between 1 and 2.5 liters and adopting the standards that would otherwise apply in 2004 (4 g/kW-hr HC+NOx and 50 g/kW-hr CO). These standards would apply for a period of three years.

The two sections below address comments related to general small-business issues and to a air-cooled engines, which represent a particular segment of the market.

a. General Small-Business Provisions

What Commenters Said:

NAHB supports the inclusion of hardship provisions for manufacturers in the proposed rule.

Westerbeke states that the small volume manufacturer and hardship provisions will be very helpful, however they are questioning the CO limit of 130 g/kW-hr. They believe that performance will be significantly better than that allowed under the small SI rule, but they have not tested the Large SI engine yet, and the CO could range as high as 200 g/kW-hr.

Our Response:

We have addressed Westerbeke's concerns by removing specific requirements for small-volume manufacturers to transition to full compliance with emission standards. If Westerbeke or any other company would need to extend the time line for meeting emission standards, we would work out with them an achievable level of emission control during the interim period.

b. Air-cooled Engines

What Commenters Said:

The Association of Equipment Manufacturers (AEM) represents manufacturers of light construction equipment such as concrete and masonry saws. (AEM is a new association formed from the Construction Industry Manufacturers Association and the Equipment Manufacturers Institute.) AEM believes that the proposal covers an extremely wide variety of engines and applications and that it appears to have been developed mainly to address the larger, more sophisticated, more expensive applications that use LSI engines, but that it is inappropriate for smaller saws using SI engines below 1.5 L displacement and generating less than 30 kW. AEM believes that the proposal imposes disproportionate costs in terms of price and performance on the less expensive and less sophisticated applications that are used in much smaller numbers. AEM requests that EPA consider the disproportionate cost in light of the minor emissions impact associated with concrete and masonry saws, compared to more sophisticated industrial applications.

AEM is also concerned that compliance with the proposed rule will cause considerable hardship to Wisconsin Motors LLC, and threaten its ability to supply engines to concrete saw manufacturers. AEM requests that EPA give consideration to extending the 2004 compliance limit, reconsidering useful life requirements, and including in the proposal small-volume provisions and equipment manufacturer flexibility provisions.

Wisconsin Motors requests that EPA consider a special provision to allow relief to engine manufacturers by a provisional limited exemption in the event of unavailability of critical emission components due to no fault of their own. They offer as an example that there are currently only three companies that manufacture electronic fuel injection systems that may be adaptable to their non-road Large SI air-cooled engines. Wisconsin Motors states that it is not clear whether any of the products will be useable in this market, but due to the cost it may be prohibitive to design, test, map, and certify all three manufacturers of this product. They add that if the supplier chose to abandon the market due to its small size, a manufacturer would have to re-certify the engine from scratch which would close all production during this time.

Wisconsin Motors states that the Large SI severe-duty air-cooled engine market is a very small niche that is unserved by any other manufacturer. They also state that the nature of the duty and operational habits of these markets demand a simple, robust, compact, and physically heavy engine. Wisconsin believes that making modifications to a non-road air-cooled Large SI engine would adversely affect one or more of these key characteristics, including the life span of the engine. They state that the addition of costly and sophisticated equipment would be a hardship in terms of simplicity, as many of the workers that perform repairs on these engines would not be able to cope with complex technology. Also, modifications could affect the weight of the engines, which need to be quite heavy for optimum operation.

Wisconsin Motors recommends, that a complete section be added to the rule that addresses the special needs of engine manufacturers who are focused on the small niche of non-automotive derived, non-road industrial air-cooled engines above 25 hp. They believe that by not addressing these engines separately, there is the possibility that these products could inadvertently be eliminated from the marketplace, which could force manufacturers to abandon the sector or offer a lower performance product and duty standard across the severe-duty applications they serve.

Wisconsin Motors states that it believes that the additional costs to convert an engine to 2007 standards could put them out of business. Wisconsin also does not believe that it is appropriate to require an engine manufacturer to absorb all of the hard and soft costs associated with an item if the "best available" technology is not robust enough to withstand the application. They believe that this would be an unfair burden on a small, limited resource company that is serving a small niche. Further, they suggest that any warranties and maintenance requirement rules for these items requires an agreement between EPA, the engine manufacturer and the supplier/manufacturer of the affected items.

Our Response:

Comments from Wisconsin and the equipment manufacturers have made it clear that some nonroad applications involve operation in severe environments that require the use of air-cooled engines. We have adopted several regulatory provisions for air-cooled engines operating in severe-duty applications, as described in detail in Section III.B.6.

We are also adopting hardship provisions to address the particular concerns of small-volume manufacturers, which generally have limited capital and engineering resources. These hardship provisions are generally described in Section VII.C. of the preamble and Chapter 8 of the Final RSD. For Large SI engines, we are adopting a longer available extension of the deadline, up to three years, for meeting emission standards for companies that qualify for special treatment under the hardship provisions. We will, however, not extend the deadline for compliance beyond the three-year period. A second hardship provision allows companies to apply for hardship relief if circumstances outside their control cause the failure to comply (i.e., supply contract broken by parts supplier) and if the failure to sell the subject engines will have a major impact on the company's solvency. We would, however, not grant hardship relief if contract problems with a specific company prevent compliance for a second time.

We believe that the severe-duty emission standards should make it less difficult for small entities like Wisconsin to certify their engines. We also believe that the hardship provisions should enable them to spread the costs of compliance over a longer period of time to ease the financial burden. Since these engines represent a niche market, with their customers such as those represented by AEM providing public comments citing the need for these engines, we expect that Wisconsin will generally be able to recover the increased costs of production when selling compliant engines.

2. Marine Diesel

a. 5-yr Delay for Small Businesses

What We Proposed:

The SBAR Panel recommended that EPA delay the standards for five years for small businesses. We accepted this recommendation, and proposed that small-volume marinizers would not have to comply with the standards for five years after they take effect for larger companies. We proposed that marinizers would be able to apply this delay to all or to a portion of their production. Thus they could sell engines that meet the standards 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.

What Commenters Said:

The Blue Water Coalition (BWC) maintains that the proposed five-year delay on small-volume manufacturers is unreasonable, and will take full implementation of the rule to 2014. BWC proposes that the EPA's Hardship Relief provision is sufficient and that implementation for the rule already takes long enough, especially given that the Agency has provided an additional two years for implementation beyond commercial marine diesel provisions.

Our Response:

While we are concerned about the loss of emission control from part of the fleet during this time, we recognize the special needs of small-volume marinizers and believe the added time may be necessary for these companies to comply with emission standards. This additional time will allow small-volume marinizers to obtain and implement proven, cost-effective emission-control technology. We are adopting the five-year delay; the standards will take effect from 2011 to 2014 for small-volume marinizers, depending on engine size. 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.

b. Effect on Small Volume Manufacturers and Marinizers

What We Proposed:

To address the special circumstances of small businesses, and particularly small volume marinizers, we proposed a set of flexibility provisions that were discussed by the Small Business Advocacy Panel assembled for this rule. These provisions include broadened engine families, waiving production line testing, waiving deterioration testing and allowing these manufacturers to use an assigned deterioration factor, streamlined certification, delaying the effective date of the standards for five years, hardship provisions, and design-based certification.

What Commenters Said:

Peninsular Engines states that it employs 10 people (in good economic times) and sells and marinizes less than 500 engines a year. Peninsular believes that their company would have difficulty in complying with the proposed regulations; e.g, the certification process alone will require a large monetary expenditure for testing equipment. Peninsular maintains that the small number of engines they produced, some 200 of which are exported out of the country, have little or no emissions impact. Further, Peninsular holds that their engines average less that 200 hours of operation annually, and that most are used for offshore (sport) fishing, resulting in virtually unmeasurable emissions levels. They state that they desire to produce engines with newer technology to reduce emissions, but do not have the personnel to equip and test new components. Peninsular asks for EPA's help in trying to lower their emission levels since the economic burden of purchasing testing equipment and supplying personnel to comply with these regulations is very expensive when divided among 200 engines per year. They further state that they already have a difficult time competing with imported diesel engines, and the additional cost of emissions control may prove prohibitive to further production.

Mercury believes that the engine testing that is required for certification and compliance, as described in the ANPRM, will make it necessary for marinizers to invest in costly testing equipment or to contract for this testing work. They incorporate by reference analysis submitted previously to show the cost impact on marinizers, and state that the cost effectiveness is expected to be in excess of $18,000 per ton of HC+NOx reduction. This would force MerCruiser to withdraw as a supplier of recreational CI marine engines. Further, their commercial CI applications are sterndrives that require power-to-weight ratios that are comparable to those of recreational compression ignition engines. Mercury Marine requests that commercial packages of CI engines with sterndrives should be included in the same category as recreational CI marine engines.

Our Response:

The purpose of the small volume marinizer provisions is to provide additional flexibility to businesses such as Peninsular that do not have large resources to absorb fixed costs such as research and development and certification testing or have the ability to quickly redesign their products. We believe that the small volume marinizer provisions, including the five year delay of the standards, hardship provisions, and other flexibilities will give small businesses the opportunity to comply with our standards.

Mercury Marine's analysis of the cost per ton was based almost exclusively on the cost impact of controlling emissions from spark-ignition engines, with no attempt to adapt the analysis to CI recreational marine engines. We were therefore unable to modify the proposed analysis to reflect this information. Recreational marine diesel engines invariably have counterpart engine models used in commercial applications. We believe that manufacturers will generally comply with the new emission standards using the same basic technologies for both commercial and recreational engines. The remaining effort to meet emission standards with the recreational models is therefore limited to applying new or improved hardware and conducting sufficient R&D to integrate the new configurations into marketable products, thus minimizing fixed costs.

c. Large Volume Manufacturers with Small Volume Line

What We Proposed:

To address the special circumstances of small volume marinizers, we proposed a set of flexibility provisions that were discussed by the Small Business Advocacy Panel assembled for this rule. These provisions include broadened engine families, waiving production line testing, waiving deterioration testing and allowing these manufacturers to use an assigned deterioration factor, streamlined certification, delaying the effective date of the standards for five years, hardship provisions, and design-based certification.

What Commenters Said:

EMA agrees with the use of special compliance provisions, and believes that large volume manufacturers should also be able to include their production inventories up to 1000 marine engines per year under the same special provisions.

Our Response:

We do not believe it is appropriate to extend the flexibility provisions for small volume engine marinizers to large businesses. If we were to give large manufacturers the same flexibility as small volume marinizers for 1000 engines per company, they would be able to use this flexibility to target certain niches for further competitive advantage. In addition, this would delay emission reductions without any real social benefit. Finally, production for most of these small companies is much less than 1000 engines.

3. Recreational Vehicles

a. Effect on Business Entities

What We Proposed:

We proposed a number of flexibility provisions that were suggested by the Small Business Advocacy Panel assembled for this rule. These provisions include additional lead-time to meet the emission standards, design-based certification, broadened engine families, waiving production line testing, waiving deterioration testing and allowing these manufacturers to use an assigned deterioration factor, allowing use of engines certified in other programs, averaging, banking and trading, and hardship provisions. For snowmobiles only, we also included a provision for EPA to set an alternative standard at a level between the prescribed standard and the baseline level until the engine family is retired or modified in such a way as to increase emissions and for the provision to be extended for up to 300 engines per year per manufacturer. We believed this would assure sufficient availability of this option to those manufacturers for whom the need is greatest.

What Commenters Said:

Fast, Inc. states that it is a small business, but will not be able to take advantage of the flexibility provided to them as proposed. They believe that EPA intended to cover all small businesses when the small entity qualifier was set at 300 units. However, in order to survive, Fast believes that they must increase their production to 1,000 sleds, but does not think that they can remain competitive if they also have to add the financial burden of emissions compliance at this point in their development. They have learned that they must increase their production to survive, but believe they cannot do so unless the unique snowmobile provision is extended to at least 1,000 sleds.

Fast purchases a limited supply of motors from Polaris, but has been informed that this quantity will not be increased. Fast states that because of this, they will need to build more of their own motors to survive or find another supplier. Fast's competitors, and potential suppliers, have estimated that the 50% emission reductions will require them to increase prices by at least $1,800 per engine (not including the usual mark up of two times the cost of the motor). Fast fears that they will not be able to afford engines that can meet the certification.

Our Response:

Fast, Inc. produces four engine models, one of which is a four-stroke design. We believe the four-stroke engine will need no development or certification work, since we allow design-based certification for this situation. We expect the two-stroke engines to qualify for the alternative small businesses standards mentioned above. As a result, Fast should have only limited development costs to reduce emissions from these engines. However, their projected sales of 1,000 units represents a substantial increase over their current volume of 180 per year. We believe 500 sleds per year is a more realistic figure. Based on this, we are increasing the limit for the alternative standards provision to 500 snowmobiles per year. We also believe the estimate of $1,800 per engine to be greatly exaggerated. We have estimated that the actual cost increase should be no more than $300-800, depending on the control options chosen.

4. Motorcycles

a. Effects on Custom Shops and Aftermarket Parts Industry

What We Proposed:

The proposal stated that no one may remove or disable a device or design element that may affect an engine's emission levels, or manufacture any device that will make emission controls ineffective. We would consider these acts to be tampering. In doing so, we generally applied the existing tampering policies developed for highway engines and vehicles to the nonroad engines.[12] We also prohibit selling engine parts that prevent emission-control systems from working properly. Finally, for engines that are excluded for certain applications (i.e., stationary or solely for competition), we generally prohibit using these engines in other applications.

What Commenters Said:

ABATE of Illinois opposes EPA's effort to extend this rule to those who build/maintain their own offroad vehicles. ABATE maintains that limiting this practice would be an economic hardship on the $14 billion after market parts industry. ABATE feels that anti-tampering provisions would prove to be costly for the 10,000 custom shops as well as for consumers. This would only serve to force owners to take their machines to dealers for service, thus driving up the cost of simple maintenance tasks. Further, consumers will be deterred from buying new models and may leave offroad recreation due to the increased financial burden placed on them.

Our Response:

The anti-tampering requirements in the proposal are essentially the same as those for other regulated vehicle/engine classes. Many of the same concerns raised by the commenters were also raised when tampering provisions were adopted for highway vehicles. However, the aftermarket parts industry is still flourishing for these vehicles, as are numerous suppliers of high-performance parts. The regulations also prevent manufacturers from requiring owners to use any certain brand of aftermarket parts and give the manufacturer responsibility for engine servicing related to emissions warranty, leaving the responsibility for all other maintenance with the owner.

Further, motorcycle custom shops do many more things than engine modifications. A very large part of their business is in providing modified frames, fuel tanks, suspension systems, custom paint jobs, etc. These would not change. Also, many if not most of the custom-shop engine modifications are cosmetic in nature (chrome valve covers, etc.), or involve replacing exhaust systems for better

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

appearance and/or performance. Again, many of the same concerns were raised regarding the relationship of the anti-tampering provisions for light duty vehicles (LDVs). Yet today compliant high-performance exhaust systems are available for a wide variety of LDVs. We see no reason to expect any differences for off-highway motorcycles.

b. Effects on Dealers and Small Motorcycle Manufacturers

What We Proposed:

We proposed 2006 off-highway motorcycle standards of 2.0 g/km for HC+NOx emissions and 25.0 g/km for CO. These standards will have the same two-year phase-in period similar to the ATV standards. EPA believes that these standards will largely be met through the use of four-stroke technology.

What Commenters Said:

The California Motorcycle Dealers Association (CMDA) questions whether or not EPA intends to subsidize motorcycle dealers for their almost certain losses because of product shortages due to the lack of publically-acceptable alternatives caused by the industry's inability to effectively respond to a standard that the CMDA believes is artificially being set too low, based on a grossly exaggerated emissions inventory for offroad vehicles.

Mach 1 Motorsports believes that this rulemaking, specifically the move towards cleaner 2-stroke engines being required for ATVs and offroad motorcycles, will adversely affect his business.

Our Response:

The California standards, which were adopted in 1994, included an HC standard of 1.2 g/km. These standards were stringent enough that manufacturers were unable to certify several models of off-highway motorcycles, even some with four-stroke engine technology. The result was a substantial shortage of products for dealers to sell in California. The shortage led California to change their program to allow manufacturers to sell non-compliant off-highway motorcycles under some circumstances. As a result, approximately a third of the off-highway motorcycles being sold in California are compliant with the standards.

The comments indicate that dealers and consumers are concerned that a similar shortage could arise nationwide if EPA adopted the California standards. EPA shared this concern and proposed standards that were somewhat less stringent than California standards, based on test data from high performance 4-stroke machines. We are finalizing this approach to ensure that adequate product can be made available in the 2006 time-frame. Although the approach we are finalizing contains somewhat less stringent standards than the California program, we believe it will achieve reductions beyond that of the California program because more products will be certified (even when the competition exemption is taken into account).

We do not believe our standards will result in any significant shortage of product. Manufacturers have had many years to develop products to meet California's standards and will have several more years to meet our standards. Manufacturers currently produce machines for all regulated subtypes that meet or are close to meeting our standards. It is highly unlikely that any manufacturer would give up sales in the entire U.S. market to avoid meeting standards that are clearly feasible and cost-effective.

H. Other

1. Noise

What We Proposed:

We requested comment on noise standards for recreational vehicles.

What Commenters Said:

The Sierra Club Recreational Issues Committee (SR-RIC) and the Natural Trails & Waters Coalition (NTWC) maintain that nonroad vehicles are one of single largest sources of noise pollution, stating that noise from these vehicles often ranges from 81 to 111 decibels, equivalent to that of a busy street or rock concert. Bluewater Network requested that noise regulations be drafted for all categories that are a part of this rule to meet the requirements of 42 U.S.C. section 4901 (the Noise Control Act). NTWC cites the Public Health and Welfare Act (PHWA) (42 USC 4901), as do SR-RIC (especially if significant conversion of 2-stroke to 4-stroke snowmobiles is not promoted), and the Adirondack Mountain Club (AMC), which states that more efficient muffler and sound reduction technology is available to support more stringent noise standards. The Appalachian Mountain Club (ApMC) states that EPA has authority under the Transportation Noise Emission provisions (40 CFR 205.1). ApMC believes EPA should strengthen the noise standards and extend them to 4-wheel ATVs. They also believe that EPA should adopt the Vermont state limit of 73 dB at 50 feet as the appropriate standard.

The American Motorcyclist Association (AMA) maintains that existing noise standards are sufficient, but that EPA should act to promote compliance with existing laws and protect riders from unreasonable laws and regulations. AMA states that EPA should develop a universally- accepted and reasonably convenient field test for noise, since the complexity of the current test procedures has made the noise standards basically unenforceable in the field. AMA states that most federal, state and local enforcement agencies use SAE J1287, a steady-state test procedure which AMA maintains is not repeatable and does not correlate well with the EPA-specified test procedure. AMA also wants EPA to work with aftermarket exhaust system manufacturers to revise the testing and labeling standards for these products. AMA states that compliant aftermarket exhaust systems for nonroad motorcycles and ATVs are virtually non-existent.

Our Response:

We appreciate the comments from the commenters. The actions taken in today's rulemaking are related to our responsibilities and authority under section 213 of the Clean Air Act, which does not authorize standards regulating noise directly. We did not propose, and are not taking final action on, any regulatory provisions based on the Noise Control Act (the cites to the Public Health and Welfare Act appear to actually be cited to the Noise Control Act). EPA may choose to take action with regard to noise control from these engines in a separate rulemaking. At that time, we will need to ensure that Congress has provided appropriations for us to begin new noise control initiatives under the Noise Control Act. As noted in the proposal, Congress has recently restricted its appropriations for actions under the Noise Control Act. This has been the case for several fiscal years, including the current year. See also Our Response: at Section I.C.6.

2. NTE Standards

What We Proposed:

We proposed a defeat-device prohibition for all types of engines and vehicles covered by this rule. In addition, we proposed off-cycle emission standards for recreational marine diesel engines and Large SI engines. We proposed no specific off-cycle requirements beyond the defeat device prohibition for recreational vehicles.

What Commenters Said:

OTC believes that NTE standards should be established for all categories to ensure that real-world operating conditions are considered.

Our Response:

The provisions adopted for recreational marine diesel engines and for Large SI engines should satisfy OTC's interest for those categories. We are not adopting similar requirements for recreational vehicles at this time. For recreational vehicles, we will rely on the defeat device prohibition to ensure that off-cycle emissions are controlled. There are three primary reasons for this. First, the emission controls expected to be used to meet the recreational vehicle standards, such as basic four-stroke engine technology, do not provide significant incentives to develop cycle-beating strategies. Higher emissions would most likely result from calibrating the engines to run richer, but that would generally also increase fuel consumption and decrease power. Manufacturers may have some incentive to run richer at wide-open throttle for additional engine protection, but their customer's demands and any wide-open throttle operation on the test cycle will discourage the manufacturers from designing their engines to run rich. Second, since the emission controls will most likely rely on simple mechanical systems, rather than electronically controlled systems, it would be difficult for manufacturers to incorporate cycle-beating strategies. Finally, requiring manufacturers to measure and report off-cycle emissions would likely take resources away from the general emission-control development process. Had we adopted such requirements, we likely would have had to delay the implementation of the standards. We will monitor the in-use off-cycle performance of these vehicles.

Summary and Analysis of Comments:
Large SI Engines

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III. Large SI Engines

A. Process and Scope

In October 1998, California ARB adopted emission standards for Large SI engines. These standards were scheduled to start phasing in with the 2001 model year, with no durability requirements (deterioration factors, useful life compliance, etc.). The next "tier" of standards in California applies fully in 2004, adding full-life compliance using the same certification standards.

What We Proposed:

We proposed to set emission standards for new Large SI engines used in any application, except those that would be subject to emission standards under another program (such as snowmobiles, marine propulsion, etc.). This would cover engines nationwide, including those in California that are preempted from state emission standards (farm and construction engines under 130 kW).

The proposed standards were divided into two tiers. The near-term standards would extend the 2004 California ARB standards nationwide in that same year. The long-term standards were selected to require an improved level of control from the optimized and recalibrated configurations of these engines, generally relying on the same emission-control technologies. We proposed procedures and standards involving transient engine operation in the laboratory. We also proposed field-testing standards and procedures that would require effective emission controls under the whole range of normal in-use operation, while allowing manufacturers to test engines in use without removing them from the equipment. In addition to more stringent exhaust-emission standards, we proposed evaporative-emission standards and an additional requirement for manufacturers to incorporate engine diagnostics starting in 2007. The proposed requirements are described and analyzed in greater detail in Section III.B.

What Commenters Said:

In regards to scope of the rulemaking, NAHB believes that EPA has not shown that construction engines contribute significantly to air pollution and that we should consider exempting construction equipment. They also commented that the construction industry should have been represented on the SBREFA panel.

NAHB believes that EPA should consider key regulatory alternatives, such as exempting construction and delaying implementation for these vehicles.

ITA commented that EPA needs to approve California ARB standards. They state that whipsawing between California ARB and EPA to ratchet up stringency is not envisioned in the Clean Air Act.

Nissan commented that EPA should get California ARB to adopt EPA flexibilities, field-testing, and allow carry-across of California data. Further, they state that the long-term standards should be harmonized with California ARB.

California ARB noted that Large SI engines preempted from California emission standards contribute 12 percent of the estimated 2010 emissions of ozone precursors from Large SI engines in California. They also stated that they will consider adopting an aligned program once EPA adopts a final rule.

Nissan and ITA both feel that EPA should not adopt long term-standards now. Nissan believes that more information is needed on the transient duty cycle, field-testing procedures, and evaporative emissions. They suggested the alternative of having a technology review with industry before standards are adopted. ITA suggests that EPA should wait at least an additional year to adopt standards that could apply in 2008 or 2009. They believe administrative efficiency (i.e. promulgating only a single rulemaking) should not prevent thorough consideration of groundbreaking standards; they believe it is better to do a complete job now than go back with corrections in the future. ITA highlighted five principal concerns: (1) Limited, inconclusive data support new standards (especially durability, transients, and off-cycle); (2) Industry has limited experience with technology under California ARB's new standard; (3) No field-testing equipment is available and there is no proven method for broadcasting torque; (4) Transient test requires new equipment and may be hard to run; and (5) Fuel quality is poor.

Our Response:

We disagree with the comments from NAHB regarding the contribution of construction equipment to air pollution. First, the appropriate test for any class or category of nonroad engines under section 213 of the Act is whether the class or category contributes (not contributes significantly) to air pollution in more than one nonattainment area. Several EPA studies over the last decade show that Large SI engines, including construction equipment, contribute to pollution in more than one nonattainment area.[13,14,15] Using application-specific parameters from our emission modeling, we estimate that air compressors, aerial lifts, trenchers, and industrial saws using Large SI engines together emitted 8,000 tons of NOx, 5,000 tons of HC, and 185,000 tons of CO in 2000.

Comments from California ARB that Large SI engines preempted from California emission standards contribute 12 percent of the estimated 2010 emissions of ozone precursors from Large SI engines in California also show that construction equipment contributes to air pollution (construction equipment below 130 kW is one of two categories that California is preempted from regulating, the other being farm equipment below 130 kW). NAHB has provided no information disputing our determination regarding the contribution from Large SI engines. Furthermore, NAHB has not provided any information that would justify treating construction equipment differently from other equipment using Large SI engines. NAHB provides no evidence that engines used in construction equipment are different from engines used in other Large SI applications. There is no technological reason preventing manufacturers from applying emission controls to engines used in construction equipment or any other specific application. See *Engine Manufacturers Association v. EPA*, 88 F. 3d 1075, 1097-98 (D.C. Cir. 1996).

The Regulatory Flexibility Act provides certain procedural opportunities to small businesses that are directly affected by an anticipated regulation. As NAHB notes, any costs to the construction industry are

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[13]"Nonroad Engine and Vehicle Emission Study—Report and Appendices," EPA-21A-201, November, 1991 (available in Docket A-96-40).

[14]"Final Finding of Contribution From Nonroad Spark Ignition Engines Rated Above 19 kW and Land-based Recreational Nonroad Spark Ignition Engines, 65 FR 76790 (December 7, 2000).

[15]"Updated Emission Modeling for Large SI Engines," EPA memorandum from Alan Stout, November 10, 2000 (Docket A-98-01, document IV-B-05).

indirect. Entities in the construction industry would generally buy regulated engines, but have no regulatory obligations. We are therefore not required to invite such companies to join this SBREFA process. They are, of course, otherwise able to participate fully in the regulatory process. See Motor & Equipment Manufacturers Association v. Nichols, 142 F. 3d 449-467 (D.C. Cir. 1998).

We are in the process of reviewing California's request for authorization for the standards they adopted in 1998. While this is clearly overdue, it has no direct bearing on our consideration of federal emission standards. The Clean Air Act clearly lays out the expectation that emission standards need to be adopted and revised over time to reflect technology development consistent with the objective of maintaining standards that require the "greatest degree of emission reduction achievable." Nothing in this final rule is inconsistent with the Act or the general intent of state and federal policymaking to maximize emission reductions in the context of available technology. In fact, much like California ARB in their original rulemaking we have made an effort to adopt provisions in this final rule that will be suitable for application both in California and the rest of the nation. Given California's continuing, acute need for further emission reductions, we believe the more stringent emission standards in this final rule provide the only path for maintaining harmonized emission standards into the future. As noted in the California ARB comments, they will consider adopting the emission standards and other provisions once we finalize them. Also, we expect manufacturers to be able to use the same emission data to certify their products for both California ARB and EPA.

In response to Nissan's concerns regarding the 2007 standards, we wish to emphasize that the proposal presented a detailed rationale and justification for emission standards, test procedures, and other prospective requirements. We believe the information presented is adequate to support a conclusion that this final rule is feasible and includes appropriate specification of emission levels, test methods, certification processes, and other provisions. With respect to the specific concerns, transient testing includes generous tolerances to ensure that manufacturers can run valid tests; field-testing procedures require a minimum level of accuracy, so inaccurate measurements would not provide a valid set of data for comparing with the field-testing standards; and evaporative requirements are streamlined so that manufacturers will face minimal design and testing burdens. We have also revised the long-term standards to allow manufacturers to balance HC+NOx and CO emissions as appropriate. Section III.B.3 addresses these issues in more detail.

ITA raises several points in its claim that this rulemaking is premature. We provide a brief response to the main points here, leaving the detailed treatment of technical issues for the discussion of how we decided what provisions to adopt for the final rule. The general response to ITA's concerns is that we have taken any uncertainty into account in setting emission standards. As we have experienced in other programs, allowing more time to further review technical issues or gather more information often leads us to adopt more stringent requirements. That approach may have merit, but with the current court-order schedule to adopt standards, we believe it is appropriate to adopt standards now using the information available, which indicates that the standards adopted for the 2007 model year are feasible and practicable. We are adopting the 2007 standards in this rule because, as noted above, the Clean Air Act requires standards that "achieve the greatest degree of emission reductions achievable" taking into account costs and other factors. While the 2004 standards meet this requirement in the short term, the 2007 standards are certainly the more appropriate long-term standards. Given the nature of these engines and the control technologies we expect to be used, automotive experience suggests there is little doubt that the standards are feasible in this time frame.

It is true that this final rule relies extensively on the results of testing with two engines. Documentation of this testing is provided in the public docket and summarized in the Regulatory Support

Document. Testing with the two engines led to three important conclusions. First, the testing showed that Large SI engines can, with sufficient engineering design effort, control emissions with comparable effectiveness during both steady-state and transient operation. Second, the testing showed that Large SI engines can effectively control emissions under all types of normal operation (not only at certain speeds or loads). Third, the testing showed that the anticipated emission-control technologies can be expected to continue to operate effectively over the useful life of the engines. The only significant deterioration observed was clearly attributed to well understood and easily preventable causes. The validity of these three findings is underscored by the fact that these two engines operated for several thousand hours without any special attention (for cleaner fuels, better maintenance, more careful operation, etc.) before they were selected for testing. This data supplements a very broad and deep set of data showing that Large SI engines can consistently achieve very effective control of emissions during steady-state operation. We have received no data suggesting that these conclusions are incorrect.

While the industry may be starting up a somewhat of a learning curve, we expect that the data presented with the proposed emission standards have given the manufacturers ample information to review the feasibility of emission standards. In fact, we believe the testing conducted before the proposal significantly advances the state of knowledge for manufacturers in their effort to optimize emission-control technology for meeting more stringent emission standards.

As described later in this document, at least one company has equipment available now for measuring emissions using field-testing procedures. The uncertainty related to torque and speed broadcasting is not whether it can be done, but how accurate it can be. It is relatively straightforward to program an engine's electronic controller to monitor engine parameters such as manifold pressure and throttle position. Programming the controller with a look-up table would enable computation of torque values that can be read from a remote device. Manufacturers may employ a variety of methods to derive torque values, but any of these would be subject to the specified accuracy tolerance. In other words, if an engine cannot derive and broadcast torque values meeting accuracy specifications, no valid field-testing measurements can be made. Data manipulation from the engines tested to support the new emission standards suggests, however, that computed torque values can easily fall within the specified accuracy. The final rule requires manufacturers to produce engines that can be tested using field-testing procedures, but does not require manufacturers to do this testing. EPA may, however, conduct field testing to verify that certified engines continue to meet emission standards in use.

We agree that some manufacturers will need to make significant capital expenditures to be able to test their engines using transient procedures. We have taken that into account in the cost analysis. The transient cycle includes some highly transient operation that may be difficult to mimic precisely; however, every engine and dynamometer has so far been able to follow the prescribed cycle with a high degree of accuracy. ITA speculates about the difficulty of running the test, but has not, to our knowledge, run test trials on engines and dynamometers to suggest where there may be equipment or engine concerns with the new duty cycle. The final rule nevertheless takes this uncertainty into account, requiring that EPA confirmatory tests meet normal tolerances for cycle statistics, while allowing manufacturers to do testing with relaxed requirements for following the trace.

Aside from anecdotal evidence showing that varying LPG fuel quality causes deposits, the only data available showing the effect of fuel quality on emissions indicate that closed-loop fuel systems are remarkably resilient (See Chapter 4 of the Final Regulatory Support Document). Emission measurements before and after cleaning out extensive (and typical) fuel deposits showed that the feedback systems were able to compensate for any effect of deposits with adjustments that kept the engines at or near the desired stoichiometric air-fuel ratios. Especially with diagnostic systems in place, we do not believe poor fuel quality puts engine manufacturers at risk of having noncompliant engines in operation.

B. Standards

What We Proposed:

We proposed to adopt two tiers of emission standards for Large SI engines. The first tier of standards would take effect in 2004. These proposed standards were aligned with those already adopted by California ARB to allow manufacturers to apply emission-control technology with minimal lead time. The timing and level of the standards were based on the expectation that manufacturers would simply increase their production of California-certified engines for the rest of the U.S., since we expected manufacturers to need no development or testing beyond what they would already do for meeting requirements in California.

We proposed to apply a second tier of standards to take effect in model year 2007, allowing three years between tiers of standards to allow time for manufacturers to further develop and optimize emission-control systems. For both 2004 and 2007, we proposed to apply the standards to all engines without a phase-in period. To address a manufacturer's potential interest to stagger compliance across engine families in different years, we proposed a "family banking" provision to allow manufacturers to delay compliance for one engine family by certifying a larger engine family early. This approach to exchanging engine families would not require any calculation of emission credits.

The stringency of the proposed 2007 standards was established using available test data showing how well engines could control emissions over all types of operation using three-way catalysts and electronic fuel systems. A given level of stringency still involves a tradeoff between CO and NOx emissions, since biasing fuel systems slightly rich increases CO emissions but decreases NOx emissions (and vice versa). The proposal noted that this tradeoff is especially important for Large SI engines, since so many of them operate in enclosed areas, exposing employees and bystanders to potentially harmful levels of pollutants. An additional factor in considering this tradeoff is that gasoline engines generally need richer air-fuel ratios when operating under high load, which makes it easier for these engines to control NOx emissions and harder to control CO emissions.

The proposal addressed the NOx-CO tradeoff by presenting a range of possible emission standards. We proposed standards of 3.4 g/kW-hr for both HC+NOx and CO and asked for comment on two other options: (1) 2.6 g/kW-hr HC+NOx with 4.4 g/kW-hr CO and (2) 4.0 g/kW-hr HC+NOx and 2.5 g/kW-hr CO. The proposed emission standards and the other combinations of suggested emission standards were based on a curve-fit through several data points showing various combinations of standards for HC+NOx emissions and CO emissions, as described in the Draft Regulatory Support Document. This curve of candidate standards generally showed how the level of the HC+NOx standard could be increased if the level of the CO standard decreased, and vice versa. The curve included a suggested HC+NOx standard as high as 6.3 g/kW-hr (with a corresponding CO standard of 1.5 g/kW-hr) and an HC+NOx standard as low as 1.3 g/kW-hr (with a corresponding CO standard of 15 g/kW-hr).

As an aid in selecting the best combination of emission standards, the Draft Regulatory Support Document created a scenario of indoor engine operation. Calculating ambient pollutant concentrations for this scenario of an engine operating in a given room size with a certain ventilation rate showed how the standards could be adjusted to balance the ambient concentrations of CO, NO, and NO_2, all of which have exposure limits recognized by industrial hygienists. The proposed emission standards were selected from the curve of candidate standards because they represented a combination of emission levels that provided nearly equal protection from CO and NO emissions (NO emissions appear to always approach dangerous levels before NO_2 becomes a problem). The other combinations of emission standards on which we requested comment provided a slightly different balance between the different interests for controlling both CO and HC+NOx emissions. Both of these suggested standards were presented as being equivalent in technological stringency to the proposed standards.

To address the concern for engines, particularly gasoline-fueled engines, that need protection strategies to avoid premature engine wear, we proposed an alternate standard of 1.3 g/kW-hr for HC+NOx and 27.0 g/kW-hr for CO. This combination of alternative standards was based on the same logic as described above for considering the tradeoff of NOx and CO emission, but allowed for less stringent control of CO emissions, expecting that the marketplace would be able to differentiate between low-CO engines for application in enclosed areas and high-CO engines for outdoor or highly ventilated applications.

While the proposed 2004 standards included testing and standards only for steady-state operation, we proposed to apply the 2007 emission standards to both steady-state and transient testing. Adding the transient testing requirements, based on simulating measured operation from in-use engines, significantly improves the effectiveness of emission standards in ensuring that laboratory measurements will correspond to reduced emissions when engines are installed and operated in nonroad equipment. We proposed to include steady-state testing as part of the 2007 standards. The steady-state duty cycles overlap significantly with the proposed transient test, but includes some different operation that may be characteristic of specific applications of nonroad equipment. As importantly, we thought that the steady-state test would provide an emissions benchmark, for example, to provide streamlined testing of production engines. As a result, we made the proposed steady-state emission standards equal to those for transient testing.

We proposed corresponding emission standards to allow manufacturers to do in-use testing by measuring emissions from engines in the field, without removing them from equipment for testing in the laboratory. The field-testing standards were set by adjusting the duty-cycle standards, as supported by emission data and the specified tolerances on measurement equipment. This adjustment allowed for 40-percent higher emissions for HC+NOx emissions and 50-percent higher CO emissions to take into account the effects of varying engine operation, varying ambient conditions, and measurement error.

The proposal included no provisions for averaging, banking, or trading of emission credits as part of the certification process, instead basing the standards on full compliance by all engine families. We requested comment on including an emission-credit program. Under such a program, we described that it would be appropriate to adopt more stringent emission standards of 2.7 g/kW-hr for both HC+NOx and CO to achieve a comparable degree of stringency relative to the proposed standards, with emission caps at 3.4 g/kW-hr for both HC+NOx and CO to prevent engines from emitting at unnecessarily high levels.

In the Advance Notice of Proposed Rulemaking we discussed detailed provisions to address the technology constraints of air-cooled engines used in severe-duty applications, such as concrete saws. We requested comment generally on issues related to air-cooled engines, but did not propose this approach because the only company producing these engines went bankrupt before the proposal. After the proposal, we learned that a new company that sent written comments was intending to restart production of the same air-cooled engines. We then distributed a memo to numerous rulemaking participants describing our interest in revisiting the issues raised in the Advance Notice of Proposed Rulemaking, including a less stringent CO standard of 200 g/kW-hr for these engines.[16]

We proposed to include diesel-derived engines fueled by natural gas in the Large SI standards if they met the proposed definition of “spark-ignition” (see Section VII.A). We proposed no special provisions for these engines.

The proposal included a provision allowing manufacturers of engines over 19 kW, but with engine displacement up to 1 liter, to certify their engines to the standards that apply to nonroad engines under 19 kW. In addition, we proposed to limit the scope of this allowance so that it would apply only to engines up to 30 kW, regardless of engine displacement.

The proposal specified voluntary standards designed to recognize a superior level of emission control for those manufacturers desiring to market such an engine. We proposed “Blue Sky” emission standards of 1.3 g/kW-hr HC+NOx and 3.4 g/kW-hr CO for duty-cycle testing and 1.8 g/kW-hr HC+NOx and 5.0 g/kW-hr CO for field testing.

The following sections consider separate areas of comment on these proposed emission standards.

1. Timing of Standards

a. Lead time

What Commenters Said:

California ARB and NESCAUM both commented that the 2004 standards should be achievable in the proposed time frame. California ARB believes that the plans laid out in the proposal were clear and the standards match their own. Further, NESCAUM states that the proposed technologies, and the technology transfer in general, are much like highway engines; given the supporting data and long lead time, they believe manufacturers will have ample time to comply with the proposed standards.

On the other hand, NAHB does not believe that 2004 will allow enough lead time for manufacturers that are not certifying in California. Likewise, Wisconsin produces the majority of their engines in applications for which the California standards do not apply (farm and construction equipment under 130 kW). They have, at this time, chosen not to certify engines for those sales that would be subject to California’s standards. Further Wisconsin Motors commented that they face a resource burden to help equipment manufacturers properly position catalysts in individual equipment models, and for policing compliance. They state that they will need additional lead time for equipment-related design work.

MECA believes that the long-term standards could be achieved considerably in advance of 2007. Nissan, Ford and GFI do not agree with this statement and have suggested delaying the implementation of the Phase 2 standards. Nissan commented that 2007 is too soon for long-term standards; they believe that 3 to 4 years are needed to study full useful-life emissions under 2004 standards. GFI commented that the cycle appears aggressive and suggested that EPA phase in a new duty cycle over a longer period of time in order for manufacturers to gain necessary experience with the cycle. Ford suggests delaying the Phase

[16]“Emission Standards for Large SI Engines,” EPA memorandum from Alan Stout to Docket A-2000-01, May 3, 2002 (document IV-B-14). This document was placed in the docket at the same time we distributed it to rulemaking participants.

2 standards until 2009, to allow for 5-year stability to recoup costs.

The Mercatus Center at George Mason University commented that the Phase 1 standards should be skipped to allow earlier implementation of Phase 2 standards at lower cost.

Our Response:

As far as we are aware, all manufacturers except three are currently certifying engines to the emission standards adopted by California ARB in 1998.[17] These standards started phasing in for the 2001 model year, with full implementation required starting for the 2004 model year. In general, companies selling compliant engines in California (representing the vast majority of engine sales in the U.S. market) are selling comparable engine models throughout the U.S. Since manufacturers would need to make little or no change in their engines to also meet EPA's 2004 standards, this confirms our belief that manufacturers will generally be able to meet the EPA standards in 2004 simply by expanding their production of California-compliant engines and that there is no reason to believe that any segment of the Large SI engine industry will fail to produce engines meeting the EPA regulations in 2004. We first communicated this expectation with the Advance Notice of Proposed Rulemaking in February 1999 and have received no comments since then to call into question this capability.[18]

We recognize that Wisconsin Motors currently has no engines certified to the California ARB standards. As a result, Wisconsin may need extra time to meet the 2004 emission standards. This concern, however, is addressed by the fact that Wisconsin is eligible for the small-business provisions that extend the deadline for meeting the 2004 standards for qualifying manufacturers (40 CFR 1068.241), as discussed in Section II.G.1. Power Great Lakes, which designs, assembles, and distributes nonroad engines from General Motors, also has not certified engines in California. Since Power Great Lakes did not comment on the proposal, it is not clear if they limit their sales to regions outside of California or if they have a different strategy for meeting California and EPA emission standards. Caterpillar has also not yet certified engines in California, presumably because their low sales volumes of Large SI engines has not led to the need to certify these products yet.

Regarding the model year 2007 standards, the proposed rule included extensive discussion of testing and emission data related to the anticipated emission-control technologies under the proposed testing protocols. The information in the record clearly supports the expectation that manufacturers will be able to procure emission-control systems, complete the design effort, and conduct testing for certification in time for the 2007 model year. In particular, the experience with the EPA-sponsored testing at Southwest Research Institute (SwRI) showed that after six weeks of design effort on an aged emission-control system that was first available over ten years ago for nonroad engines, it is possible to achieve substantial compliance with the new emission standards. The remaining effort to isolate high-emission areas of engine operation, while not insignificant, would clearly be achievable in time to conclude engineering efforts to make a certified engine available for use in any anticipated commercial application.

[17]"Emission Data from California-Certified Large SI Engines," EPA memorandum from Alan Stout to Docket A-2000-01, February 11, 2002 (document IV-A-13).

[18]"California Requirements for Large SI Engines and Possible EPA Approaches, EPA memorandum from Alan Stout and Beverly Brennan to Docket A-98-01, January 29, 1999 (document II-B-2).

The long-term standards may well be achievable earlier than 2007, as suggested by MECA, but we are not accelerating introduction of these standards for two main reasons. First, setting 2004 standards allows us to achieve substantial early emission reductions by harmonizing with the existing requirements from California ARB. Given this first tier of standards, we believe manufacturers should have a period of stability to recover amortized costs and conduct an orderly design effort to prepare their several product lines for the next tier of standards. We generally allow three years between tiers of emission standards. Since we expect manufacturers to meet the 2007 standards primarily by optimizing calibrations, we include no variable costs and anticipate relatively small fixed costs, especially once these are calculated on a per-engine basis. As a result, it should not be necessary to further delay the long-term standards for amortizing the costs associated with 2004 compliance. Ford does not explain why they cannot amortize the relatively small fixed costs associated with the 2004 standards over three years. Also, neither GFI nor Nissan provide any evidence that the 2007 standards are infeasible in the proposed time frame. Second, as pointed out by manufacturers, the transient-testing and field-testing procedures and standards present a new and significant challenge, both for acquiring the equipment and expertise to do the testing and for designing engines to meet the standards. The field-testing standards in particular will require manufacturers to understand their engine's emission-control characteristics much better than is required by the first tier of standards with steady-state testing.

The Mercatus Center's suggested alternative implementation schedule would be appropriate to consider in the absence of the emission standards already established in California. However, given the California ARB standards, it is clearly best to adopt harmonized standards that allow us to achieve near-term emission reductions at the proposed levels with minimal costs. Manufacturers must meet California standards in 2004 regardless of any EPA rulemaking. Considering an approach to omit the proposed 2004 standards to accelerate the proposed 2007 standards for implementation in 2005 or 2006 would put manufacturers in a development and certification crisis by effectively forcing them to redesign and recertify their whole product line in one or two years.

b. Transition to new emission standards

What Commenters Said:

Ford commented that, to avoid market disruption, 100% "phase-in" should be kept.

Nissan had many suggestions for the transition to new emission standards, such as the adoption of a flexible approach for small-volume product lines. They also commented that an alternative phase-in should be specified, like for light-duty vehicles; with this, they believe there should be no restriction on years, sales, or volumes. Nissan commented that EPA should consider giving credit to sales of engines certified to California ARB 2001 standards to help with the transition to new the emission standards, and that perhaps this could include some discount as they are only zero-hour standards. They also believe we should adopt an optional emission-credit program in 2004 to help manufacturers transition to new standards by allowing very small engine families to remain uncontrolled.

Our Response:

Remaining questions regarding the timing of emission standards relate to the method of phasing in the standards to cover all models. We generally agree with Ford's preference for a simple approach of applying standards to all engines in a single year. This should be possible for the large majority of engine families. As described above, we believe setting the combination of standards in 2004 and 2007 allows enough time to design and certify all engines to the new emission standards. Phasing in percentages of engines over multiple years would introduce significant complexity to manufacturers' compliance efforts and is not warranted by the need to allow more time to integrate new technologies across product lines. At the same time, the proposed family-banking provisions provide flexibility for manufacturers desiring to spread out the design and certification effort over multiple model years. We believe the family-banking provisions address Nissan's comments by providing an alternative phase-in, with manufacturers certifying an engine family early to earn delayed compliance with a smaller family. Meeting California's 2001 standards does not help us establish that families can meet EPA standards, so we would not provide credits for certifying to those standards. On the other hand, if manufacturers have sufficient data to certify that their engines (beginning with the 2002 model year) will continue to comply with the California standards over the full useful life (using the same test procedures), they may use that data to certify to the 2004 standards.

We are making two adjustments to the proposed family-banking provisions to address Nissan's comments. First, we are applying these provisions to the 2004 standards, not only the 2007 standards. Manufacturers may not, however, use early compliance with the 2004 standards to delay introduction of engines meeting the 2007 standards. Second, we are adjusting the compliance calculation methodology to account for the number of engines in an engine family, rather than simply counting engine families and requiring that delayed families be smaller than the accelerated families. This would allow a manufacturer, for example, to delay certification with two separate engine families—perhaps over multiple model years—with very low sales volumes, as long as the combined sales are offset by a sufficient number of early-complying engines.

2. Level of standards—2004

What Commenters Said:

STAPPA and OTC support the proposed Phase 1 standards.

California ARB suggests that EPA adopt their emission standards on a nationwide basis as a necessary step to help California achieve the emission reductions outlined in measure M12 of their 1994 State Implementation Plan (SIP). This would reduce emissions from engines preempted from the California standards. Further, they state that harmonization would help to minimize confusion and expense resulting from significantly different state and federal requirements for engines that are not preempted from the California standards. (p. 6)

MECA, Ford, ITA, and GFI all support harmonization with California ARB in 2004. GFI commented that the limited SwRI data is the only support for meeting standards out to 5000 hours; therefore, the 2004 standards should require compliance only for 3500 hours, as is stated in the California ARB standards. ITA further commented that, to match California ARB, the deterioration factor should be based on 3500 hours of operation and the in-use standard should be relaxed from 4.0 to 5.4 g/kW-hr over the full useful life.

Our Response:

Commenters generally supported the approach of adopting standards in 2004 to align with the concurrent requirements established for California. The certification data from California ARB suggest that manufacturers are already producing engines that will meet the proposed 2004 emission standards over the full useful life. We nevertheless agree with ITA and GFI that it would be very difficult in the short period before 2004 to design engines to new standards, so we agree that it is appropriate to harmonize with California ARB's approach to deterioration factors, useful life, and in-use testing standards for 2004 through 2006 model years.

3. Level of standards—2007

a. Stringency of 2007 standards

This section relates to the general level of stringency of the emission standards. The next section addresses issues related to appropriately balancing HC+NOx and CO emission levels for a given level of stringency. Later sections address special considerations that apply to air-cooled engines and diesel-derived natural gas engines.

What Commenters Said:

Application-specific standards would be problematic for non-integrated engine manufacturers selling loose engines to many customers. They believe engines in this size range are better regulated on the basis of engine size and type (SI or CI). There are many applications for the various small engines and an engine manufacturer does not know which specific applications an engine may be used in, thus, determining a "worst-case" application is not feasible and may not be representative of an engine's emission performance. (Briggs 4)
Emission-control technology works for any application, so application-specific standards are not necessary. (MECA 3)
Technology will exist by 2007 to achieve substantial emission reductions. Aim higher; do not miss this chance to reduce emissions. (PA 2)
New Hampshire is in full support of the proposed standards for Large SI engines and encourages more stringent standards that are reasonable achievable. (NH 2)
California ARB recommends the most stringent HC+NOx standard feasible, while still significantly controlling CO emissions. New data show that California ARB's 1998 standards overestimated deterioration. A 2007 standard of 1 to 2 g/hp-hr (1.3 to 2.7 g/kW-hr) HC+NOx has been proven feasible. (CARB 7)
Adopt 1 to 2 g/hp-hr (1.3 to 2.7 g/kW-hr) NMHC+NOx standard. (NESCAUM 2, plus e-mail correction)
Nonroad SI engines are so much like highway engines that manufacturers should be able to transfer automotive technology to achieve 1 to 2 g/hp-hr (1.3 to 2.7 g/kW-hr) NMHC+NOx standard with a "corresponding" CO standard. (STAPPA 4)
Strongly support EPA's 2007 standards with transient testing. Incorporate EGR and spark timing to achieve greater reductions with long lead time until 2007. EPA's data show HC+NOx emissions at half of the most stringent proposed standard. (OTC 2)
EPA should tighten the 2007 HC+NOx standard to 1.4 to 2.8 g/kW-hr HC+NOx, while keeping the proposed 3.4 g/kW-hr standard for CO. California ARB certified an LPG engine with 0.64 g/hp-hr HC+NOx. (MECA 3, plus e-mail correction)

Support MECA targets; California ARB's certification data show better emission control than the proposed levels. (EDF 14)
Strongly support automotive-style controls in 2007. (Bluewater 8)
ITA states that EPA believes transient emissions will be higher than steady-state emissions. The paucity of test data reduces confidence that this has been adequately accounted for in setting the standards. This also applies to off-cycle control. (ITA 9)
Automotive technologies not necessarily transferrable to industrial engines; separate control systems must be developed for industrial applications. (Ford 3)
Control technology has seen sporadic use in forklifts. SwRI's testing with two of these engines says little about the feasibility of across-the-board compliance by the industry. (ITA 6)
"There is very little information showing how these systems hold up under nonroad use." (ITA 6)
"ITA recognizes the high technical and professional qualifications of SwRI and has no reason to question the test results that SwRI reports." (ITA-ANPRM 11)
SwRI testing shows extremely variable, and sometimes extremely high deterioration rates. -GM C2–HC+NOx 0.35 -> 0.87 (248%) -GM C2–CO (657%) -GM 100%-20% point–HC+NOx 0.57->3.5 (614%), etc. -GM @isolated points–CO (271 to 6222%) -Mazda C2–CO 1.5->3.25 (216.7%) -Mazda HC+NOx shows slight negative deterioration, undermining the validity of the test. (No off-cycle data on new catalyst.) -Several catalysts in the field were found inactive, including GM catalyst; rampant catalyst damage doesn't bode well for durability. (ITA 7-9)

Our Response:

We agree with commenters that application-specific standards would be inappropriate. With the exception of air-cooled engines and diesel-derived engines (described below), all Large SI engines are very similar. Also, emission testing has shown that the emission-control technologies can be effective under any variety of engine operation and the test procedures reflect the range of expected in-use operating characteristics. Large SI engines designed to a uniform set of standards can therefore all incorporate the anticipated emission-control technologies effectively to achieve substantial emission reductions in any application. Moreover, we expect that the low-emission engines will have major improvements in durability, reliability, and fuel economy, so there is no application in which equipment manufacturers or operators should claim to need an engine designed to a less stringent standard.

Commenters supporting more stringent standards expressed a consistent interest in setting HC+NOx emission standards between 1.3 and 2.7 kW-hr. Our proposed standards reflect the new information on deterioration referenced by California ARB. The less stringent proposed emission standard for HC+NOx emissions of 3.4 g/kW-hr was based on a corresponding CO emission standard of 3.4 g/kW-hr. The Draft Regulatory Support Document presented a "Range of Feasible Emission Standards" in consideration of different pairs of HC+NOx and CO emission standards. The suggested range of HC+NOx emission standards falls roughly in the middle of the range of standards presented in the Draft Regulatory Support Document. In general, these tabulated values represent a consistent level of stringency, with varying emphasis on HC+NOx or CO emissions.[19]

The very low emission levels referenced from California ARB's certification database are illustrative, but provide an incomplete picture because they are generally based only on the seven-mode steady-state duty cycle. We took into account transient and off-cycle emissions in selecting the proposed standards. As described in Chapter 6 of the Final Regulatory Support Document, we have developed transient adjustment factors showing that emissions during transient operation are substantially higher than during steady-state operation.[20] Since we proposed the same numerical standards for both steady-state and transient emissions, the emission standards are in fact more protective than simply applying tight standards to steady-state testing. Absent any comments regarding the relative numerical values for steady-state and transient testing, we continue to believe (as described in the summary of the proposal above) that it is appropriate to set the same emission standards for both types of testing.

With respect to MECA's specific recommendation for a combination of stringent HC+NOx and CO standards, we believe that shifting to tighter control of HC+NOx while allowing a slight increase in CO emissions addresses the concern reflected by their comment. We are therefore adopting standards whose highest HC+NOx level is within the 1.3 to 2.7 (or 2.8) g/kW-hr level suggested by the commenters, based on the test data, which allows for even more stringent HC+NOx levels for engine families if appropriate. As discussed below, we will allow somewhat higher CO levels to compensate for the lower HC+NOx levels.

We disagree with MECA's comment that we should tighten control of HC+NOx emissions without increasing the proposed CO standard, and with the general feedback that we should adopt standards more stringent than what we proposed. The new standards are based on test data that rely on the technologies that were available to us at the time. Accordingly, these standards 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 additional 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. For example, we describe in the Final Regulatory Support Document why we are not basing emission standards on the use of spark timing, combustion-chamber redesign, gaseous fuel injection, or exhaust gas recirculation. In addition, many of the most advanced automotive technologies focus on reducing cold-start emission, which is a much less significant concern for industrial engines. Rather than aiming for a numerical emission standard that looks very stringent, we believe it is most important to adopt testing requirements to ensure that manufacturers will design their engines for effective control of in-use emissions under the wide range of normal operation. Even without these additional technologies, we anticipate that manufacturers will be reducing emissions by about 90 percent from uncontrolled levels. Further optimizing an engine with a full set of emission-control hardware to produce further, relatively smaller, emission reductions while meeting transient and field-testing standards is more of a burden than Large SI manufacturers can bear in the projected time frame.

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[19]The proposed alternate standards were not taken from the table of candidate standards, but rather were based on data from engines relying on engine-protection strategies. These alternate standards show up as a less stringent combination of HC+NO and CO values; this is discussed further under Section III.B.3.b below.

[20]Note that we make an exception for steady-state emissions during high-load operation for engines that need engine-protection strategies, as described in Section III.B.3.b.

We did not base the proposed emission standards on the potential to control emissions using EGR or retarded spark timing, as suggested by the Ozone Transport Commission. We believe EGR as an emission-control technology has not yet been shown to be appropriate for these applications, mainly because most of these engines operate with so much transient operation that an EGR controller would be unable to calibrate or time exhaust recirculation rates to coincide with appropriate engine speeds and loads. Also, catalysts convert about 90 percent of engine-out emissions, so to the extent that EGR or spark timing could reduce engine-out emissions, only 10 percent of that reduction would represent an additional increment of control beyond that already achieved with the catalyst system. Future work in achieving more stringent emission controls will very likely focus on more sophisticated control of air-fuel ratios, rather than incorporating either EGR or retarded spark timing.

With regard to ITA's comments about the information supporting emission standards for transient engine operation, we continue to believe that test data sufficiently demonstrate the feasibility of the new standards. The emission standards are based on testing with two engines that consistently showed that the emission-control system could be adjusted to operate effectively under transient conditions. These engines were from different engine manufacturers and both experienced in-use operation well beyond the useful-life period of 5000 hours. Without any special effort to preserve or maintain the engines or emission-control systems, we were able to make modest adjustments on each engine to achieve emission levels consistent with the new emission standards. This included steady-state and transient testing over prescribed duty cycles and off-cycle measurements over a wide range of engine operation. The control technology depends primarily on the engine's ability to control air-fuel ratios within a narrow band around stoichiometry. Testing with the two engines showed that this was generally possible over all types of operation. The only exception we found was the need for rich air-fuel ratios at high-load conditions for certain engines, which we address in Section III.B.3.b below.

Ford's pessimism about applying automotive technology to Large SI engines is unsupported and contrary to available information. Currently available catalyst and electronic fuel systems for Large SI engines, while originally developed for automotive engines, have already been adapted for specific application to nonroad engines and are sufficient to meet the final standards. As described above, EGR and spark timing are technologies that have been used in automotive systems that we agree are not appropriate for Large SI engines at this time. The latest automotive technologies focusing on controlling cold-start emissions may be transferrable to nonroad engines, but operating characteristics make these advances much less relevant for nonroad engines. In any case, the technologies on which we based the proposed emission standards on nonroad technologies are available today for Large SI engines, so the feasibility of the standards in fact does not rely on projecting new transfer of automotive technology.

ITA's concern about the limited experience with nonroad application of the projected control technologies is similarly unfounded. The infrequent use of three-way catalysts in forklifts or other nonroad applications makes it no less viable as a control technology. ITA provides no information to support its statement, which contradicts MECA's claims that the vast majority of these engines are used in similar applications that are compatible with the emission-control technologies that manufacturers are expected to use to meet these standards. More important is the fact that these systems have been in service for over ten years in forklifts and other types of nonroad equipment. Even with limited sales volumes, this time has allowed companies to develop and tune the technology to work out any issues related to the durability, reliability, or performance of engines using these systems. The SwRI testing involved two engines that had accumulated thousands of hours of operation with the control technologies without any special attention for more careful maintenance or superior fuels. Nevertheless, both engines were readily programmed for effective control of HC, NOx, and CO emissions over the new transient duty cycle and many kinds of off-cycle operation. Further work would target the few remaining areas where control of air-fuel ratios was inadequate. This could be resolved either by spending significant time to optimize an engine with the same fuel system (e.g., adjusting the engine's electronically controlled algorithms to more carefully control air-fuel ratios over varying speeds and loads) or by upgrading slightly to a fuel system with a more sophisticated controller that allows more direct control over air-fuel ratios and other engine parameters. These techniques are already in common use in automotive engines and could easily be applied to Large SI engines. ITA's reference to our quote citing the lack of information showing how these systems hold up under nonroad use was our characterization of the state of knowledge before SwRI conducted the testing program to evaluate aged emission controls under transient operation. We believe the information now available amply shows that the targeted emission-control technologies hold up under nonroad use.

Several points counter ITA's arguments concerning the high and variable deterioration rates. First, as a technicality, ITA's incorrect calculations inflate the observed deterioration rates. For example, emissions rising from 0.35 to 0.87 g/hp-hr represents an increase of 148 percent, not 248 percent. Second, the proposed emission standards are based on the deteriorated values, so any observed deterioration serves only to help the manufacturer plan for certifying new engines to show that they meet full-life emission standards. Third, all the high deterioration rates are from the engine that had the observed catalyst degradation with a known and easily preventable cause. To the extent that manufacturers are able to design systems with less deterioration, they would increase their compliance margin in meeting emission standards. Fourth, even though the observed emission levels show significantly higher relative emissions from the older systems, the absolute emission levels from the aged systems still meet the emission standards. For example, increasing HC+NOx emissions from 0.35 to 0.87 g/hp-hr does not call into question the feasibility of meeting a standard of 2.0 g/hp-hr. Fifth, while several individual points of engine operation showed relatively high deterioration rates, no trend emerged from the pair of engines tested showing that Large SI engines would be incapable of adequately controlling emissions under a specific type of engine operation. Generally, any problems experienced by one engine were not common to the other engine. This underscores our expectation that additional design work—such as improving control of cylinder-to-cylinder air distribution, electronic feedback of air-fuel ratios, and other combustion-related parameters—will be sufficient to resolve any remaining issues. Sixth, SwRI did not conduct off-cycle (steady-state) testing with the Mazda engine since the seven modes of the C2 duty cycle showed no significant variation in emissions with new and aged catalysts. Further off-cycle testing with this engine was omitted to allow for additional testing in other areas. Seventh, we have added the cost of precision diameter calipers in the economic impact analysis to take into account the need for more careful production processes to prevent the kind of catalyst damage observed in the field. We continue to believe, as supported by California ARB comments, that the available test data support adoption of emission standards based on a relatively small degree of deterioration of control technologies.

b. Balancing Control of HC+NOx and CO emissions

General: 2007 standards (recommended above) should be for both gasoline and LPG. Electronic controls and closed-loop systems get past the tradeoff of controlling CO and NOx+HC emissions. (MECA 3)
General: Engine optimization can take care of CO tradeoff. Improve engine design details to meet standards while under heavy load instead of accommodating current technology limitations. (OTC 3)

General: Adopt 1-2 g/hp-hr NMHC+NOx standard and drop alternative (high-CO) standards. CO and toxic (HC) exposure concerns compel more aggressive handling of emission tradeoffs. (NESCAUM 2)
General: Nonroad SI engines are so much like highway engines that manufacturers should be able to transfer automotive technology to achieve 1-2 g/hp-hr NMHC+NOx standard with a "corresponding" CO standard. Drop alternative (high-CO) standards. EPA should require manufacturers to simultaneously control all three pollutants. (STAPPA 4)
Selecting standards: Support alternate standards to recognize different capabilities of gasoline and LPG engines and letting market forces sort it out. Do not base standards on indoor-outdoor distinction— (1) Let OSHA be responsible for exposure concerns, (2) Do not create presumption that only LPG engines can be used indoors, (3) Not realistic to expect only "indoor" forklifts to operate indoors (split use, rental, second owner, fuel storage issues) (4) Manufacturers may curtail sales of high-CO models for fear of stigma or liability. (ITA 24-26)
Selecting standards: No preference among listed options for NOx-CO tradeoff. Manufacturer should be able to certify to a curve instead of locking into one combination. Manufacturer shouldn't be held to certification levels, as long as the combination of emissions meets the formula. (ITA 18)
Selecting standards: Recommend CO standard of 9.0 g/hp-hr for indoor engines–based on C2 measurements with new engines. Data on LPG engines show HC+NOx = 0.42 g/kW-hr; CO = 6.15 g/kW-hr. Consider compliance margin. (Ford 3)
Selecting standards: Ford supported the standards described in the memo updating our approach to emission standards for steady-state measurements, but noted that they have no data or other basis for commenting on the feasibility or appropriateness of standards for transient testing or field testing. (Ford e-mail update)
Selecting standards: Zenith endorses proceeding with the approach in the memo updating our approach to standards. The flexibility for certification and a common approach for all fuels are major strengths. (Zenith-II)
Engine protection: Gasoline engines need to run rich at wide-open throttle, which is less problematic for high-octane LPG. Result is higher CO emissions from gasoline. Under the proposed 1.3 g/kW-hr HC+NOx standard, recommend a CO standard of 40.2 g/kW-hr to allow a 50-percent compliance margin. Data on gasoline engines show HC+NOx = 0.59 g/hp-hr (0.79 g/kW-hr); CO = 17.8 g/hp-hr (23.9 g/kW-hr). (Ford 4)
Engine protection: California ARB certification data show only slightly higher HC and CO emissions from gasoline than from LPG. Recommend common standard. D2 cycle should reflect the higher weighting of wide-open-throttle operation (5% vs. 2% on C2); necessary departure from stoichiometry results in very poor catalyst efficiency for HC and CO emissions. Controlling HC and CO at wide-open throttle limited by cylinder-to-cylinder air distribution and sophistication of controls (rich bias reverting back to stoichiometric...). (Zenith 1) Updated memo regarding standards leaves a need to address high emissions at wide-open throttle; a separate standard allowing double the CO emissions on the same sliding scale should apply to fixed-speed engines to account for this. (Zenith-II)

Engine protection: Alternate (high-CO) standards show bias towards gasoline-fueled engines. We shouldn't depend on the assumption that gasoline engines are more likely to be used outdoors. Also, by allowing higher CO for some engines, EPA jeopardized the justification for the regular standards. (NPGA 4)
Exposure: OSHA supports reducing exposure to emissions and thereby avoiding a range of adverse health effects associated with ambient ozone, CO, and PM levels, especially respiratory impairment and related illnesses; however, OSHA has concerns that the proposed standards could be construed as preempting them from enforcing its own occupational safety and health standards that address employee exposure to air contaminants. OSHA is concerned that EPA's intent in the proposed standards may be misconstrued. OSHA believes that there could be circumstances in which forklifts used at a facility could be in compliance with the proposed standards but the employee exposures could still be above OSHA's permissible exposure limits due to the number of vehicles and their cumulative emissions. In this case, OSHA would need to enforce its regulations to protect employees in this hazardous condition. OSHA would like for EPA to add the following language into the final rule: In accordance with the limitations provided in section 310(a) of the Clean Air Act (42 U.S.C. §7610(a)), nothing in this rule shall affect the Occupational Safety and Health Administration's authority to enforce standards and other requirements under the Occupational Safety and Health Act of 1970 (29 U.S.C. §§ 651 et seq.). (OSHA 1)
Exposure: EPA should not adopt standards to address indoor exposures; therefore remove the Phase 2 standards. CAA 213 points to National Ambient Air Quality Standards, not exposure. (Briggs 5, 6)
Exposure: It is not appropriate to set costly national mobile-source standards to address postulated personal-exposure scenario. It is simply not feasible or efficient to attempt to address each of these scenarios through mandatory emission standards that apply to all engines. Rely instead on local workplace controls. Due to variation in emissions, it is more efficient for OSHA's regulations to address these concerns. (Briggs 5)
Exposure: Basing standard on hypothetical operation to meet threshold-limit values is problematic. (1) It's misleading to associate unsafe pollutant levels with emission rates of a particular piece of equipment (need to consider size and configuration of room, ventilation rates, number of engines, traffic patterns, etc.) (2) Analysis should use OSHA's 50 ppm permissible exposure limit instead of ACGIH's 25 ppm threshold limit value (ITA 20)
Exposure: EPA's emphasis on indoor emissions is misplaced. OSHA sets a ppm specification to reflect all relevant parameters. EPA can't quantify benefits of reduced exposure. EPA can't show any need to reduce emissions beyond 2004 levels, which already has marked reductions. Leave exposure concerns to OSHA and let manufacturers choose any point on the curve. (ITA 22)
Other: Allowing high methane emissions from natural-gas forklifts poses an exposure problem ("hydrocarbons are hydrocarbons"). Adopt total-hydrocarbon standards for all engines. (NPGA 6)
Other: Do not require "low-CO" label: (1) it would unnecessarily restrict the appropriate use of many units, (2) There is no evidence that individuals need additional protection, (3) There is no evidence that a label would provide significant protection. (ITA 26)
Other: Need permanent label warning against use of outdoor engines for indoor applications. (Bluewater 8)

Our Response:

Commenters representing states, environmentalists, and manufacturers of emission controls generally emphasized primary control of HC+NOx emissions with varying degrees of interest in simultaneous control of CO emissions. Commenters urging us to rely on engine technologies to get past the tradeoff of NOx and CO emissions did not share any new information pointing out how the proposed standards succeeded or failed in applying engine technologies to require optimum control of all pollutants. The tradeoff of NOx and CO emissions is an inherent function of an engine's air-fuel ratio (high NOx and low CO with lean operation; low NOx and high CO with rich operation). We agree that engine technologies such as three-way catalysts and closed-loop fueling control achieve reductions in all pollutants, but the tradeoff remains after applying any given technology. We therefore continue to believe that the curve of candidate emission standards represented by three-way catalyst systems with optimized fuel systems represent the greatest degree of emission control achievable. Commenters advocating stringent control of emissions all expressed an interest in HC+NOx standards that would prevent any engines from certifying at an emission level greater than 2.7 g/kW-hr (2.0 g/hp-hr). This recommendation plays a foundational role in our effort to apply emission standards that we believe appropriately address the need to balance emission control of all the pollutants, as described in the rest of this section.

For those commenters objecting to the proposed alternate standards, we generally agree that it is better not to adopt less technologically stringent standards to accommodate concerns for the tradeoff of HC+NOx and CO emissions. As described in the following section, we believe it is appropriate, however, to adopt a set of emission standards that allows for some tradeoff in HC+NOx and CO emissions based on *equivalent* technological stringency. Also, to the extent that necessary engine-protection strategies affect the achievable degree of emission control, this should be reflected in the emission standards, but not at the expense of achieving effective control of emissions in use, as described further below.

Selection of Emission Standards

We recognize the concerns raised by ITA related to adopting emission standards based on indoor or outdoor operation. We agree that facility managers can ensure safe indoor operation of any Large SI engines meeting emission standards by properly accounting for the degree of engine operation, the size of the room, and ventilation rates. This is true even if manufacturers produce engines with CO emissions higher than the most protective levels contemplated in the proposal. Compared with uncontrolled engines or even engines meeting 2004 standards, testing with the transient duty cycle and adding engine diagnostics ensure that all certified gasoline engines will achieve large reductions in CO emissions under the 2007 standards. Emission standards that maximize control of CO emissions would provide substantial protection even under nearly worst-case scenarios. There are clearly many instances in which engines can operate safely indoors with less than maximum control of CO emissions. For example, large operating areas, high ventilation rates, and light or infrequent engine operation may provide adequate protection to meet occupational standards even if the engine has somewhat higher CO emissions. At the same time, we believe customers should not be prevented from buying a piece of equipment designed for stringent control of CO emissions as a result of emission standards that do not recognize the need to address exposure concerns. We agree with ITA that OSHA is responsible for worker safety and health and we have no intention of interfering with OSHA's legitimate role.

We believe that ITA's recommended approach of adopting a range of emission standards along the proposed continuum reflecting the tradeoff of NOx and CO emissions is an appropriate way of addressing the concern for indoor and outdoor operation. Using the logarithmic curve recommended by ITA, we believe it is appropriate to allow manufacturers to meet emission standards by showing that both HC+NOx and CO emissions fall within the values represented by the curve. However, we agree with commenters supporting more stringent standards that we should adopt HC+NOx emission standards within the 1.3 and 2.7 g/kW-hr range. To implement this, we first specify emission standards of 2.7 g/kW-hr for HC+NOx and 4.4 g/kW-hr for CO. This pair of points was suggested in the notice of proposed rulemaking as a possible alternative to the proposed standard, reflecting an equivalent level of stringency with a slight additional focus on controlling HC+NOx emissions more than CO emissions (66 FR 51123, October 5, 2001).

However, we are including an option for manufacturers to certify their engines to different emission levels to reflect the inherent tradeoff of NOx and CO emissions and to add an incentive for HC+NOx emission reductions below the standard. Generally this involves meeting a less stringent CO standard if a manufacturer certifies an engine with lower HC+NOx emissions. Table 1 shows several examples of possible combinations of HC+NOx and CO emission standards for duty-cycle testing and field-testing. The highest allowable CO standard for duty-cycle testing is 20.6 g/kW-hr (15.4 g/hp-hr), which corresponds with HC+NOx emissions below 0.8 g/kW-hr (0.6 g/hp-hr).

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

	HC+NOx	CO
Duty-cycle testing	2.70	4.4
	2.20	5.6
	1.70	7.9
	1.30	11.1
	1.00	15.5
	0.80	20.6
Field testing	3.80	6.5
	3.10	8.5
	2.40	11.7
	1.80	16.8
	1.40	23.1
	1.10	31.0

*As described in the Final Regulatory Support Document and the regulations, the values in the table for duty-cycle testing are related by the following formula: $(HC+NOx) \times CO^{0.784} = 8.57$. These values follow directly from the logarithmic relationship presented with the proposal in the Draft Regulatory Impact Analysis. The analogous formula for field-testing standards is $(HC+NOx) \times CO^{0.791} = 16.78$.

While the proposal contemplated emission standards with HC+NOx emission levels as low as 1.3 g/kW-hr, we believe it is appropriate to extrapolate available HC+NOx emission standards two steps further for four reasons: (1) several commenters expressed an interest in seeing HC+NOx emission standards reaching at least down to 1.0 g/kW-hr (2) about half of the 2001 and 2002 engine families certified in California are certified with emission levels below 0.8 g/kW-hr HC+NOx, (3) extending the curve provides additional flexibility to manufacturers with an incentive to maximize HC+NOx emission reductions and (4) the "high-CO" standard of 20.6 g/kW-hr is still more protective than the proposed alternate standards based on outdoor operation. As described in the Draft Regulatory Support Document supporting the proposal, we believe engines controlled to meet any of the combination of standards in Table 1 are reducing emissions to the greatest degree achievable, considering the appropriate factors.

We cannot, however, accept ITA's recommendation that engines not be held to specific certification levels, as long as a manufacturer meets one of the pollutant combinations on the table. The main reason for allowing manufacturers a range of standards to meet for CO and HC+NOx is to allow manufacturers to design engines meeting the different environmental needs of particular equipment and user groups and to allow equipment manufacturers and users to make informed purchases of engines that best meet those needs. However, equipment manufacturers and users will not be able to do this unless they can be assured that the engines will meet the emission standards to which they have been certified. We therefore cannot allow engines to exceed their certified levels for any particular pollutant in use.

Ford's test data are consistent with these emission standards. With their very low measured HC+NOx emission levels (0.42 g/kW-hr), the measured CO emission level (6.15 g/kW-hr) would fall under the applicable CO standard with a substantial margin, even after allowing for somewhat higher emissions during transient operation.

Engine Protection

The table of standards above does not take into account the fact that some engines are unable to maintain sustained stoichiometric operation at high engine loads. Engines running rich at high load typically continue to have low HC+NOx emissions, but CO emissions increase substantially. However, operation over the transient duty cycle involves very little sustained high-load operation. Table 2 shows the total time during the 20-minute cycle with engine loads exceeding various thresholds. This alone shows that the standard for testing over the transient duty cycle needs little or no adjustment to account for rich operation under high-load conditions. Delaying rich operation would further ensure that emission-controls continue to function properly while still protecting against overheating. As a result, consistent with comments from Zenith, NPGA, environmentalists, and states, we do not believe emission standards for the transient emission test should be adjusted to account for engine-protection strategies.

Table 2
Evaluation of High-Load Operation Over the Transient Duty Cycle

Torque threshold (percent of maximum at a given speed)	Total time over torque threshold (seconds)	Percent of 20-minute cycle	Average number of seconds during each minute
90%	16	1.3	0.8
85%	23	1.9	1.2
80%	41	3.4	2.0
75%	67	5.6	3.4

The steady-state duty cycles have a fixed weighting to account for emission levels at high-load operation. Also, delaying enrichment does not help with steady-state emissions, because emissions are measured only after engine operation and emission levels have stabilized. We are therefore setting a maximum CO level of 31 g/kW-hr during steady-state testing for engines needing protection strategies. This corresponds to the highest CO emission level we are allowing under field-testing standards, as noted in Table 1 and described further below. This less stringent standard would apply to all steady-state testing with the C2 or D2 duty cycles for certification, production-line, or in-use testing. The emission standards described in Table 1 would still apply to these engines when tested over the transient duty-cycle. We are also applying the field-testing standards equally to different engines, regardless of whether or not they are certifying to a less stringent CO emission standard for steady-state testing. This reflects our expectation that engines undergoing normal operation in the field will continue to meet emission standards. Manufacturers can plan to meet field-testing emissions standards only for an engine that relies on engine-protection strategies to the extent that they ensure that sustained high-load operation rarely occurs in use. We believe this approach addresses Zenith's concern for controlling CO emissions from engines needing protection strategies.

Unlike the proposed alternate standards, we are adopting an HC+NOx emission standard of 2.7 g/kW-hr to correspond with the less stringent CO standard for taking engine-protection into account. We do not believe it is necessary to require a more stringent level of HC+NOx emissions to compensate for the higher CO emissions for a combination of reasons. First, these engines must continue to meet the same standards that apply to all engines for transient testing and field testing, so the relaxed standards for these engines will be limited to modes of operation that should rarely occur. Also, requiring more effective control of steady-state HC+NOx emissions for engines using protection strategies would prevent manufacturers from making these engines with the maximum degree of CO control we would otherwise allow under the standards for transient operation. We believe that engines relying on protection strategies can effectively control CO emissions when not operating at high loads. The practical effect of this provision is to increase the viability of safely using gasoline engines for operation in areas where human exposure is a primary concern.

The Ford test data with their gasoline engine show that their emission levels comply with this less stringent CO standard for steady-state testing. For example, with a measured emission level of 23.9 g/kW-hr, they would have roughly a 20-percent compliance margin relative to a standard of 31 g/kW-hr. The proposed curve of candidate emission standards incorporated a 10-percent compliance margin, even though the measured emissions were from aged engines not designed to meet emission standards. Our emission modeling typically incorporates an assumed 20-percent compliance margin for spark-ignition engine emissions. We believe that Ford's recommended 50-percent compliance margin is not justified, especially considering the time available to make adjustments to the engine's emission-control system in general and protection strategies and the NOx vs. CO tradeoff in particular. This shows that the less stringent CO standard for steady-state testing accounts for high-load operation to the extent it is included in the weighting of those modes in the C2 and D2 duty cycles.

In addition, we are adopting a combination of provisions to ensure that manufacturers will take steps to allow enrichment only under exceptional circumstances. This is necessary to ensure that engines in nonroad equipment do not operate substantially under engine-protection regimes involving compromised control of emissions. We are making the less stringent CO standard for engine-protection strategies available subject to our approval. To be able to certify to the less stringent CO standard, manufacturers would need to detail any engine-protection strategies employed on their engines in their application for certification and describe what steps they will take to ensure that this kind of operation will be rare for equipment using their engines. For example, if engine enrichment starts with loads over 80 percent, manufacturers could show that certain applications rarely operate that way (such as forklifts or welders, as represented by the transient duty cycle). Manufacturers may in other cases need to adopt a policy of sizing engines appropriately for a specific application. For example, for a given engine installed in an irrigation pump, the engine may be rated up to a certain pumping capacity, above which the equipment manufacturer would need to install a bigger engine that is unlikely to operate above the loads at which engine-protection strategies would occur.

The comment from Zenith highlights the concern for engines using protection strategies. The California certification data is based almost exclusively on emission measurements with the ISO C2 duty cycle, which has a very low weighting of high-load operation. The emphasis on accommodating higher CO emissions from the ISO D2 duty cycle comes from the fact that this cycle has a substantially greater weighting of high-load operation. For engines not needing separate treatment for engine protection, we are applying the same standards for all duty-cycle testing, using both steady-state and transient duty cycles. As described in the summary of our proposed emission standards, we continue to believe the emission standards that apply to all steady-state testing should be the same as those that apply to transient testing.

We understand NPGA's concern that the less-stringent CO standard for engine protection accommodates a technology limitation that applies specifically to gasoline engines. This is similar to the comments from state and environmental groups discouraging us from pursuing alternate standards that would allow higher CO emissions. We believe the standards we are adopting address the technical limitations of these engines without compromising the effectiveness of emission controls in the field. As noted above, we have restricted this option to steady-state testing, based on the specific duty-cycles prescribed in this rulemaking. Engines utilizing protection strategies must meet the same standard for transient duty-cycle testing as all other engines. To the extent that the transient duty cycle reflects the in-use operating characteristics of Large SI engines, engines certified to low emissions using this cycle will achieve good control of emissions in the field. Similarly, the same field-testing standards apply to all engines, which adds further assurance that engines approved to meet the less stringent CO standard for steady-state testing will in fact have in-use emission levels consistent with those from other engines. If an engine in its nonroad installation had normal operation that included extended time with rich air-fuel ratios, it would likely fail to meet the field-testing standards. Finally, the measures we are adopting to reduce the likelihood of sustained operation under engine-protection conditions should help to ensure that this rarely occurs.

As described above, we agree that we should not base our program on the assumption that gasoline engines will be used only outdoors. We do not agree, however, that allowing the marketplace to differentiate between low-HC+NOx and low-CO engines (within the bounds of standards in Table 1 and the engine-protection option) undermines the validity of the standards, given the tradeoff between HC+NOx and CO emissions. Some customers clearly prefer, and in many cases depend on, gasoline engines for their applications. For example, some operators have invested in gasoline fueling facilities for common fueling of cars and nonroad equipment; other equipment may operate at different locations requiring access to automotive stations selling gasoline. We believe it is not appropriate to set standards that eliminate gasoline engines as a viable alternative for industrial applications where they can achieve the same degree of in-use emission control as other engine types. As noted above, the restrictions associated with the alternate standards for engine protection should prevent any substantial increase of in-use emissions.

Individual Exposure

As shown in Chapter 6 of the Final Regulatory Support Document, EPA emission standards will dramatically reduce individual exposure to engine exhaust emissions from new Large SI engines. However, EPA standards do not ensure that any particular facility will have only low-emitting engines operating in enclosed areas; nor do they ensure that facilities using such engines will have pollutant concentrations below the levels required by OSHA. Facility operators will clearly continue to bear significant responsibility to monitor the degree of engine operation and implement ventilation strategies sufficient to ensure compliance with OSHA requirements. Also, OSHA regulations will clearly continue to be necessary to ensure that workplace personnel are protected from exposure to harmful levels of pollutants from engine exhaust. The comments from ITA and Briggs & Stratton emphasize this point. It was not our intent to preempt or interfere with OSHA's legitimate role of enforcing its occupational standards, which we state clearly in the preamble to the final rule.

The emission standards for Large SI engines address the fundamental need for states to attain and maintain the National Ambient Air Quality Standards. We are therefore adopting the 2004 and 2007 standards requiring emission reductions reflecting the greatest degree of emission control achievable for HC, NOx, and CO, considering costs and other factors, as directed by the Clean Air Act. The emphasis on reducing individual exposures to engine exhaust emissions is an additional element of our thinking in shaping the requirements for Large SI emissions. This is consistent with Clean Air Act section 213(a)(4), which directs us to reduce any emissions that pose a threat to human health. The consideration of individual exposure did not affect the level of stringency of the emission standards, but rather has a bearing on balancing the tradeoff of controlling relative levels of different pollutants. We therefore disagree with Briggs & Stratton's assertion that we should not address individual exposure and further disagree with the assertion that the 2007 standards are not justified.

Briggs & Stratton implies that the "postulated scenario" is unreasonable or unrepresentative, but offers no suggestion for a more appropriate consideration of whether people may be harmed by engine emissions. As described above, we believe it is appropriate and consistent with the Clean Air Act to set national mobile-source standards to reduce emissions that will clearly save lives, reduce hospital admissions, and generally protect many workers and others in close contact with these engines from potentially harmful exhaust concentrations. Whether the cost of adding the emission controls justifies applying the technology requires some judgment, but in this case, the magnitude of the reductions and the associated benefits clearly support a decision to impose the associated costs. The standards significantly reduce emissions associated with ozone and CO nonattainment and personal exposure. In addition, other health and welfare concerns and the cost savings associated with the control technology are large (estimated to be more than six times the initial cost increase). We further believe it is both feasible and efficient to address these health and welfare concerns through mandatory standards that apply to all engines. With expected emission reductions of about 90 percent achievable with the anticipated technologies, we believe that the emission controls will protect individuals, including but not limited to workers, in a very wide range of usage scenarios, including outdoor use. Relying on workplace controls exclusive of applying engine control technologies would remove an essential tool for facility managers attempting to meet occupational standards and would be of no benefit for exposures outside of the workplace.

ITA's objections to associating emission levels with an unsafe environment is similarly misplaced. While it is true that facility managers can limit engine operation, increase ventilation rates, maintain continuous measurements of pollutant concentrations, and take other steps to stay within occupational exposure standards, it is pointless to imply that reducing emissions by 90 percent will not provide an important tool for facility managers. Indeed, emission measurements from a variety of uncontrolled forklifts shows that CO emission rates can reach levels as high as 1 percent (10,000 ppm) or even 9 percent (90,000 ppm) of engine exhaust gases.[21] Exhaust with 90,000 ppm CO could certainly cause sustained exposures above OSHA's permissible exposure limit of 50 ppm.

Both Briggs & Stratton and ITA misinterpreted our scenario for calculating ambient concentrations from various engine emission levels. The analysis expressly avoided drawing specific conclusions about the absolute ambient concentrations of individual pollutants; rather, the analysis was merely an attempt to compare the relative exposures to the three primary engine exhaust constituents posing a risk to exposed individuals. The analysis compared the relative ambient concentrations of NO, NO_2, and CO under a range of emission standards reflecting the NOx-CO tradeoff, as described above. By evaluating relative emission levels, our conclusions depended very little on the specific assumptions related to engine power, operating hours, facility layout, or ventilation rates. Because the analysis evaluates relative health risks, it is appropriate to rely on the threshold limit values from ACGIH as the basis for comparison.

Reviewing an OSHA report summarizing ten years of CO violations related to industrial trucks shows, however, that our analysis was strikingly analogous to multiple occurrences of CO poisoning, as shown in Table 3.[22] These anecdotal experiences reinforce the validity of the analysis, even on an absolute basis, while the additional 163 documented violations underscore the need to address the issue more broadly.

[21]"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 II-A-36).

[22]"OSHA Report of CO Violations from Industrial Trucks," EPA memo from Alan Stout to Docket A-2000-01, February 8, 2002 (Docket A-2000-01; document IV-A-11).

Table 3
Selected Scenarios of Occupational Exposures to Engine Exhaust Emissions

Scenario	Room dimensions (ft.)	Total volume (ft^3)	Ventilation	Outcome
EPA analysis	40 × 60 × 20	48,000	natural ventilation only	—
Virginia, May 1994	50 × 60 × 18	54,000	natural ventilation only	one dead
Nebraska, November 1995	25 × 100 × 18	45,000	natural ventilation only	six hospitalized

The OSHA report of CO violations related to industrial trucks allows us to fairly estimate the benefits of reducing exposure levels. The 2004 standards, by focusing on HC+NOx emissions and relying on steady-state engine testing, require little reduction in CO emissions.[23] The 2007 standards more evenly balance reductions in CO, HC, and NOx emissions and have additional provisions to ensure that in-use engines will continue to control emissions, including transient testing, field-testing standards, and engine diagnostics. We believe this collection of requirements will help reduce ongoing CO violations reported by OSHA. This means that introducing compliant engines across the country will aid in preventing on average up to 17 OSHA CO violations and two or three cases of hospitalization or death every year in the U.S. in addition to reducing CO concentrations in nonattainment areas. As described above, however, OSHA oversight is necessary to ensure compliance with occupational standards. Even aside from these projected health benefits, there is a substantial economic benefit of applying emission controls that help facility operators comply with occupational standards. To the extent that engines operate at reduced emission levels, facility managers can scale back ventilation rates for dramatic savings on winter heating and also reduce costs for cleaning up residue from engine exhaust products.[24]

Other Issues

Compared with other hydrocarbon species, methane has a very low reactivity, which argues against us considering it to be an ozone precursor. Similarly, methane's low reactivity prevents it from posing the same exposure risk as that from toxic compounds such as benzene and 1,3-butadiene. We therefore generally do not set technology-forcing standards based on methane emission levels.

We generally agree with ITA's reservations regarding engine labels restricting the use of indoor and outdoor equipment. While low-CO engines are clearly most protective of exposed individuals, as described above, we believe engines operating at the high-CO end of the spectrum of standards could be

[23]This is demonstrated by a manufacturer's advertisement of low-emission California-certified engines, which includes a warning that the the engine should be used only in well ventilated areas (Docket A-2000-01, document IV-A-38).

[24]"Clearing the Air at Nippon Cargo," Modern Materials Handling, April 2001, p. 93 (Docket A-2000-01; document IV-A-39). This article documents the cost- and labor-saving benefits for a facility where 21 forklifts were converted to low-emitting natural gas engines.

safely operated indoors in many situations, pursuant to OSHA regulations.

4. Field testing standards and procedures

What Commenters Said:

Clean Air Technologies, Inc. states that they have developed a portable device capable of meeting the demand for field testing in the proposed rulemaking. They believe their equipment can meet the various constraints of trade-offs with testing accuracy and repeatability as well as cost considerations. They believe that much of the knowledge amassed from highway testing can be readily applied to nonroad vehicles and recommend that the hardware and testing strategies currently in place for highway applications be considered in this rulemaking.
Support field-testing concept, but presumed deterioration factor is too high, especially with anticipated low-sulfur gasoline and current low-sulfur LPG. (MECA 3)
Support field testing standards (STAPPA 3,4)
Proposed margin in field-testing standard to address variability seems excessive (but no data to support alternate conclusion). (CARB 9)
Field-testing standards not appropriate: -catalyst temp and exhaust flow cause varying emission levels (need to severely limit operation) -can't certify to infinite conditions -uncertain testing protocol -makes standards more stringent -field-testing equipment not accurate enough -do highway engines first -ability of field-testing equipment to accurately measure emissions sufficiently to determine in-use compliance has not been established (Ford 4)
Field-testing is problematic: -Equipment and procedures not established. -Full-range compliance over full range of power and ambient conditions is too risky. (Cat 6)
It is impossible to do enough testing to show compliance at all possible ambient and operating conditions. Engine can only be <u>designed</u> for compliance at all conditions. Require compliance at conditions specified on the engine's emission label. Consider limits (such as maximum altitude) that the manufacturer may specify to customers. (Cat 7)
Supports basic field-testing concept, but it seems hard to ensure compliance under uncertain and broad operation and conditions; torque uncertain and NOx sensors sensitive to drift and contaminants (e.g., ammonia). Need technology review. (Nissan 7)
ITA noted EPA's statement that transient emissions will be higher than steady-state emissions. The paucity of test data reduces confidence that this has been adequately accounted for in setting the standards. This also applies to off-cycle control. (ITA 9)
Field testing has *potential* cost and convenience advantages. EPA justifies higher field-testing standard by pointing out uncertainties. It's not clear that there is sufficient data to support standards for such a new approach. No test equipment available yet. EPA leaves it to manufacturers to figure out torque broadcasting. If procedures are premature, then standards are premature too. (ITA 10-11)

Recommend adopting "safe-harbor" procedure to add some degree of certainty without sacrificing EPA's interest in having reasonably realistic in-use testing. EPA and manufacturer could negotiate consensual alternate testing. ITA ready to propose forklift cycle (the dominant application, though not the only one).(ITA 34)
Stringency and comprehensiveness of transient test adds considerable assurance that engines control emissions under a wide range of conditions. (ITA34)
Allow lab test to supersede noncomplying field test. (ITA 35)
Manufacturer should not be prevented from generating in-use credits because EPA assigned duty cycles other than the transient test for certification. (ITA 36)
Mechanically controlled engines can't broadcast torque. (Cat 7)
Torque broadcasting depends on fuel-system supplier's cooperation. (Wisconsin 14)

Our Response:

Stringency-Related Issues

The field-testing standards have been adjusted to account for measurement variability and the effects of varying engine operation and ambient conditions. Deterioration of emission control is factored into the duty-cycle standards, so no additional margin for deterioration is taken into account in establishing the field-testing standard. The selected values are based on specified tolerances for test equipment in the regulations and on data showing how emissions vary under different operating conditions.[25] We therefore believe the proposed standards represent an appropriate allowance for higher levels of emissions than specified in the duty-cycle standards. Over time, the industry may be able to improve measurement techniques for field-testing, which would serve to increase the manufacturer's available compliance margin when applying technology to meet the whole set of emission standards that apply.

Manufacturers' concerns about the appropriateness or feasibility of the proposed field-testing procedures and standards is generally addressed by the test data on which we based the proposed requirements, as summarized in Chapter 4 of the Final Regulatory Support Document. The test engines had a normal degree of catalyst-temperature and exhaust-flow effects. Measurements from engines after optimizing the calibrations showed how much emissions vary due to such changing engine parameters, including the whole range of normal engine operation observed from instrumented equipment. We agree that compliance with field-testing standards will require design engineers to better understand their engines' emission behavior over a wide range of possible engine operation. Nevertheless, our testing with a pair of aged engines equipped with the expected emission-control technologies provides insight into the technological and procedural approaches we would expect manufacturers to take to comply with field-testing standards. The test engines were optimized for broad control of emissions, with only a few remaining areas where further control was necessary.

Though the standards cover a theoretically infinite degree of variability, we have shown that testing a wide range of steady-state points and several transient duty cycles can demonstrate a consistent and predictable level of control for any additional operation. We do not believe manufacturers will need to

[25]See §1065.910.

test an “infinite” or inappropriately large number of steady state and transient combinations. Engine manufacturers will be required to map their engine’s emission performance across the range of their engines’ operation. However, manufacturers will be able to quickly narrow their test programs to focus in on those areas of operation where the emissions are higher and come closer exceeding the field-testing standard. Engineering experience and logic dictates that manufacturers will not expend resources testing areas where emissions are well below the standard. The same is true with respect to ambient conditions. The effects of temperature on emissions are fairly well known, so manufacturers may limit their testing to the ambient conditions that cause the highest emissions. Alternatively, manufacturers may choose to avoid testing under conditions representing the endpoints of the established ranges by testing under “mid-range” conditions and relying on established extrapolation methods to ensure that their engines will meet emission standards when tested throughout the range of specified test conditions. If the manufacturer shows that engines meet emission standards under the most challenging conditions, then engines will clearly meet the standards under less challenging conditions.

Similarly, we expect the manufacturers’ statements at certification that they meet the field-testing standards to be based on reasonable evidence of compliance, including the engine mapping discussed above, engineering analysis and good engineering judgment. We do not expect manufacturers to have tested every possible combination of points to be able make their certifying statement.

In addition, we did put limits on the range of engine and ambient conditions that are subject to the field-testing provisions. For example, during emission tests ambient air temperature must be between 13 and 35˚ C and barometric pressure must be between 600 and 775 mm Hg.

By limiting the field-testing standards to normal operation, we allow manufacturers to base engine designs on any limitations they place on in-use operation. For example, if a manufacturer includes in the emission-related installation instructions a warning that the engine must not be installed in a pump greater than some specific pumping rate, and takes steps to enforce that restriction, we would not consider such engine operation to be “normal operation” under the field-testing requirements. In some cases, manufacturers may also program their engines with a governor or other device to prevent engines from operating at certain speeds or loads.

To the extent that manufacturers would otherwise design their emission-control systems to function effectively only over the narrow range of engine operation and ambient conditions represented by the certification duty cycle, we agree that the field-testing standards would increase the overall stringency of the regulation. (However, the prohibition against defeat devices would not allow manufacturers to use emission-control techniques outside of test conditions, so the increase in overall stringency is questionable.) Any such increase in stringency will correspond directly with a more effective control of emissions from in-use engines as they undergo normal operation in nonroad applications. On the other hand, we believe manufacturers have available emission-control hardware (and software) that allows for more robust control over a wide range of operation and conditions. With some additional engineering time, manufacturers can ensure that engines operate properly over the whole range of normal operation.

Clean Air Technologies provided comments stating that they already have equipment available to measure emission using the proposed field-testing procedures. Moreover, as described above, we have established the field-testing standards to take into account measurement tolerances and the variation in emissions due to varying engine operation and ambient conditions. As a result, valid emission tests are possible only if all the equipment is accurate enough to meet the specified tolerances. In the early years of this program, manufacturers are more likely to devote most of their effort to meeting the field-testing standards as they learn better how their engines behave under different types of operation. However, as they gain experience in designing robust emission-control systems and in measuring emissions from engines in the field, we would expect manufacturers to focus on meeting the duty-cycle standards, knowing that emission variability has been controlled enough that the field-testing standards no longer pose a significant additional constraint in their efforts to comply with standards. Given the comment from Clean Air Technologies and the very active interest in this type of equipment in the rest of the industry, we believe that measurement equipment will be widely available well ahead of the time that the field-testing standards apply in 2007. We also believe that the engine technology to meet the field-testing standards is sufficiently known that a technology review is not necessary. However, we would entertain such requests if new information provided ample basis for a review.

We are pursuing a similar program to set field-testing standards for highway engines. The proposed field-testing requirements take into account the unique aspects of operation and technology for nonroad spark-ignition engines. We believe the information available is ample to support our conclusions in finalizing field-testing procedures and standards for Large SI engines.

As noted above, our reference to increasing emissions with transient operation refers to the state of technology before recalibrating or upgrading to address these concerns. Manufacturers can take steps to control emissions during transient operation to reduce or eliminate an engine's tendency to have higher emission levels from transient operation than from the corresponding operation measured in steady-state modes. The test engines demonstrated the capability of controlling emissions under a wide range of operation, without revealing any inherent constraints that would compromise the ability of Large SI engines to control emissions under specific conditions. ITA also does not suggest that there is any such constraint, but rather would prefer only to see additional data to support the conclusion. We believe that the data on multiple test engines sufficiently corroborate the showing that the field-testing standards are achievable. In particular, any uncertainty remaining after observing the data from the test engines has been taken into account in setting the standard. Additional testing would more likely reduce this uncertainty than raise new questions; this could then lead us to justify field-testing standards that are more stringent, not less.

It is not clear why ITA qualifies the field-testing cost and convenience advantages as "potential." We believe manufacturers will clearly do well to rely on these procedures to meet emission-testing requirements at a substantially lower cost than would be involved with laboratory testing. ITA's reference to the unavailability of equipment is also surprising, since they declined an opportunity to do a demonstration project with the company that has developed equipment specifically for this purpose, preferring to continue their own work on a method for testing and technology for continued compliance.[26] This also contrasts with the comment from Clean Air Technologies citing the current availability of the necessary measurement equipment. Manufacturers can broadcast engine parameters to the engine's electronic control unit for calculation of instantaneous torque values. This requires some additional development time, but can be done by programming look-up tables and engine model-specific information into the electronic control unit (see further discussion below). The tolerances on the torque calculation allow for a relatively approximate determination of torque values, with this degree of uncertainty taken into account in setting the emission standards. Recent developments have shown that new techniques may be available to achieve much more accurate measurement and calculation to generate instantaneous torque values.

[26]E-mail message from Dave Miller, Clean Air Technologies to Alan Stout, EPA, December 21, 2001 (Docket A-2000-01; document IV-D-156).

We recognize the merit of a specified equipment-based procedure to provide a benchmark for evaluating emission levels measured from engines that remain installed in the equipment. Especially in the context of the manufacturer in-use testing program, such a procedure may help establish a minimum level of operation for showing that engines meet emission standards. An objective of the field-testing standards is to ensure that engines control emissions under all types of normal operation. We therefore disagree that manufacturers should be able to avoid any type of normal engine operation by relying instead on the safe-harbor procedure. As described above, we have taken the variability of different types of engine operation into account in setting the field-testing standards. In addition, as noted by ITA, any such safe-harbor procedure would necessarily apply only to a single type of equipment. Finally, as described in the next paragraph, no single duty cycle (either engine-based or chassis-based), can adequately represent the whole range of in-use operation these engines will experience in the field.

The transient test requirements clearly provide substantial assurance that engines will be controlling emissions under the kinds of operation seen when installed in the various types of nonroad equipment. We believe the field-testing standards are an appropriate supplement to the duty-cycle standards for two reasons. First, no duty cycle, even one with transient engine operation, and even one performed using field-testing procedures can capture the whole range of "normal operation" from the dozens of different types of nonroad equipment. This may be especially important, since some of these engines will be operating in enclosed areas where high emission levels pose a concern for individual exposures in addition to the more general issue of CO and ozone formation in urban areas. The transient duty cycle includes many different combinations of speeds, load, accelerations, and decelerations, but it cannot include or substantially weight the whole range of operation that engines from an engine family may experience. This is underscored by emission data generated to support the proposed emission standards. A continuous trace of the emission data for one of the engines showed exceptionally high emission levels when it was operating under the segment of the duty cycle representing the typical operation of the instrumented forklift with relatively light-load operation.[27] This engine had sufficiently low emissions when measured over the whole composite duty cycle, but if that engine were to operate for extended periods with that kind of light-load operation, actual emission levels would be much higher than expected.

Second, without the field-testing procedures (and standards), manufacturers would be able to meet in-use testing requirements only by removing engines and testing them in the laboratory. ITA's hesitation notwithstanding, we believe the field-testing procedures will provide substantial savings to manufacturers, in addition to the assurance that their engines are designed to function well under all types of engine operation.

<u>Administrative Issues</u>

We agree that mechanically controlled engines are limited in their ability to broadcast torque. For these engines, it may not be possible to measure emissions from engines that remain installed in the equipment. For this reason, we proposed that the torque-broadcasting requirement apply only to electronically controlled engines. Mechanically controlled engines must therefore be tested in the laboratory under the in-use testing program, unless subsequent methods of broadcasting torque become available. Measuring emissions in the laboratory does not, however, take away the manufacturer's responsibility to meet field-testing emission standards. We or the manufacturer could test such engines

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[27] "Observed Variation in Transient Emissions," EPA memorandum from Alan Stout to Docket A-2000-01, September 9, 2002 (Docket A-2000-01; document IV-B-41).

in the laboratory to determine whether they meet field-testing standards by specifying a dynamometer-based schedule of operation to represent in-use operation for the equipment powered by the engines in question.

For electronically controlled engines, torque broadcasting only depends on component suppliers to the extent that engine manufacturer's do not have in-house engineering expertise to program engine controllers. This is not an inherent limitation on any company's ability to design for torque broadcasting, so we do not believe any additional accommodation is necessary for this concern. However, we are waiving the torque- and speed-broadcasting requirement for small businesses, since they may have difficulty getting cooperation from component suppliers. We would nevertheless expect small businesses to incorporate broadcasting whenever possible to preserve the potential to do field testing instead of laboratory testing of in-use engines.

Once manufacturers have an approved plan for testing engines under the in-use testing program, we would expect that plan to dictate the testing until the manufacturer reaches a pass or fail conclusion. If field testing shows that an engine family may be noncompliant, manufacturers may remove engines for testing in the laboratory. This additional testing would not change the fact that the engine family has emissions above the standard, but may help to identify the cause or extent of the excess emissions. We could use this information in deciding whether remedial action is appropriate.

If manufacturers choose to use laboratory testing to meet the requirements of the in-use testing program, they must operate the engines over the duty cycles used for certification. We may specify additional testing to show that engines would meet the field-testing standards under different operation.

5. Averaging, Banking, and Trading (ABT)

What Commenters Said:

Opposes ABT program if it makes the standards more stringent than without an ABT program, since it would force everyone to use ABT. Tracking sales separately for California, for other states that adopt California standards, or for export would be difficult or impossible. This is especially true for loose-engine sales where the equipment manufacturer makes the final delivery to the ultimate purchaser. (Ford supplement)
Not opposed to ABT, but do not do it before 2007 to avoid high-FEL engines going to California. Adding ABT would necessitate a more stringent standard. (CARB 8)
Uncertainty surrounding 2007 standards— deterioration, testing changes, new duty cycles, fuel quality, limited data—prevent conclusion that ABT is not needed or that adding ABT should be done with 20% tighter standards. It is unclear why EPA believes it is appropriate to start withholding ABT if most engines can meet standards. Recommend adding ABT without changing standards (adding ABT is worth it even with tighter standards). (ITA 23)
Nissan supported the idea of ABT for its flexibility, especially with several established emission categories instead of the manufacturers determining their own family emission limits. (Nissan 5)
Include ABT to encourage early introduction of new technology and gain environmental benefit. Besides, it's in all the other programs. Do not use discounts or limit credit life. (Cat 7)
Cap FEL sufficiently to address indoor exposure concerns. (Bluewater 8)

Adopt optional ABT to allow very small engine families to remain uncontrolled; start ABT with 2004 standards. (Nissan 2)

Our Response:

The issues raised by ITA are all general in nature and do not relate to any emission-control issues that might be engine family-specific. With a couple of narrow exceptions, anticipated emission-control technologies can be applied nearly uniformly across the range of Large SI engines. Engines generally need to have an electronically controlled closed-loop fuel system to control air-fuel ratios so the catalyst can do its work to reduce emissions. These systems generally allow for a level of fine-tuning (through more careful control of air-fuel ratio or increased catalyst volume), so design engineers should never be in a situation of being unable to certify an engine family without using emission credits from another engine family. The available emission data show that it is feasible for all engine families to meet the standards. In fact, if some Large SI engines can meet more stringent emission standards to generate emission credits, we question why all Large SI engines could not meet those same emission standards. Also, as ITA noted on page 4 of their comments, there is already enough complexity in the certification process that one should pause before wanting to add accounting steps to balance emission levels for different engine families and track state-specific sales. Given the California ARB standards, we are already requiring manufacturers to add emission-control technologies with very short lead time, so it's not clear that manufacturers could use emission credits to achieve earlier emission reductions. We believe the family-banking provisions described in Section III.B.1.b address Nissan's concern regarding small engine families.

Most of Caterpillar's engine models are different than other Large SI engines by relying on lean air-fuel ratios instead of stoichiometric combustion with a catalyst. Nevertheless, as described in Section III.B.7, they are already producing stationary engines for Texas that meet the final emission standards in this rulemaking. It is therefore unclear that this situation justifies additional provisions for an emission-credit program.

We believe the flexible approach to adopting HC+NOx and CO standards more closely reflects the technology characteristics of these engines. The flexible standards nevertheless have some characteristics that overlap with a more traditional emission-credit program. The flexible standards incorporate a tradeoff between emission constituents for a given engine family, while an emission-credit program allows for a tradeoff between engine families for a given emission constituent. The flexible standards in effect allow the manufacturer to select a set of family emission limits for the engine family.

Normally, EPA establishes emission averaging, banking, and trading (ABT) programs as part of the certification program for new emission standards. These are intended to provide opportunities for manufacturers to optimize technology mixes and minimize costs while still providing customers the products they desire and delivering the prescribed emission reductions. These programs also are environmentally beneficial because they tend to create the incentive to develop and implement lower emission technology and allow standards to be set at lower levels and introduced earlier than might otherwise be possible.

The situation for Large SI engines is unique relative to other engines categories and there are several circumstances which lead us to conclude that the benefits attendant to a traditional ABT program are better provided through the sliding scale approach to the standards we are implementing here. First, the Large SI category is not homogeneous. Unlike essentially every other category for which we have allowed ABT, it includes both variable- speed and constant-speed engines which certify using different test cycles, C2 and D2, respectively. Allowing credit exchanges between engines certified on these two different duty cycles is practically and environmentally problematic since emissions generated over different cycles are not readily exchangable. Second, the Large SI engine category has many engines which use different fuels (gasoline and gaseous fuels such as LPG are both very common). Gasoline-powered engines tend to be used more in outdoor equipment such as airport tugs while gaseous fuels are used in equipment more often used in confined areas, such as forklifts, where lower CO emissions are valuable from an occupational health perspective. A credit exchange program could create a situation where CO emissions for a particular equipment/engine application used in a more confined area are higher than necessary because credits were used, and thus could undermine the emissions purpose of using the gaseous fuels. Very tight FEL caps might be needed to address this concern. Third, Large SI usage patterns are substantially more heterogeneous than many other mobile source sectors. There are definite load, temporal and spatial use issues which raise potential questions about environmental neutrality if credit exchanges are allowed. For example, some large SI industrial engines operate almost continuously under moderate load while others are used infrequently or under relatively light load conditions. Some are dominantly rural, such as agricultural irrigation pumps, while some are dominantly urban, such as airport tugs. While the effects could go either way, these disparate characteristics make it difficult to allow credit exchange programs such as ABT without creating the possibility for unknown or unintended environmental impacts. Addressing these concerns could well require discounts or other restrictions that would make ABT unattractive.

EPA staff believes that the major benefits of an ABT-like program can be accomplished through the sliding scale standards approach without the potential problems listed above. Under this approach, manufacturers select each engine family's standards from a sliding scale where selection of one value (e.g, for CO) then the provides a corresponding HC+NOx value. This has two distinct benefits. First, it allows the optimization of emission levels focused on where the engine will be used. For example, engines that tend to be used more in confined areas can be lower in CO and somewhat higher in HC+NOx while the converse can be true for engines that are more likely to be used in more wide open spaces. This is especially valuable in this category because the basic emission control costs for all engines will be very similar, and the flexibility and value of these emission level trade-offs can be gained for very little or no cost. Based on past experience, the traditional FEL caps of other programs would limit this flexibility relative the program we are finalizing. This also has the attendant benefit of providing the manufacturer the inherent flexibility of taking advantage of NOx/CO trade-offs which occur in Large SI engines without having to drive both emission levels below set standards.

We believe the flexible approach to adopting HC+NOx and CO standards more closely reflects the technology characteristics of these engines. Moreover, the flexible approach to adopting the standards makes any emission-credit program for certification much less workable. With a sliding scale, calculating positive or negative emission credits for any particular engine family would generally require a bivariate calculation reflecting the relative values of each pollutant. If such a calculation were possible, any associated benefits would substantially overlap with the benefits already realized by adopting the flexible standards.

6.   Severe-duty Engines

What Commenters Said:

Do not provide any breaks for air-cooled engines. (Ford ANPRM)

Testing shows that concrete-saw engines can meet the proposed emission standards. Water-cooled engines can meet standards taking engine protection into account (described above), even for severe-duty applications. The separate standards under consideration for severe-duty engines should therefore be removed. (Zenith 2, May 14, 2002)
Air-cooled engines have several advantages over water-cooled engines in concrete saw applications. Omitting the cooling system and using a “V” configuration allows for a compact engine design, which is important for ease of operation, visibility, and size constraints (doorways, etc.). Lighter weight, better power density, and lower cost are possible without the cooling system. Radiators on water-cooled engines cause maintenance problems or are ineffective for concrete saws because the concrete dust hardens on the cooling fins. Air-cooled engines are not converted from automotive, so they are less likely to change in ways that are problematic for nonroad applications. (Soffcut)
Wisconsin purchased the assets of Wis-Con Total Power, which was taken over and eventually liquidated by its lender in March 2001. Wisconsin makes engines for severe-duty applications, which is a very small market niche unserved by any other manufacturer. These engines need to be simple, robust, compact, and heavy. The operating environment in severe-duty applications is so severe that radiators clog, making water-cooled engines inoperable. Air-cooled engines rely more on over fueling for cooling, so they will be less susceptible to problems related to high ambient levels of dust and fine particulate. The operating characteristics in these applications calls for simple engines that are easy to use and maintain. Air-cooled engines are also heavier, which serves concrete saws well, improving the handling and performance of the machine. (Wisconsin 1-2)
Application-specific standards would be appropriate, but some applications are so severe, operated by such low socioeconomic types, with such a difficult need to develop compliant product, and such low sales that we should just exempt them. (Wisconsin 8-9)
Severe-duty conditions may affect catalysts and sensitive electronics for controlling emissions. Engines will get low maintenance (low price, short life, remote use, non-technical users). The emission contribution of these engines is very small. Therefore adopt less stringent standards. (AEM 2)
Many concrete saws are under 25 hp. Mid-range saws are only 30-35 hp with little or no design difference, so adopting Large SI technologies is a big step change. Air-cooled engines have no highway counterpart (and no business relationship with automotive companies). Applying Small SI standards is most appropriate for all concrete saw engines (liquid-cooled too). (AEM 3)
Allow more lead time for 2004 standards. (AEM 5)
Raising the 1-liter/30-kW threshold to 2.9L/49.5 kW would cover all the air-cooled models, but meeting Small SI standards in 2004 would also not be easy. (Wisconsin 6)
One option is to expand the lawn&garden exemption up to 1500 cc (like the temporary relief for small-volume manufacturers, which goes up to 2.5 L). This could be limited to “severe-duty” or small-volume. (AEM 3)
No data show that catalyst technology is robust enough for severe-duty. (Wisconsin 6)
Air-cooled engines are not automotive-derivative, so port fuel injection is cost-prohibitive. Need rich operation at high load for engine cooling; old data shows that 6.5 g HC+NOx and 37 g CO (on C2 test) is achievable. (Wisconsin 4)

Applying the same standards to air-cooled engines as the larger, more sophisticated, more expensive, and more prevalent applications imposes disproportionate costs (price and performance). (AEM 4)
Fixed costs are especially problematic for low-volume air-cooled engines (5000 to 6000 annual sales), which are generally not subject to California ARB standards under the Clean Air Act. Shorter lifetime limits the benefit of fuel savings. (AEM 4)
Electronic fuel systems for governed engines are not available yet; need a sophisticated system. (Wisconsin 6)
Allowable maintenance should be relaxed for severe-duty (case-by-case). (Wisconsin 11)
Need longer warm-up period for LPG engines due to freezing at the vaporizer. (Wisconsin 7) Ambient temperatures are a big factor, but warm-up can take in excess of 15 minutes at 0 degrees. (Wisconsin 1; April 23, 2002)
Applications rarely operate at intermediate speed, so G2 cycle would be better. (Wisconsin 13)

Our Response:

Emission standards

We agree with Ford that it would be inappropriate to set different emission standards engines depending on whether they are air-cooled or water-cooled. This would allow customers in some cases to choose between two different types of competing engines with different emission-control capabilities. This could provide an unfair competitive advantage for high-emitting engines. On the other hand, we are aware that air-cooled engines already predominate, and have been more suitable, in certain applications. In this case, we would risk eliminating from the marketplace a category of engines that has proven to be necessary (or generally more suitable) for these applications by not setting separate standards to take into account the unique capabilities of these engines.

The Clean Air Act directs us to set standards requiring the greatest degree of emission control achievable from nonroad engines, considering a variety of factors. The Act generally does not provide for broad discretion on our part to exempt engines from emission standards for any of the reasons cited by Wisconsin. We believe these engines can clearly adopt emission-control technologies to reduce emissions, so it is not appropriate to provide an outright exemption from emission standards. We would also not expect water-cooled engines to be designed specifically for severe-duty applications and they would not likely be commonly used in applications involving the most challenging operating environments. As a result, we believe water-cooled engines should meet the same emission standards that apply to engines used in any other application.

We believe the best way to address the competing concerns for these engines is to adopt separate standards for severe-duty engine families. Controlling CO emissions presents a bigger challenge for air-cooled engines. This is partly because of their inherent variability—especially the relatively uneven cooling from air-cooled engines that can cause greater variations in cylinder-to-cylinder control of air-fuel ratios. The limited cooling potential also requires more extensive use of rich air-fuel ratios at high-load operation to maintain engine durability. This fuel enrichment is similar to the concerns described in Section III.B.3.b for engine protection, but to a much greater degree because of the need for greater steps to prevent overheating. Both of these factors primarily affect the engines' ability to control CO emissions. The emission data reported by Southwest Research Institute showed steady-state CO emission levels of around 40 g/kW-hr on an engine with a new catalyst.[28] This baseline emission level needs adjustment to take into account the effect on emissions of both transient operation and in-use deterioration. As described in Chapter 6 of the Final Regulatory Support Document, we have estimated that transient CO emissions are 70-percent higher than steady-state emissions. To estimate an appropriate deterioration factor for severe-duty engines, we assign a value of 1.5, which is slightly higher than the CO deterioration factor for automotive-derived Large SI engines. These factors together would lead to predicted emissions of about 100 g/kW-hr for these engines during transient operation at the end of the useful life. Applying a compliance margin of 20 percent leads to a duty-cycle CO emission standard of 130 g/kW-hr. This less stringent duty-cycle CO standard applies to both Tier 1 and Tier 2 engines. We believe the same allowance of 50 percent should apply to these engines for field testing to take into account in-use variability and measurement error, which leads to a field-testing CO standard of 200 g/kW-hr.

As described above, these air-cooled engines rely on enrichment during high-load operation to prevent overheating. As a result, controlling CO emissions poses the biggest challenge. The Southwest Research testing with an air-cooled engine showed achievable HC+NOx emissions levels below 1 g/kW-hr. Even after we apply a transient adjustment factor, a deterioration factor, and a compliance margin, the data supports our expectation that these engines can meet the same Tier 1 and Tier 2 HC+NOx standards that apply to other engines.

The less stringent CO standards are technically appropriate for these engines and pose little harm to the environment or public health. Severe-duty engines account for less than 5 percent of overall sales of Large SI engines, so they contribute a small amount of the total CO emissions from the category that may be contributing to any nonattainment area. Moreover, the nature of severe-duty engines prevents them from being used in enclosed areas. The factors that lead to air-cooling also call for high ventilation rates, for example, to overcome the effects of concrete dust around the work site.

We would understand severe-duty engine families to be those in which the majority of engines are used in severe-duty applications. Severe-duty applications include concrete saws and concrete pumps and any other applications for which the manufacturer shows clearly that air-cooled engines are necessary to survive in a severe-duty environment. For example, if the operating environment for a specific application prevents an engine's radiator from functioning properly, showing that air-cooled engines are needed to perform that particular function. The current use of air-cooled engines in a particular application would strongly support this showing. This arrangement generally prevents these higher-emitting engines from gaining a competitive advantage in markets that do not already use air-cooled engines, without overlooking the need to ensure the viability of air-cooled engines where they are needed. Zenith's comment relies on the fact that there are a minority of water-cooled engines currently operating in severe-duty applications. While this does occur, it is also clear from AEM and Soffcut's comments that they depend on continued production of air-cooled engines for these applications and that water-cooled engines may be unable (and up to this point have been unable) to meet the requirements needed for all types of operation in severe-duty applications. Setting standards that effectively eliminate air-cooled engines from the market would force these and other companies to convert to water-cooled applications, even though air-cooled engines have thus far been the only technologies that have

[28] "Three-Way Catalyst Technology for Off-Road Equipment Powered by Gasoline and LPG Engines," by Jeff White, et al, Southwest Research Institute, prepared for California ARB, California EPA, and South Coast AQMD, (SwRI 8778), April 1999 (Docket A-2000-01; document II-A-8).

consistently met the needs of severe-duty applications.

Because the only current manufacturer of air-cooled severe-duty engines is also a small business, resolving these technical issues overlaps with our separate provisions addressing small-volume concerns. As described in Section II.G.1, we believe the hardship provisions address the concerns of small businesses transitioning to full certification of their product lines to the emission standards. This also addresses concerns related to the lead time associated with applying emission standards on the established schedule. More specifically, we believe it is not necessary to revise the "one-liter" provisions to allow severe-duty engines to meet Small SI emission standards on an interim basis.

The availability of control systems for certifying and producing compliant engines is another temporary issue that we believe is best addressed by our hardship provisions. The technology is available and has been demonstrated to work on these engines. The Southwest Research testing showed that these engines can be fitted with electronically controlled fuel systems and three-way catalytic converters. The severe-duty nature of the operating environment poses a significant challenge for exterior caking and ingestion of abrasive particles. These factors have primary effects on engine durability, with no apparent direct effect on the anticipated emission-control system. An aging severe-duty engine should still have a feedback system that keeps air-fuel ratios near stoichiometry during normal operation and a catalyst that converts engine-out pollutants to harmless emissions. Electronic control units can be protected from the elements with a protective case that is installed to protect it from any problems related to heat, vibration, or ambient particulate levels. Intake air filters should prevent the engine from ingesting any particles that would be big enough to go through the engine and plug the catalyst. As a result, we believe these engines can successfully use these control technologies to meet the standards described above throughout the useful life. The remaining effort is to commercialize the technology for the whole range of engine models. In the long term, engine manufacturers may be in a better position by hiring the expertise for in-house development of the technologies, perhaps in cooperation with a component supplier, rather than relying solely on suppliers to provide a finished product for meeting emission standards.

The remaining question related to emission standards is whether severe-duty engines can meet the long-term standards established based on the emission-control capabilities of water-cooled, automotive-derived engines. Available test data show that closed-loop technology with a three-way catalyst allows these engines to operate safely within the 2.7 g/kW-hr HC+NOx standard for transient and steady-state testing.[29] In addition, the 3.8 g/kW-hr HC+NOx standard for field testing represents a small additional design effort, mainly because severe-duty engines are generally governed to operate at constant speeds (with varying loads). For constant-speed engines there is only a limited degree of variation in engine operation for designing the emission-control system.

The standards we are adopting for severe-duty engines reflect their technological capabilities. This takes into account the design and development costs of complying with emission standards, the variable costs associated with applying emission-control hardware, and any affects on how these engines perform (see Chapter 5 of the Final Regulatory Support Document for detailed cost estimates). The calculated fuel savings from applying emission-control technologies exceeds the estimated cost of applying control

[29]"Three-Way Catalyst Technology for Off-Road Equipment Powered by Gasoline and LPG Engines," by Jeff White, et al, Southwest Research Institute, prepared for California ARB, California EPA, and South Coast AQMD, (SwRI 8778), April 1999 (Docket A-2000-01; docment II-A-8).

technologies and is comparable to that estimated for water-cooled engines; the shorter lifetime for air-cooled engines is generally offset by a higher estimated annual usage and a higher baseline fuel-consumption rate.

Other Issues

The allowable maintenance provisions limit the amount of maintenance that manufacturers may schedule for their engines. More frequent maintenance may be necessary if the engine needs repair or if the diagnostic system alerts the operator to a malfunction. As described in Section III.B.6, severe-duty engines may qualify for a shorter useful life. In this case, we would also change the allowable maintenance specifications to permit scheduled maintenance items at least at the end of the useful life.

We agree that air-cooled engines face an additional constraint related to warming up the engine. This is especially true for LPG-fueled models, which lack the ability to use engine coolant to regulate vaporizer temperatures. As a result, vaporizer freezing and irregular fuel flow rates are common after starting engines. Gasoline-fueled models would not be as dramatically affected, but they also would need a longer time than water-cooled engines to achieve stabilized air-fuel ratios and overall emission control. On the other hand, air-cooled engines used in severe-duty applications generally have infrequent cold starts, since the equipment generally runs for a full shift with little downtime during a workday. We are therefore specifying that the warm-up period before measuring transient emissions is up to 15 minutes for severe-duty engines (compared with three minutes for other engines). During the initial 15-minute period, we would expect manufacturers to take any appropriate steps to reduce emissions. In the application for certification, all manufacturers must describe how they manage the emission-control system during the warm-up period. For severe-duty engines, this must include a consideration of how soon the engine can start operating at stoichiometric air-fuel ratios (this should be considerably less than the full 15 minutes allowed to warm up the engine).

The proposed D2 steady-state duty cycle for constant-speed engines includes five modes of operation at rated speed. The G2 cycle recommended by Wisconsin uses the same modes, with additional operation at idle. Since air-cooled engines maintain engine speeds at idle of 1200 rpm to maintain engine cooling, the G2 cycle would not appropriately represent the way air-cooled engines operate in the field. Most air-cooled engines operate at fixed speeds that can be adjusted by the operator to maintain a proper cutting speed at the blade tip. These adjustable speeds are generally close to rated speed even though they are adjustable. Moreover, the emission data on which we primarily base our conclusions about emission-control capabilities for these engines were collected on the D2 cycle. We therefore believe it is appropriate to specify that steady-state emission measurements with severe-duty engines rely on the D2 cycle.

7. Diesel-derived Natural Gas Engines

What Commenters Said:

Include diesel-derived natural gas engines as Large SI. (Ford 2)
These engines are so different, EPA should have a separate rulemaking (Cat 2)
Proposed standards acceptable, except for 2007 CO standards. Harmonize with California ARB, or set CO std $\geq$ 5 g/kW-hr (7 g/kW-hr for field testing). Proposed alternate standards are acceptable. (Cat 3)

Lean-burn engines with air-fuel ratio control have NOx emission levels of 1 to 2 g/kW-hr. HC (nonmethane, nonethane) typically adds up to 1 g/kW-hr, though this can be 4 to five times higher with in-use fuels. CO emission levels from these engines range from 3 to 5 g/kW-hr. (Cat-II 12-13)
Responding to EPA's memo regarding the flexible approach to emission standards, Caterpillar responded that the NMHC+NOx standard should not go below 3.4 g/kW-hr and the CO level should not go below 5.0 g/kW-hr. Fuel variability prevents such careful control of emissions. It would take a lot of effort and new technology to be sure that engines comply under all conditions with all possible fuels. This would require the use of catalysts and would be difficult to achieve before 2004. (Cat-III 2)
Certification fuel needs to specify "methane number," but there is no industry standard. (Cat 4)
The proposed transient cycle doesn't fit: (1) Natural-gas lean-burn engines spend most of their time at 100 percent load and speed; engines come with a warning not to operate below 50% load for more than two continuous hours to prevent combustion chamber fouling (cycle has average load of ~30%). (2) Turbocharger performance isn't good at low loads (impacting performance and emissions). (3) Engine/application not designed for major load swings, especially for generators and gas compressors. (4) Transient response is limited. (Cat 5, Cat-II 22-24)
Recommend steady-state test that is a variation of ISO D1 cycle: Equal weighting of two modes at rated speed, one mode at 100 percent load and one at 75 percent load. (Cat-II 1)
Limit in-use testing to > 50 % load. (Cat 6)
Do not require transient testing for engine families with less than 500 units or for any engines with rated power below 100 kW. Limit tests to "reasonable" size dilution equipment and current dynos. (Cat 6)

Our Response:

We do not believe it is necessary to undertake a separate rulemaking to appropriately regulate diesel-derived natural gas engines. As shown by the comments on the proposed rule, focusing on any necessary changes to reflect the unique characteristics and capabilities of these engines is possible in this rulemaking. We believe that the final emission standards described above, by allowing a flexible approach to controlling HC+NOx and CO emissions, accommodates Caterpillar's expressed concerns related to the CO standard. In fact, the combination of 2.7 g/kW-hr HC+NOx and 4.4 g/kW-hr CO is slightly less stringent than the emission standards that already apply to engines Caterpillar sells for stationary applications in the state of Texas.[30] These levels are also generally consistent with emission levels discussed by Caterpillar in their supplemental submission of emission data. This may require the use of an oxidation catalyst to ensure adequate control of CO emissions, but only to the extent that is already necessary for engines sold in Texas or other areas with more stringent standards. We are aware of the effects of fuel variability, and therefore specify that compliance testing should be done with fuels meeting certain fuel specifications. Unlike ITA's concerns with LPG, the variability of natural gas fuels directly affects engine-out emissions with no apparent long-term affect from accumulation of deposits or other enduring effects. Finally, we are not applying the Tier 2 standards until 2007, so Caterpillar should need to make few if any changes to their engines before 2004.

[30]"Gas Engines Application and Installation Guide," Caterpillar manual, 1997, p. 12 (Docket A-2000-01; document IV-E-16).

We believe the composite transient cycle is broadly representative of a wide range of Large SI engine operation. However, it is clear from Caterpillar's comments that some may be designed for a specific application in which engine operation is limited to a narrow range that does not significantly overlap with operation included in the certification duty cycle. If some engines in the engine family would be used in applications in which the more general engine operation occurs, no accommodation would be necessary for the unique operation. In that case, we would risk increased emissions only from in-use operation that is not covered by the certification test. On the other hand, where all the engines in an engine family have physical limitations that prevent sustained operation over the certification duty cycle, it would not be appropriate to require emission measurement over that cycle. To address this concern, we are modifying the regulations to say that a different duty cycle applies to an engine family if the manufacturer is able to show that engines in the field rarely operate below 75 percent load. Such engines would need to certify using a steady-state duty cycle consisting of two equally weighted modes at rated speed—one at 100 percent load and one at 75 percent load. These engines would not be subject to transient emission testing, but would need to meet the field-testing standards. Field testing relies on normal operation, so this would include low-load operation only to the extent that it normally occurs in the final installation. This combination of standards is sufficient to ensure adequate in-use emission control without forcing the engines to certify using test procedures that are inconsistent with the manufacturer's design and installation instructions. Limiting this provision to high-load engines also prevents manufacturers from applying the different duty cycle inappropriately.

Except for these high-load engines, we have observed that Large SI engines generally have a high degree of transient operation. The transient testing requirements are an important part of ensuring that in-use engines are able to control emissions. We do not believe that the size of an engine family should limit a manufacturer's ability to test engines or comply with transient-based emission standards. Small businesses with capital constraints may have some particular concerns, but those are best addressed through our hardship provisions. The proposal reflected Caterpillar's concern for transient testing of very large engines with the temporary exemption for transient testing of engines over 560 kW. As stated in the proposal, we intend to revisit this when we consider similar testing requirements for nonroad diesel engines. We believe that the approach described above for high-load engines is the most appropriate way to address the concerns for transient testing.

8. Engines Less than 1 Liter

What Commenters Said:

Support the lawn & garden exemption, since engines with displacement less than 1 liter share design characteristics with Small SI engines and are made by the same companies. Omitting the 30-kW threshold would make it easier to identify the correct standards that would apply to each engine; displacement is a more objective criterion. (Briggs 3)
Strongly support treating engines small than 1 liter as Small SI (air-cooled, no electrical system, three-way catalyst infeasible and/or not cost-effective ...). (EMA 2)
Recommend deleting 30-kW cap. Agree that it's unlikely to get that much power from 1-liter engines, but EPA should not discourage power-density innovations that would improve air quality. (EMA 3)
40 CFR part 90 provisions re. rpm limits and governors prevent engines from exceeding 30 kW. Added complexity of 30-kW cap far outweighs potential benefit. Departure from harmonization with California ARB could cause big burden. (Tecumseh 1)

Our Response:

We continue to believe it is appropriate to apply Small SI emission standards and certification provisions to engines under 1 liter. Engines under 1 liter share many design characteristics with Small SI engines. However, this decision does not prejudge or preclude future rulemaking activity to explore more stringent emission standards, both for non handheld Small SI engines and for Large SI engines under 1 liter. In fact, recent engine technology developments in this category show a new potential for achieving emission levels beyond the Phase 2 Small SI standards. We are concluding in this rulemaking only that the requirements in this final rule for Large SI engines, especially the 2007 standards and test procedures, are not appropriate for engines with less than 1-liter displacement.

Comments addressing the proposed 30-kW cap generally reinforce the concerns we expressed about the possibility of developing small engines with higher power output to compete with engines with more than 1-liter displacement. We do not believe that adding a power threshold would pose unreasonable additional complexity. Rather, as described in the proposal, we believe it is necessary to rely on both power and displacement thresholds to appropriately differentiate engines into categories for applying standards. Manufacturers can easily use the displacement and power criteria together to identify before certification which standards would apply to any given engine model. We are eager to discourage innovations that would lead companies to be able to offer a high-emitting engine that would have an unfair competitive advantage over existing engines of comparable power that are capable of meeting the more stringent Large SI emission standards. It is true that 40 CFR part 90 specifies governor and engine-speed limits, but we are changing those provisions in this rulemaking to adopt separate emission standards for recreational vehicles. It's not clear why Tecumseh believes there will be additional complexity if their engines will not be exceeding the 30 kW threshold. It is also not clear what additional burden will result from setting a power threshold that California ARB has not yet adopted, where there are no engines currently produced that will be affected by the 30-kW cap.

9. Blue Sky Engines

What Commenters Said:

Support proposed Blue Sky program. Adopt 2007 Blue Sky standards 40 percent below mandatory levels. (CARB 9)
Adopt Blue Sky standards (also for 2004 - 2007), including tax incentive program to encourage early sales of low-emission engines. (Nissan 1, 3, 4)

Our Response:

We are adopting the proposed voluntary Blue Sky emission standards, with two adjustments to reflect the way we are adopting standards for engines generally. We are increasing the voluntary CO standard from 3.4 to 4.4 g/kW-hr to align with the most stringent standard incorporated into the sliding scale for the regular standards. Similarly, we are decreasing the voluntary HC+NOx standard from 1.3 to 0.8 g/kW-hr to align with the most stringent standard incorporated into the sliding scale for the regular standards. Manufacturers may start producing Blue Sky engines in the 2002 model year. We do not have the authority to offer any kind of financial incentives to encourage early introduction of emission-control technologies.

C. Other Requirements

1. Evaporative controls

What We Proposed:

For heating a fuel tank from 72˚ to 96˚ F, we proposed an evaporative emission standard of 0.2 grams per gallon of fuel tank capacity for gasoline-fueled engines. However, rather than requiring emission measurements to show compliance, we proposed that manufacturers could rely on a design-based certification with one of the following designs: use of pressurized fuel tanks, air bladders inside fuel tanks, automotive-type systems with carbon canisters, or collapsible bladder tanks. Additionally, we proposed that manufacturers must use either self-closing or tethered fuel caps and incorporate fuel lines meeting the automotive industry performance standard. Finally, to prevent boiling fuel during operation, we proposed a standard that limits maximum fuel temperatures during continuous operation at ambient temperatures of 86˚ F.

What Commenters Said:

Support proposed evaporative controls to achieve substantial reductions with little engineering change. (CARB 8)
Limited number of gasoline engines would not justify the costs of implementing and certifying engines to evaporative emission requirements. EPA should assess the need and cost-effectiveness of these requirements. If such requirements are justified, Ford supports design-based requirements. (Ford 8)
Evaporative requirements shouldn't be part of engine certification (no control over fuel tanks, etc.). It is manufacturers' responsibility to inform equipment manufacturer of EPA requirements and the types of technologies that can meet the requirements. (Wisconsin 13)
EPA's proposal is technologically feasible if automotive technology is used. Supports design-based certification; just do not require testing; canister system should be primary, since pressurized tanks can leak, bladders permeate. (Nissan 6)
Does not oppose proposed fuel-hose specifications or fuel boiling provisions as proposed. (Nissan 6)
No control over selection and installation of fuel systems. Meeting standards would substantially increase costs. Loose-engine manufacturers should not need to test for evaporative emissions. (MMC)
Evap controls problematic, since fuel injection is expensive and engine manufacturers sell to many equipment manufacturers. Certifying family for all applications would be expensive. Exempt air-cooled engines from evaporative requirements (or remove the 30-kW threshold). (Briggs 8)

Our Response:

Commenters generally supported the proposed requirement to incorporate evaporative emission controls into Large SI engines. The concerns related to burdensome test requirements generally do not apply, since we would expect every manufacturer to rely on the design parameters spelled out in the regulations to design a complying system. Chapter 5 of the Final Regulatory Support Document presents estimated costs and benefits of the evaporative control requirements to show that they are reasonable and cost-effective. In fact, the estimated fuel savings related to preventing fuel evaporation significantly exceed the cost of the controls.

For those manufacturers selling loose engines without fuel tanks, we would expect them to rely heavily on the design specifications in the regulations to fill out the emission-related installation instructions for equipment manufacturers. In most cases, this would require the engine manufacturer only to specify the material for fuel lines, a minimum pressure limit and basic fuel tank parameters, and a note that the fuel system must be configured to avoid fuel boiling. (Equipment manufacturers would then need to install Large SI engines in their products consistent with the emission-related installation instructions to avoid violating the prohibition against tampering with certified systems.) Even for engine manufacturers that have no control over the complete fuel system, we believe this is a reasonable responsibility for engine manufacturers to help address the need to reduce evaporative emissions.

We have shown in our assessment of the projected costs and benefits of this rulemaking that the costs associated with fuel injection are fully justified by the expected emission reductions and the associated improvement in fuel economy. This is reinforced by one company's efforts to market a small fuel-injected engine with rated power at 20 kW. In general, the fuel saved by reducing hydrocarbon emissions more than offsets the estimated cost of adding the controls. In addition, the emission modeling we present in Chapter 6 of the Final Regulatory Support Document shows that uncontrolled evaporative emissions are about 15 percent of projected total hydrocarbon emissions from these engines after applying technologies to control exhaust emissions, so evaporative emissions are not an insignificant source from these engines. As described above, we believe that design-based certification allows the engine manufacturers to specify an approach to addressing evaporative emissions that can either be incorporated directly by the engine manufacturer or delegated with clear specifications to equipment manufacturers. Either way, controlling evaporative emissions involves very low costs to design and implement the appropriate technologies. We do not believe air-cooled engines warrant any special treatment related to evaporative-emission control.

2. Engine Diagnostics

What We Proposed:

We proposed a requirement that engines must diagnose malfunctioning emission-control systems, beginning with the 2007 model year. The proposed regulations specifically called for diagnostic systems that would show a fault whenever an engine would operate for a full minute without operating at stoichiometry. Engines for which a different diagnostic system would be necessary were allowed to develop an alternate approach.

What Commenters Said:

Support diagnostic requirement, but recommend more robust system to ensure proper operation in-use, including catalyst monitoring, etc. Such systems should be feasible by 2007. (see California ARB's requirements for sterndrive and inboard marine engines). (CARB 8)
Support basic diagnostic requirements (like California ARB marine SD/I) (NESCAUM 3)
Support basic diagnostics. (STAPPA 4)

Proposal is good, but the one-minute specification should be only a guideline. (Nissan 6)
Ford supports the proposed diagnostic requirements and emphasized that we should not require emissions monitoring. Ford recommended that we modify the proposal to require diagnosing only during continuous closed-loop operation. (Ford 7)
Diagnostics–previous attempts at diagnostic systems have failed. Not clear that air-cooled engines can operate at stoichiometry. (Wisconsin 12)
Diagnostics are good (and already used for maintenance); new requirements must provide clear benefit to customer and/or environment. (Cat 5) Regulate the purpose, not the method, of diagnostic controls to maintain technology choices. (Cat-II 15)
Diagnostics are infeasible for air-cooled engines, since they do not have electrical systems, catalysts, etc. Create a separate category for air-cooled engines (or remove the 30-kW threshold). (Briggs 6-7)

Our Response:

Commenters generally supported the proposed diagnostic requirements. Crucial to the effectiveness of a diagnostic system is the expectation that operators will respond to diagnostic system warnings, making repairs to keep the emission-control system functioning. Absent a mandatory inspection-and-maintenance program, we can only depend on operators making decisions in their own interest to maintain their equipment appropriately. The proposed requirements emphasize control of air-fuel ratios as the primary variable affecting the ability of the emission-control system to function correctly. Losing control of air-fuel ratios also degrades engine performance, (either power output or fuel consumption), so that operators have a clear incentive to respond positively to a diagnostic warning light.

For cars and light-duty trucks, our diagnostic system requirements call for monitoring of misfire and reduction in catalyst conversion efficiency. These additional diagnostic features would sometimes point out the need to restore the emission-control system when there is no appreciable affect on engine performance. Also, 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 includes 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 positively to diagnostic warnings if the system is clear and simple.

An example illustrates a typical scenario. During the engine-testing program with Southwest Research Institute, a 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.

We disagree that the one-minute threshold should be a guideline only. The regulations need to define a specific target to be meaningful. This target should be far enough removed from typical engine operation to prevent diagnostic systems from falsely signaling a fail condition. Engines typically cross stoichiometric air-fuel ratios roughly once per second, so we believe that a sixty-second threshold is appropriate for triggering the fail signal. With the possible exception of open-loop operation to address engine-protection, there is no valid emission-control strategy with stoichiometric engines that involves over 60 seconds of operation without reaching stoichiometric air-fuel ratios. At the same time, the regulations allow manufacturers to get our approval to design alternate diagnostic systems. In this case, we may approve a design that triggers a fail condition after less than 60 seconds of open loop operation.

We agree that diagnostic systems should detect air-fuel ratios only during closed-loop operation. Manufacturers should go to great lengths to avoid producing engines for products or applications where they will have sustained open-loop operation. Nevertheless, it is more appropriate to address this through field-testing standards and certification provisions, rather than as an issue for diagnostic systems. If the diagnostic light would come on only because the engine is operating in open loop for longer than 60 seconds, this would show that the operator may be using the engine in the wrong application, but would not provide any information showing how to correct the problem. Also, operators seeing a diagnostic light come on (temporarily) only during certain types of operation would be unlikely to have confidence in the diagnostic system, which is crucial to its effectiveness.

The prescribed diagnostic systems can be as simple as monitoring air-fuel ratios to ensure that the engines operate at the targeted levels. For most engines this involves readings to show that the engine is operating at stoichiometry. We expect this same approach of established technology to work for severe-duty engines. The regulations also allow for manufacturers to develop alternate systems if they are appropriate for showing that systems are functioning properly. Previous unsuccessful diagnostic attempts likely involved more sophisticated functions.

There are no industry standard specifications for nonroad diagnostic systems. We believe the industry standards that apply to automotive systems will generally be compatible with those for Large SI engines. However, we agree that manufacturers may have a need to depart from automotive norms for their nonroad products. We are therefore encouraging, but not requiring manufacturers to meet the appropriate industry standards in creating their diagnostic systems.

Briggs & Stratton presumes that air-cooled Large SI engines will not have electronically controlled engines. It is unclear, however, how they would meet Large SI emission standards without electronic fuel injection systems or catalytic converters. Electronically controlled engines in this size range are already available in the marketplace and catalysts can undoubtedly be applied to these engines. We address the need for separate emission standards for air-cooled engines in Section III.B.6.

3. Closed Crankcase

What We Proposed:

We proposed to require manufacturers to prevent crankcase emissions from Large SI engines. This was based on the expectation that closed crankcases and positive crankcase ventilation are well established technologies that can be readily adapted from automotive engines.

What Commenters Said:

Nissan supports the proposed requirement for closed crankcases. (Nissan 6)
Crankcase control would be costly with lean-burn turbocharged engines; can't afford risk of downtime with remote engines. Measure crankcase separately and add it to exhaust (like EPA regulation of marine diesel engines). (Cat 4)
Waive crankcase requirement for severe-duty applications. (1) crankcase vacuum draws in damaging concrete dust, (2) small emissions impact, (3) expensive to retool engines that do not have automotive PCV ports. (Wisconsin 12)

Our Response:

For the reasons cited by commenters, we are adopting a more flexible approach to controlling crankcase emissions. For most engines, closed crankcases with positive crankcase ventilation is readily achievable. To accommodate the concerns for turbocharged engines or engines operating in a severe-duty application, we will allow manufacturers to vent crankcase vapors to the atmosphere if a closed crankcase is impractical, but require that crankcase emissions be measured and added into any exhaust emission measurements. The combined exhaust and crankcase emissions would be used to show that engines meet emission standards.

4. Useful Life and Warranty Periods

What We Proposed:

EPA proposed a minimum useful life period of seven years or 5,000 operating hours, whichever comes first. The proposed warranty period for was the first half of an engine's useful life, in operating hours, or three years, whichever comes first. For emission-related components with a replacement costs of more than $400, we proposed a minimum warranty period of at least 70 percent of the engine's useful life or 5 years, whichever occurs first. We requested comment on the need to set a shorter useful life period for severe-duty engines.

What Commenters Said:

Useful life: Allow shorter useful life for air-cooled engines: life to rebuild is commonly 1500 hours; 1000-hour life is common with bad maintenance. (Wisconsin 10)
Useful life: Adopt shorter useful life for air-cooled engines. Estimated typical lifetime is 3000 hours and three years. (AEM 2)
Warranty: Warranty should change with useful life. 1 year/2000 hours would be acceptable. (Wisconsin 11)
Warranty: Warranty should match LDV: 2 years or 25% of UL (1250 hours). (Ford 6)

Warranty: Warranty period should be 2000 hours or two years to match existing commercial warranties and take durability uncertainties into account (especially fuel quality). Manufacturers should not pay for bad fuel quality with extended warranties, since manufacturers can do nothing to remedy bad fuel. Remove longer warranty for high-cost parts. (ITA 28)
Warranty: Allow warranty exclusions traceable to substandard fuel (proposed regulations are ambiguous: §1048.120(a) and §1068.115(a) imply that warranty exclusion is acceptable, but §1068.115(b) doesn't specifically allow it). Recommend deleting §1068.115(b), since we can never list all the circumstances justifying warranty denial. (ITA 29)

Our Response:

We agree that manufacturers should be able to specify a shorter useful life if their products rarely operate as long as the useful life established for other engines. To address this concern, we are incorporating provisions previously adopted for commercial marine diesel engines. To qualify for this provision, the manufacturer would need to have field data showing that the majority of engines in the family rarely operate longer than the recommended alternative useful life value. We would also expect that mechanical warranties and recommended overhaul intervals would not be longer than the recommended useful life value. Warranty periods should clearly not exceed the useful life periods. We therefore specify that warranty periods should be half of the useful life, rather than identifying a specific period for warranty or tying the warranty to half of the *minimum* useful life.

Both Ford and ITA suggest inappropriate benchmarks for establishing minimum warranties for emission-control periods. The Clean Air Act has specific language dictating minimum warranty periods for automotive emission-control systems, which include warranty periods as long as 8 years or 80,000 miles for certain emission-related parts. While we may consider applying the same periods to other engines, the language in the Act is not prescriptive for nonroad engines. We do not believe it is appropriate to apply the automotive warranty periods to Large SI engines. We believe it is also inappropriate to base warranty requirements on existing commercial warranty periods. This would provide inadequate assurance that emission-control systems are designed to function properly for most of the useful life.

We believe a more appropriate point of reference for establishing warranty periods is our other nonroad programs, which generally set warranty periods at half the useful life. This provides a reasonable balance between the manufacturer's responsibility to design and produce engines that will operate for an extended period with significant defects to emission-related components and the owner's need to accept responsibility to correct defects that are more likely to result from general wear-and-tear or perhaps some inappropriate operation or ongoing maintenance. Manufacturers will generally incur substantial additional warranty costs for emission-related components only if those components are designed or produced in a way that prevents them from functioning properly for extended periods.

We disagree that manufacturers will be unable to incorporate design features to prevent fuel-related deposits (see Chapter 4 of the Final Regulatory Support Document). In cases where warranty claims can be attributed to low-quality fuels, however, we would generally consider this to be the manufacturer's responsibility only to the extent that manufacturers currently honor such warranty claims.

We agree with ITA's assessment regarding the ambiguity of parallel lists of reasons for permitting and not permitting denial of warranty. We have therefore omitted the proposed §1068.115(b). This leaves open the issue related to the status of warranty claims stemming from low-quality fuel that is widely available. This is clearly a fundamental issue with respect to the viability of LPG as a motor fuel. It is clearly not a sustainable situation for operators and manufacturers to resolve such maintenance or warranty problems on a widespread or long-term basis. The most important way we have addressed this is to allow manufacturers to prescribe more frequent maintenance if they anticipate that engines will be used in areas in which they expect there to be problems related to substandard fuel (see §1048.125). This is similar to automotive maintenance instructions for oil changes, which may be more frequent for severe-duty applications.

We believe the longer warranty periods for high-cost parts is an appropriate additional assurance that manufacturers will be taking steps, both in designing engines and implementing warranty policies, to ensure that emission-control systems will be working for most or all of the engine's useful life. We are therefore finalizing the longer warranty periods for high-cost parts.

D. Test procedures

1. Transient testing procedures

What We Proposed:

We proposed procedures and standards starting with the 2007 model year that would require emission measurement during transient engine operation on a dynamometer. We developed the transient duty cycle as part of this rulemaking. We published the transient duty cycle with the Advance Notice of Proposed Rulemaking in December 2000, encouraging manufacturers to join us in evaluating the cycle by testing a variety of engines in different laboratories.

We proposed to waive the emission standards and testing requirements related to transient duty cycles for engines over 560 kW, with the intent to revisit this issue in the context of a rulemaking to set emission standards for nonroad diesel engines, for which the issue of facility constraints for testing large engines is a central issue.

What Commenters Said:

Support transient testing. (STAPPA 3)
Recommend that 2007 standards be based on the proposed transient duty cycle to ensure effective emission control under typical operation. (CARB 8)
Support proposed transient duty cycle, which closely reflects real-world operation. (MECA 3)
Cycle appears aggressive. Perhaps phase in new duty cycle over a longer period of time so manufacturers can gain experience. (GFI)
Only SwRI has run the transient test, and found it challenging. New dynos will be expensive and even then it will be hard to achieve the extremely precise controls demanded. Further experimentation would likely lead to changes to ease burden without losing representativeness or accuracy. ITA offers its time and resources to EPA. (ITA 12)
At $2 million per test cell, the transient equipment too expensive to justify for its air-quality benefit. (Ford 3)

Transient cycle raises questions related to warm-up procedures, dynamometer specifications, etc. Define the duty cycle and conditions eventually and set the standards after that. (Nissan 6)

Our Response:

We agree with ITA that the transient duty cycle includes substantial operation with rapidly changing engine speeds and loads. However, this is entirely based on real measurements from normally operating equipment, so it is appropriate to use this cycle as a "reference point" for designing Large SI engines to control emissions. Remaining questions regarding the specific transient cycle are isolated to whether test equipment can accurately follow the prescribed trace. ITA relies on second-hand information to describe the difficulty of running the transient test, but provides no evidence regarding any attempts by ITA or its members to operate its own engines over the proposed duty cycle. Given the lack of data from ITA on the proposed cycle, we are unclear what time and resources ITA is prepared to offer for future work to establish a different duty cycle.

In addition, we have taken a flexible approach in setting the requirements for running the transient duty cycle in the laboratory. While EPA testing must conform with cycle statistics typical of other engine-testing programs, we allow manufacturers to deviate from these cycle statistics if equipment limitations prevent fully following the trace. As a result, any EPA testing to evaluate whether engines meet emission standards must closely follow the duty-cycle trace to be considered valid. In contrast, we do not believe that equipment limitations should prevent a manufacturer from generating transient test results that characterize an engine's emissions with sufficient accuracy. Moreover, manufacturers have a clear incentive to follow the trace as closely as possible to achieve accurate test results, since manufacturers will be responsible to meet emission standards anytime we do testing that accurately reproduces the full transient cycle. We will continue to evaluate this issue over time to determine whether the cycle statistics should eventually apply equally to manufacturers' testing or whether different cycle statistics should apply for all testing.

Ford's comment regarding the cost of test facilities is curious, given the fact that they do all their emission testing under contract. Without a complete change in this arrangement, they would incur only a small incremental cost for hiring transient test runs in addition to ongoing efforts involving steady-state procedures. Even if in-house testing becomes necessary, it is not clear why the parent company's facilities for testing heavy-duty highway engines would not be available for development or certification testing. Other manufacturers also may find it most cost-effective to pursue contracted testing, rather than building new test facilities. We have nevertheless incorporated into the cost analysis a substantial allowance to take into account the likelihood that several manufacturers will choose to build new test facilities. This does not change our assessment of the overall feasibility or cost-effectiveness of the new standards or the need to use a test cycle that accurately represents typical engine operation.

Our proposal included a fully developed set of specifications for testing equipment and procedures related to the new transient test. These specifications are based on our experience with multiple Large SI engines in addition to the years of experience gained in measuring transient emissions from other types of engines. Absent specific comments recommending changes to the proposed procedures, we continue to believe they represent an appropriate means of exercising engines and measuring their emissions. As described above, the duty cycle is based completely on measured observation from equipment during routine operation. Also, emission data show that the three-minute warm-up before starting the transient test is enough to ensure that emission-control systems can be fully functioning by the time measurement begins. For cold-start emissions, manufacturers are required to describe in their application for certification how they design their engines to operate during the first three minutes when there is no requirement to measure emissions.

2. Certification Fuel

What We Proposed:

For gasoline test fuel, we proposed to adopt the same specifications that apply to automotive testing, including the revised sulfur cap of 80 ppm. We also proposed California ARB's specifications for LPG and natural gas. However, we proposed to apply the fuel specifications to testing only for emission measurements. Service accumulation between emission tests could be done with certification fuel or with any commercially available fuel of the appropriate type. Also, manufacturers could choose either certification fuel or a commercially available fuel for in-use testing to show compliance.

What Commenters Said:

California ARB's test gasoline allows sulfur up to 40 ppm, while EPA allows up to 80 ppm–harmonize. (Nissan 6)
Caterpillar believes that it would be unduly restrictive to require a manufacturer to comply on all gaseous fuels that might be encountered. Certification fuel specifications for natural gas should allow for more impurities. Recommended specifications align with measured fuel properties, which would make it easier to do testing in the field. They state that if the limits for fuel were set to the following maximum limits that they propose, they would be able to depend on the typical pipe line natural for certification and development testing: methane- 87%, ethane- 5.5%, propane (and higher)- 1.2%, butane- 0.35%, pentane- 0.13%, hexane (and higher)- 0.1%, oxygen- 1.0%, and inerts- 5.1%. Caterpillar believes it is necessary to separate out butane and pentane to ensure that the fuel composition is appropriate. Consider methane number (even though there is no established defining procedure). Data show 60 to 100 percent increase in CO and four- to five-fold increase in NMHC with decreasing methane number from in-use fuels. (Cat 4, modified in Cat-III 1)
Supports LPG test-fuel specifications. (Nissan 6)
It's arbitrary and contrary to the National Technology Transfer and Advancement Act to adopt California ARB LPG fuel specifications instead of the industry standard HD-5 (ASTM 1835). California ARB certification fuel may not be available across the U.S. (NPGA 2)
California ARB adopted HD-10 test fuel specification to accommodate high propene content in California fuel (more propene from refinery production than from natural gas processing). California ARB specifies 80 ppm sulfur maximum sulfur concentration for LPG certification fuel (vs. 123 ppm for HD-5). (NPGA B3)
Allowing commercial fuel for in-use testing is good. (Wisconsin 13)

Our Response:

Our proposed specifications for gasoline sulfur concentrations are consistent with EPA requirements for automotive testing and with the highest level of gasoline sulfur that engines will see in the field. California's tighter tolerance on gasoline sulfur levels does not pose a harmonization problem, since manufacturers can meet EPA specifications by using the California fuel. Also, any testing up to 80 ppm will have no substantial effect on catalysts or other parts of the emission-control system to cause an engine to fail to meet emission standards. We are therefore finalizing the gasoline test fuel specifications as proposed.

Caterpillar's data showing the fuel properties from field measurements of natural gas is helpful in establishing the expected range from commercial fuels. We are therefore changing the specified certification fuel properties for natural gas according to their recommended levels.

When there is an enforceable standard regarding in-use LPG fuel quality, or universal use of any such voluntary standard, we will change our specifications for certification fuel to align with the in-use fuel. Until that occurs, we believe it is necessary to adopt fuel specifications reflecting the normal range of in-use fuels, which includes substantial amounts of fuel not meeting the HD-5 grade for internal-combustion engines.

3. Test Speed

What We Proposed:

Both transient and steady-state testing depend on determining the "maximum test speed" for an engine. We proposed a methodology that would fix this speed at the point at which the engine's speed-power point on the lug curve would be furthest from the zero-power, zero-speed point. For governed engines, the lug curve is based on operation with the governor installed.

What Commenters Said:

> Allow manufacturer to specify maximum test speed, since maximum speeds vary by application. The proposed definition of maximum test speed would require testing at speeds that are beyond the highest speeds seen in governed industrial engines. (Ford 6)

Our Response:

It is important to specify the maximum testing speed in a way that includes the highest speeds an engine would experience in the field. Maximum test speed determines how the engine is tested for both steady-state and transient procedures. If in-use engines operate beyond the specified maximum test speed, manufacturers could meet duty-cycle standards without regard to whether the emission-control system works beyond the maximum test speed. Conversely, if maximum test speed is set at points that never occur in use, manufacturers are designing their engines to control emissions under conditions that will occur only in the laboratory. We resolve this by allowing manufacturers to establish the maximum test speed while the engine's governor is installed. Manufacturers should select the governor that allows the highest expected engine speed for all the different applications and installations. We have added regulation language in §1065.401 to state this more clearly.

E. In-use testing

What We Proposed:

We proposed a program in which we could direct engine manufacturers to test a small number of field-aged engines to show that they meet emission standards. Under this program, we would select up to

25 percent of a manufacturer's engine families in a given year for testing. To address specific concerns for exceptional circumstances, we also proposed to allow alternate compliance demonstrations for three situations: (1) engines with unique features that prevent emission measurements under the in-use testing program, (2) engine families with total sales below 200 per year, or (3) engines installed in applications for which testing is not possible without irreparable damage. We proposed an in-use credit program to provide an alternative remedy for manufacturers that have an engine family with exceedances.

What Commenters Said:

Generally acceptable. (Nissan 6)
If an in-use engine exceeds emission limits, ... there would be a finding of noncompliance. (ITA 19)
In-use testing problematic for Westerbeke: (1) Marine engines have water in exhaust. (2) Testing costs for lab testing are disproportionately high. (3) Subject to testing every year (with only one engine family). (Westerbeke 1)
Manufacturer in-use testing not appropriate: (1) Manufacturer has no control over engine after sale (EPA should work with owners). (2) Engine families smaller than 500 units should never have in-use testing. (3) EPA needs to write and fund a more detailed program before comments are possible. (4) In-use ABT is good. (Cat 7)
Ford promotes the testing of in-use engines, but recommends that EPA require manufacturers to test only engine families that have a production volume greater than 2,000 units for a particular model year to avoid impractical test requirements from a cost and time standpoint. (Ford 8)
Consider resource burden for companies with limited resources. (Wisconsin 14)
Allow flexible procurement to address small families/busy applications; consider off-shore or in-house selections. (Nissan 6)
California ARB testing should satisfy EPA requirements. (Nissan 3)
Proposed field-testing approach might leave too much discretion to the individual compliance staff, risking unequal treatment for different manufacturers. Manufacturer-specific directions to test under given ambient conditions with certain duty-cycles may lead to unfair treatment. (ITA 33)
Clarify whether, under the in-use testing program, EPA or the manufacturer will select whether engines are tested in the laboratory or with field-testing procedures. (ITA 35)
Not clear if emission controls can withstand bad fuel quality; need to give it a few years to collect data before applying standards to in-use engines (Wisconsin 11)
Manufacturers should be able to select fleets operating on HD-5 LPG until EPA sets nationwide fuel specifications. (GFI)
If catalysts have sulfur contamination, EPA should allow high-temperature catalyst operation to burn off sulfur before testing. (GFI)

Small air-cooled engines do not have catalysts or long life, so estimating deterioration factor is not so hard. Testing one application doesn't allow for estimating emissions from the engine family any better than laboratory testing. No hour meters, so checking hours is difficult and expensive. Due to high costs of in-use testing with no improvement in accuracy, recommend exempting air-cooled engines from in-use testing. (Briggs 9)

Our Response:

ITA reiterates a common misunderstanding of our in-use testing and recall programs. A single in-use engine exceeding emission standards would not constitute a finding of noncompliance. Under the in-use testing program for Large SI engines, manufacturers test at least four engines, with additional testing if any engines exceed emission standards. If there is a sufficient number of failing engines to show that the engine family as a whole is exceeding the standards, we could pursue remedial action. Even in that case, we would need to adopt an appropriate remedy to address the engine-family failures. Manufacturers could use the in-use averaging program to avoid further remedial action. If an engine has high emissions that are clearly attributed to poor fuel quality and no engine-design remedy is available, we would likely not pursue a recall.

We attempted to address Westerbeke's specific concerns in the proposal. We would allow alternate test demonstrations for engines installed in equipment for which in-use testing is impractical. If manufacturers are concerned about testing costs, they can use the field-testing procedures or, in Westerbeke's case, develop a low-cost alternate testing plan. As described in the proposal, we would not require annual testing of any engine family. In selecting engine families, we take into account the number of engine families a manufacturer has, the sales volumes represented by engine families, and any other factors to prevent unfairly burdening individual companies or inappropriately focusing on individual engine models.

We have set up the in-use testing program in a way that allows manufacturers to select a fleet of candidate engines from their production. Some of these may be operated directly by the manufacturer. We will select engine families for in-use testing during the model year, when the engines are still in production, so we believe manufacturers should generally be able to keep track of enough engines to ensure the availability of test engines. Tracking the engines during their use in the field allow the manufacturer to more easily ensure that the engines get proper maintenance during service accumulation. As described above for small-volume manufacturers, we believe it is not necessary to exempt small families from in-use testing requirements. We intend to take into account the size of an engine family and a company's ability to test in-use engines in deciding how often to require in-use testing.

We recognize the need expressed by Nissan to allow flexibility in selecting engine families for in-use testing. In the proposal we specifically allowed for manufacturers to rely on an in-house fleet of engines as part of the pool of candidate engines for in-use testing. Engines sold and used outside the U.S. would have no value in showing that engines certified for sale in the U.S. continue to meet emission standards, so this would not be acceptable. However, if engine families are very small, we may need to make some unique accommodations. If we select an engine family and the manufacturer is unable to create an appropriate set of engines that would be available for later testing, we may agree that it would be necessary or appropriate to select a different family.

With respect to Caterpillar's inability to comment on the proposed in-use testing program, we believe we proposed requirements with sufficient detail and background to allow full consideration of feasibility, cost, and protocol associated with in-use testing. It is not clear what additional detail would have been necessary to facilitate comment on the proposal.

We fully intend to cooperate with California ARB in administering the in-use testing program. Any information or data available to one agency would be available to both agencies, so we would be able to draw conclusions from the same set of testing. At the same time, we cannot write the regulations to limit our ability to select engine families for in-use testing based on the decisions of California ARB's Executive Officer. To the extent that manufacturers make a single product to meet emission standards in California and the rest of the U.S., we would have less reason to pursue any separate testing from that desired by California ARB.

Our experience in past programs has shown that we apply the same treatment to different manufacturers. Compliance staff coordinate directions to manufacturers through a common management decision process. We may publish a guidance document that would serve to announce any general policy decisions in administering in-use testing or field-testing requirements. If we have reason to believe that a manufacturer is not meeting emission standards in some way, however, we may pursue additional testing from that manufacturer in a way that is specific to our concerns.

In administering the in-use testing program, we have no intent to specify whether manufacturers should use laboratory or field-testing procedures. Manufacturers may generally choose either method, based on the availability of equipment, previous experience with testing, or many other possible factors. If manufacturers choose to use laboratory procedures, however, this does not take away their responsibility to design and produce engines capable of meeting the field-testing standards. While we would generally not direct manufacturers to do field testing as part of the manufacturer in-use testing program, we could do our own testing to evaluate whether an engine family meets any of the final emission standards, whether that involves duty-cycle testing in the laboratory or field testing with engines installed in any type of nonroad equipment.

The emission data supporting the proposed emission standard included consideration of the effects of fuel quality on the feasibility of meeting emission standards over an engine's useful life. We concluded that the data support the feasibility of the standards, so we do not agree that we need to collect additional data before applying the emission standards to in-use engines. Similarly, we do not agree that test engines should operate only on HD-5 fuels. Data from the aged engines on which the emission standards are based include thousands of hours of operation on in-use fuels that were not restricted to HD-5 specifications. Fuels for test engines need not be more carefully regulated than the developmental engines.

As described in Section III.F.1, we do not expect sulfur contamination of catalysts to be commonplace. However, if sulfur contamination were shown to cause a finding of noncompliance for an engine family, we would take that into consideration in identifying an appropriate remedy.

We disagree with Briggs & Stratton's assessment related to the need for in-use testing for Large SI engines. Once these smaller engines are modified to meet emission standards, they will have the same need for estimating deterioration factors and ensuring lifetime emission controls as the larger engines. Electronically controlled small engines will be equally capable of tracking engine operating hours. We strongly disagree with the unsupported position that testing engines from the field in any given application is no more useful than testing engines in the laboratory. We believe that testing based on the real experiences of production engines operating in normal use is an important step in ensuring that engines are operating consistent with emission standards and the original engine design.

F. Other Issues

1. In-use LPG Fuel Quality

What We Proposed:

We proposed no standards for in-use LPG fuel quality and there are currently no standards in place. However, we requested comment on the various issues regarding the quality of in-use LPG fuel.

What Commenters Said:

GPA defines fuel specifications for in-use LPG, including a motor-grade fuel (apparently refuting EPA's claim in the proposal that there are no enforceable fuel standards). (GPA 1)
Most in-use LPG produced in the U.S. today adheres to GPA/ASTM specifications (GPA did not note which specifications). (GPA 2)
ASTM specifications are enforceable on a contractual basis. Products that do not meet specifications are occasional only, likely with a lower price. Observation is based on "industry feedback." (GPA-II)
In contrast, ITA contends that neither law nor contracts assign responsibility or accountability for fuel quality. They note that LPG distributors do not provide information related to fuel specifications and believes that even producers cannot reliably certify that fuel meets specifications. ITA adds that certifying fuel quality at the point of production would be meaningless because contaminants are introduced in the distribution chain. ITA further points out that the HD-5 specification, even though it was designed as a motor fuel, has no different specification for volatile residue or residual matter and is therefore likely not an adequate standard for current engines. (ITA-II)
Nissan also pointed out that there is no regulation or other compliance obligation requiring LPG producers to provide motor-grade fuel to forklift users. Nissan pointed out that the motor-fuel specification (HD-5) was designed over 35 years ago for diesel-derived engines. Nissan also shared an observation that EPA seemed to be unconcerned with in-use LPG fuel quality unless it affected emissions. Nissan favors decreasing olefin content to 1-2 percent and eliminating entrained oil to decrease gum formation. California ARB data show that NOx emissions may increase by 14 percent when operating on the lower-quality fuel. Nissan also believes that LPG distribution introduces contaminants. Metallic particles have been found in the fuel and engines develop corrosive deposits. Vaporizers account for 38.4 percent of warranty claims. Nissan concluded that it would be better for them to promote sales of gasoline engines to avoid the problems associated with low-quality LPG fuels. (Nissan-II)
Regulating in-use LPG is problematic: (1) Storage capacity for separate motor-grade LPG is difficult; (2) unclear compliance responsibility (producers vs. marketers); (3) Producers may abandon motor-fuels market. (NPGA 2)
Fuel quality varies geographically, but no test data support the concern that bad fuel increases emissions. NPGA agrees that emission controls appear to be tolerant of deposits, especially with routine cleaning. (NPGA 4)
LPG industry wants to work with EPA to determine an appropriate course of action to improve the uniformity of fuel quality. (NPGA 4)

GPA 2140 fuel specifications are a recognized industry standard that tracks nationwide fuel better than EPA's proposed fuel specification. California in-use fuels have higher propylene than the rest of the U.S., since they rely more on refinery sources (rather than natural gas processing). The proposed sulfur specification allows up to 80 ppm, while GPA 2140 allows up to 123 ppm. "NPGA would endorse the existing industry standard of GPA 2140 as the fuel specification for in-use fuel." GPA 2140 fuels are commonly available commercially. (NPGA-II)
Adopt California ARB's in-use LPG specifications (85% minimum propane, 10% max propene). (CARB 9)
Extend California's in-use fuel specifications nationwide. (STAPPA 4)
Propane composition can vary, but closed-loop fuel metering can mitigate any effects. Deposits from heavy-end hydrocarbons and sulfur can adversely affect emission controls, so establish uniform fuel quality specifications (recommend harmonizing with California ARB). (MECA 3)
Very little emission data on fuel effects, since California ARB standards just started. (1) Data on 2004 systems should be of limited long-term value, since 2007 technologies will require a higher degree of precision and sophistication. (2) Diagnostics will help, but may not indicate the need for cleaning (3) cleaning may not help anyway, since sulfur and phosphorus deposits require part-replacement. (4) Engine technology is not available to prevent contamination. (5) Filters are expensive and do not remove sulfur anyway. (6) Heavy hydrocarbons dissolve in LPG at high pressure. (7) Additives do not remove deposits and may harm engine performance (and can't ensure universal use). (ITA 12-14)
Adopting in-use LPG fuel specification would be best, but it would take time to reach consensus on the right specification and figure out how to enforce it. (ITA 14)
Need cleaner in-use fuels, especially LPG; normal cleaning of components is not enough to maintain good control of air-fuel ratios. (Nissan 1, 4, 5)
Recommends regulating in-use LPG to HD-5 specifications (no supporting information). (Ford 4)
Recommends regulating in-use natural gas. (Ford 4)
Not clear if emission controls can withstand bad fuel quality; need to give it a few years to collect data before applying standards to in-use engines. (Wisconsin 11)
Adopt and enforce in-use fuel specifications (such as California ARB's); take sulfur-based odorant into account. Fuel filters and additives do not work, since they (1) do not address sulfur, (2) won't be applied universally, (3) discourage efforts to produce cleaner fuel. (GFI)
The Propane Education and Research Council (PERC) provided information in response to other LPG-related comments. With respect to phosphorus, PERC noted that this is not a gaseous compound, so it would take very small amounts of this contaminant to fail the specification for residual matter (for commercial or motor-grade fuel). Also, phosphorus is not a naturally occurring element in the production of LPG (whether from refiners or gas processors). Any phosphorus that would exist as a contaminant in crude oil would more likely show up in gasoline than in LPG. PERC also noted that odorants typically contribute about 18 ppm of sulfur to the fuel. Additional sulfur typically leads to total sulfur concentrations of 45-50 ppm. Any higher sulfur concentrations would exceed the ASTM specification for being too corrosive and would be an unacceptable product in the marketplace. (PERC)

Our Response:

As described in Chapter 4 of the Final Regulatory Support Document, the engine testing which forms the basis for the new emission standards was done with engines that had operated for several years using normal in-use LPG fuels. The vaporizers and mixers had extensive deposits, showing that these engines were not spared the burden of operating with fuels that cause the problems that are central to the concerns manufacturers raise. The test engines showed that cleaning the mixer had little effect on emissions. All tests were conducted without cleaning the vaporizer, so any further investigation could only show how engines might operate with emission levels even lower than we measured. Also, if deposits accumulate to the point that the engine's feedback system is not able to compensate sufficiently to keep the engine operating at stoichiometric air-fuel ratios, the diagnostic system will alert the operator to the fact that maintenance is needed to fix the problem.

Furthermore, we believe the information from PERC adequately refutes the manufacturers' concerns related to sulfur and phosphorus contamination. Our experience with automotive systems has shown that sulfur levels below 50 ppm do not pose a substantial long-term threat to the proper functioning of catalytic converters. Moreover, because LPG is a gaseous fuel, much of the sulfur condenses out of the fuel, forming powdery yellow deposits in the fuel system upstream of the combustion chambers. While this presents a different problem, sulfur deposits in the fuel system clearly do not affect catalyst performance. Phosphorus in the fuel would cause catalyst problems when concentrations exceed approximately 1000 ppm, which is much lower than can be expected from any LPG currently produced. As a result, we do not believe that varying fuel quality should affect manufacturers' ability to show that their engines meet emission standards throughout the useful life.

At the same time, we are aware that varying LPG fuel quality poses a difficult problem for operators trying to use and maintain these engines. These problems have been described in the literature as follows:

> ...[D]esign, performance, and field problems do exist with LP-Gas engines and a market expansion for LP-Gas is restricted.... [I]f the composition of the LP-Gas remains uncontrolled then prime mover sales will continue to decline.[31]

While this is a description from engine manufacturers in 1962, it mirrors the comments from manufacturers in this rulemaking forty years later. It seems that fuel suppliers and engine manufacturers are fast approaching a crossroads. As noted by Nissan, there is a growing thought that gasoline engines can meet emission standards without the concern for varying in-use fuels and the related maintenance and warranty problems. We intend to continue to stay abreast of developments in this area, trying to learn to what extent fuel quality affects an engine's emission-control capabilities and overall performance characteristics. If new data show that specific changes of in-use LPG fuels are necessary, we will be interested in pursuing a regulation to achieve this. This is most likely to result from the experience gained by manufacturers when testing engines under the in-use testing program. Until that time, we believe it is best for fuel suppliers, engine manufacturers, operators, and other interested parties to work together on a voluntary basis to resolve the observed challenges and problems in a satisfactory way. This may involve a combination of things, including: (1) a commitment by fuel producers to supply high-quality motor fuels, (2) fuel testing, certification, and labeling to identify fuel properties at all points in the distribution chain, (3) additives that may be introduced at any point in the distribution chain, (4) an

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[31]"LP Gas Engine Fuel, 'To Be or Not To Be: That is the Question'," from the Proceedings of the Forty-First Annual Convention of the Natural Gas Processors Association, 1962 (Docket A-2000-01; document IV-A-93).

effort to upgrade the LPG distribution infrastructure and change practices as needed to prevent introduction of contaminants, (5) introduction of engine technologies to prevent further fuel contamination and to prevent deposits.

2. Form of Hydrocarbon Standards

What We Proposed:

We proposed to adopt total hydrocarbon standards for LPG and gasoline engines. For natural gas engines, the same emission standards would apply, but hydrocarbon measurements would be based on nonmethane hydrocarbons, not total hydrocarbons.

What Commenters Said:

NPGA noted that methane is about 3 percent of the proposed 2004 emission standards, acknowledging that this is a minute quantity. (NPGA 5)

Our Response:

We understand NPGA's comment about methane to be an endorsement of the proposed approach to base standards on total hydrocarbon emissions, while allowing manufacturers to certify based on measured NMHC emission levels.

3. Noncommercial Fuels

What We Proposed:

We proposed to require all engines to meet emission standards over their full range of adjustability.

What Commenters Said:

Caterpillar states that the industry has purposely made easily adjustable engines because these engines must be capable of operating on a large variety of fuels. They believe adjustments must be allowed to obtain the lowest emissions, without cumbersome costs or time requirements to make these adjustments. Caterpillar suggests that the regulations must recognize the effect of fuel variation on engine setup and provide adequate flexibility to make these changes as the equipment is relocated. Engine timing must often be adjusted to match the fuel on which it is operating, and must be adjusted manually. Without the ability to adjust timing, an engine's fuel and load capability would be severely hindered. Further, the air-fuel ratio must also be adjusted to match the specific fuel and the timing. (Cat 7)

Our Response:

All emission measurements for showing that engines meet emission standards rely on testing with fuel meeting the established test fuel specifications. If manufacturers need to rely on operators to make adjustments to engines when operating on the test fuel to meet emission standards, we would not have enough assurance that these engines will be controlling emissions when operating on commercial fuels that mimic the test fuel. Manufacturers should be able to build in internal feedback strategies to compensate for the relatively narrow range of parameters with test fuels.

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

4. Electric Forklifts

What We Proposed:

We did not propose any requirements or incentives aimed at increasing the use of electric forklifts or other types of equipment.

What Commenters Said:

Bluewater Network urges EPA to require a zero-emission standard for all categories in this rule where it is possible to use electric equipment. They believe the use of electric-powered alternatives to spark-ignition equipment, namely forklifts, has potential for substantial emissions reductions and decreased CO exposures. Further, they believe the current proposal is inexpensive and offers great potential for consideration of electric equipment, given the current cost structure. (Bluewater 8)
The California Electric Transportation Coalition (CalETC) suggests that we set emission standards based on “propulsion systems” rather than engines. The recommended approach would allow alternate systems such as fuel cells or batteries to meet standards. Zero-emission electric-based technologies should be able to generate emission credits that can be sold to other companies. EPA should adopt incentives, emission-credit programs or other regulatory programs to encourage the use of these zero-emission technologies.

NPGA opposed increased use of electric forklifts for many reasons: -increased electricity consumption. -electricity production also involves emissions. -there are substantial inefficiencies in converting energy for electricity into power for forklifts; 27 percent of the fuel energy is available to the end user. -battery disposal is a significant environmental issue. -this would be in conflict with the energy-conservation goals of the National Energy Policy Act. -battery-powered forklifts do not match the performance of engine-powered models. (NPGA 6)
The market has clear reasons to choose either battery- or engine-powered forklifts (cost, battery issues, performance characteristics, maintenance). Banning engine-powered forklifts would cause significant market dislocation. EPA has the authority to regulate engines, not to ban them. (see ITA 27-28)

Our Response:

We do not believe it is necessary or appropriate to require the use of electric forklifts at this time. Applying emission-control technology to internal-combustion engines, as contemplated in this rulemaking, removes most of the air-quality advantage of operating battery-powered forklifts. As other commenters note, there are significant energy, performance, and other issues implicated by such a mandate. Before we would contemplate any electric forklift requirement, we would need to undertake a rigorous analysis of full life-cycle environmental and economic impacts of the two alternative power sources, considering the source of electricity generation for charging batteries and problems associated with battery disposal. In addition, as Clean Air Act section 213 refers to regulation of nonroad engines, which are defined as internal-combustion engines, we would have to review our authority for regulating based on "propulsion systems" before any such regulation could be contemplated.

5. Federal Preemption

What We Proposed:

Although some aircraft utilize engines similar to those described in this proposal, we did not propose emission standards for aircraft or aircraft engines—aircraft are covered under a separate part of the Clean Air Act (sections 231, 232, and 233). Aircraft ground support equipment (GSE), which are classified as nonroad vehicles, are also covered by section 209(e) of the Clean Air Act which prohibits states and political subdivisions from enforcing standards relating to the control of emissions from nonroad engines and nonroad vehicles, though California may receive a waiver of federal preemption for most types of nonroad engines and other states may adopt California standards.

Current EPA regulations define aircraft as needing airworthiness certification from the Federal Aviation Administration (FAA). Our proposed definition of aircraft in these regulations would exclude all aircraft from emission standards, including those aircraft that do not receive an airworthiness certificate from FAA.

What Commenters Said:

The Air Transport Association (ATA) has concerns with statements in the proposed rule regarding the authority of states with respect to aircraft ground support equipment (GSE). ATA believes that these statements appear inconsistent with the Federal Aviation Law’s control of aviation and with section 209 of the Clean Air Act which preempts states from regulating emissions from these vehicles.

ATA requests that the final rule acknowledge that section 209(e) of the Act preempts state regulation of existing nonroad vehicle emissions; further, they request that EPA revisit the preamble language in the final rule to ensure that it is consistent with Federal Aviation Law and section 209. The proposed rule states that section 209 preempts states "from setting emission standards for *new* engines or vehicles"; ATA believes that this is potentially misleading with respect to GSE due to the fact that this preemption is for *new and existing* nonroad vehicles. ATA also requests that the final rule describe and clarify the California "opt-in" process for standards. They believe the discussion of the California "opt-in" process is misleading in the proposal and provide clarification that California may regulate emissions only after applying for a waiver of federal preemption from EPA. ATA states that, for section 209, nonroad sources may be regulated as either a "federal" nonroad vehicle subject to federal standards, or a "California" vehicle for which a preemption waiver has been granted and statutory lead-time provisions have been met.

ATA requests that EPA clarify and explain the limited nature of use restrictions under the Act in the final rule. They have concerns with the statement in the proposal that "there is generally no federal preemption of state initiatives related to the way individuals use individual engines or vehicles." They state that this is inaccurate and incomplete in that section 209(e) was specifically revised to preempt State and local retrofit requirements imposed on vehicle "owners or operators regardless of the impact on engine manufacturers." Further, they state that the Act allows states to impose certain traditional restrictions on how a vehicle is used such as transportation control measures. These controls may reduce emissions, but do not generally impinge upon the standard setting authority for mobile source emissions exclusively given to the federal government and California. States are given the authority to regulate stationary sources, or anything that is "local in nature."

Lastly, ATA requests that the final rule acknowledge the limitation on state regulation of GSE under the Federal Aviation Law. ATA also believes that the aforementioned statement in the proposal ignores the preemptive effect of the Federal Aviation Law on potential state and local efforts relating to GSE. Attachment A, a letter from FAA to EPA, states that for aviation there are a "number of statutory and regulatory provisions that generally preempt states from regulating the area of commercial aviation." Further, the Federal Aviation Act's system extends to aircraft-related ground operations and the Airline Deregulation Act provides that a state "may not enact or enforce a law related to...service of an air carrier...", both of which preempt states from regulating GSE.

Our Response:

While we do not believe our discussion of federal preemption in the preamble to the proposed rule was inaccurate, we agree in general with the ATA's comments. States are initially preempted under section 209(e) from promulgating emission standards for new and existing nonroad engines. However, California may under section 209(e)(2) request authorization to promulgate emission standards for any type of nonroad engine, excluding new locomotive engines and engines in new farm or construction equipment which are smaller than 175 horsepower. California may not enforce such regulations until it has received authorization from EPA. As the commenter notes, EPA must make certain particularized determinations regarding a request from California before granting such authorization. Other states may enact emission standards identical to California's and may enforce these standards after California has received its authorization, as long as two years of lead time has been provided.

Regarding use restrictions, EPA agrees that certain regulations of vehicles in use, for example retrofit requirements, would generally be considered emission standards, rather than use restrictions and thus covered by the preemption of section 209(e). However, EPA also notes, and the commenter acknowledges, that many types of restrictions (idling restrictions, for example) can validly be called use restrictions. As the commenter notes, Congress and the courts have held that such restrictions were inherently local in nature. EPA's regulations contain further discussion on this point. See 40 CFR part 89, Subpart A, Appendix A.

EPA's statement in the proposal that there was no federal preemption of state initiatives regarding the use of nonroad engines was only intended to apply to federal preemption under the Clean Air Act. State regulation of specific types of nonroad engines may be subject to other federal restrictions besides those under section 209 of the Clean Air Act. EPA does not need to make any determinations in this rulemaking regarding whether federal aviation law restricts the ability of states to regulate airport ground service equipment. States and localities should keep the arguments of ATA in mind if they attempt to regulate airport ground service equipment in the future.

Summary and Analysis of Comments: Rec CI Marine

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IV. Recreational Marine Diesel

A. Emission Standards

1. Level of the Standards

What We Proposed:

We proposed to apply the same exhaust emission standards to recreational marine diesel engines as are already in place for Category 1 commercial marine diesel engines. Section II.A.3 discusses the technological feasibility of these standards. As discussed in Section II.E.1, these standards are based on levels measured over the ISO E5 duty cycle. Testing according to the not-to-exceed provisions, as discussed in Section II.F, would also apply with modified emissions limits. Table II.A-1 presents the proposed HC+NOx, PM, and CO standards for recreational marine diesel engines. The subcategories refer to displacement in liters per cylinder. We did not propose smoke standards.

Table II.A-1: Proposed Recreational CI Marine Emission Standards

Subcategory	HC+NOx g/kW-hr	PM g/kW-hr	CO g/kW-hr	Implementation Date
power ≥37 kW 0.5 ≤ disp < 0.9	7.5	0.4	5.0	2007
0.9 ≤ disp < 1.2	7.2	0.3	5.0	2006
1.2 ≤ disp < 2.5	7.2	0.2	5.0	2006
2.5 ≤ disp < 5.0	7.2	0.2	5.0	2009

What Commenters Said:

EMA commented that the proposed standards are too stringent, especially for naturally aspirated engines, and that we should finalize standards using the less stringent levels proposed by the European Commission. In contrast, they also commented that the proposed PM and CO standards are higher than the baseline emissions for most engines and that the proposed HC+NOx emission standard would only result in small emission reductions. EMA expressed support for not including smoke standards in the proposal stating that smoke is adequately controlled by the proposed PM standards and that market pressures prevent engine manufacturers from selling smoky engines. Cummins also commented that users would not tolerate visible emissions from their vessels.

NMMA also commented that they we should set standards using the less stringent levels proposed by the European Commission. However, they commented that we have no justification for regulating CO. Hatteras Yachts commented that they would support the proposed standards if the not-to-exceed provisions (discussed below) were not included.

ARB commented that they have proposed emission standards of 7.5 g/kW-hr HC+NOx, 0.2 g/kW-hr PM, and 5.0 g/kW-hr CO and recommends that we consider adopting similar standards. OTC and NESCAUM expressed support of our proposed standards and commented that we should consider more stringent standards in the future based on technology such as oxidation catalysts and particulate filters. Sonex commented that the standards are not technology-forcing because they have already achieved lower emissions with their technology.

Sierra Club commented that they opposed our proposed standards because they are not protective enough of public health and the environment. STAPPA and ALAPCO commented that we should regulate emissions to the greatest extent possible and that we should set HC, NOx, and PM standards that would achieve the same percent reduction in emissions as for new highway engines. MECA commented that we should harmonize the marine standards with current and future land-based diesel engine standards. Bluewater commented that particulate filters and lean NOx catalysts should be required on all diesel-powered pleasure boats. They commented that our own data showed that our proposed standards would lead to a doubling in PM by 2030.

Our Response:

We are finalizing the emission standards as proposed. These emission standard levels are the same as those for commercial marine engines and are similar to those proposed by ARB.

Manufacturers commented that we should finalize the emission standards proposed by the European Commission (EC) for CI recreational marine engines for our national standards. These emission levels are presented in Table II.A-2. This table also presents the U.S. standards finalized today and average baseline emissions based on data presented in Chapter 4 of the Final Regulatory Support Document on engines for which we had data on both HC+NOx and PM.[32] Based on this data, we believe that the proposed European emissions 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. because engines are already performing better than the proposed EC limits.

Table II.A-2: EPA and Proposed European Standards Compared to Average Baseline Levels for CI Recreational Marine Emissions

Pollutant	EPA Standards g/kW-hr	Proposed EC Standards g/kW-hr	Baseline Emissions g/kW-hr
HC+NOx	7.2-7.5	9.8 NOx, 1.5 HC*	9.2
PM	0.2-0.4	1.4	0.2
CO	5.0	5.0	1.3

* HC increases slightly with increasing power rating.

EMA, who commented that we should use the proposed European levels, also commented that our standards will not reduce PM from baseline levels and that the standards will only result in a small reduction in HC+NOx. They use this argument to state that technology forcing standards are inappropriate because the emissions reductions would be too small to matter. We disagree that the standards will not result in PM reductions. The data reported in the above table is average PM emissions from engines which would be subject to the 0.2 g/kW-hr PM standard under this rule. Engines in the average above with PM above this level would have to be modified meet the standards. In addition, manufacturers will presumably design their engines with some margin for error during compliance. Therefore, even if the perfect averaging of credits were to be applied, some PM reduction would be achieved. The costs and emissions reductions of these standards are analyzed in the Final RSD which shows a favorable cost per ton of emission reduction.

As discussed in Section II.A.3. and in Chapter 4 of the RSD, the standards are based on emissions control technology that will be available by the implementation dates. These standards are cost effective and take into consideration the other factors relevant

[32] If we include HC+NOx data from engine tests that did not include PM measurement, the HC+NOx average decreases to 8.6 g/kW-hr.

under section 213(a). It would therefore be inappropriate to consider less stringent standards as suggested by engine manufacturers.

We received several comments stating that we should consider emission standards, either in this rule or a future action, that achieve the same emission reductions as upcoming standards for highway engines. We anticipate that on-highway engine manufacturers will use NOx adsorbers and particulate filters to meet the 2007 standards for heavy-duty on-highway engines. However, the standards for CI recreational marine engines are based on the technology that we anticipate will be used to meet Tier 2 commercial marine and Tier 2 land-based nonroad diesel emission standards. We believe that these standards are appropriate because CI recreational marine engines are generally derived from commercial marine and nonroad engines. Due to the comparatively low sales volume of these engines, they are technology followers that rely on research and development performed on their nonroad counterparts. As discussed in Section II.A.3, we do not believe that it is feasible or appropriate to base the new standards for recreational marine engines on technology being developed to meet future on-highway emission standards because of fuel and cost issues. However, as new technology is applied to nonroad applications, including the fuel used for such applications, we may consider further emission reductions which could be comparable with on-highway emission standards.

Bluewater commented that our estimates show that PM will nearly double by 2030 even with our new standards. However, our analysis actually showed an estimate that PM would double without new standards. In Chapter 6 of the Final RSD, we estimate that the new standards will reduce the baseline 2030 PM emission inventory by 25 percent.

NMMA commented that we have no justification for regulating CO from diesel engines. EMA commented that our standards would not reduce CO from baseline levels. However, both commenters asked for the standards to be the same as proposed by the European Commission. For CO, this level is 5.0 g/kW-hr which is the level we are finalizing. As discussed in our proposal, we intend for the CO emission standard to serve as a cap on uncontrolled emission levels to prevent manufactures from increasing CO emission levels as they control other emission constituents.

We continue to believe that setting smoke standards for recreational marine engines is not required at this time. We do not consider smoke to be a concern both because the PM standards would serve to limit smoke emissions and because the operators of the vessels generally desire low smoke levels and thus purchase engines with smoke controls. There is currently no appropriate test procedure for measuring smoke emissions from these engines. Existing land-based test procedures include lugging operation which is not generally seen in marine engine operation. In addition, recreational marine exhaust often exits below the water line. However, should smoke emissions from marine engines prove to be a problem after these regulations take effect, we would take action at that time to develop an appropriate remedy. In all likelihood, those engines that are currently generating nuisance complaints are older or poorly maintained engines. Further, our in-use maintenance requirements should prevent smoke emissions from regulated engines due to poor maintenance.

2. Implementation Dates

What We Proposed:

The proposed implementation dates are presented above in Table II.A-1. These implementation dates provide manufacturers two years of additional lead time beyond the implementation dates for commercial marine to adapt technology to their recreational marine engines.

What Commenters Said:

EMA commented that we should delay the implementation date of the standards until at least 2008 to give the European Commission time to implement Tier 2 standards that are equivalent to U.S. standards and to permit alignment between CI and SI recreational marine engines. They also commented that recreational marine engines need at least two years of lead time after the commercial marine standards to transfer technology from commercial marine engines to recreational marine engines and to stagger the need for manufacturer's research and development costs. Because this rule is not being finalized until late 2002, they commented that we are not giving four years of lead time as noted in the NPRM, but only really giving them three years beyond the finalization of this rule and that the effective dates should be delayed by another year to give them four years of lead time for engines with a proposed effective date of 2006. Cummins commented that the effective dates of the standards for engines below 1.5 liters per cylinder should be the same as for SI marine engines of the same power levels.

EMA commented that engines with less than 2.5 liters per cylinder, but more than 560 kW would essentially have no lead time beyond the land-based nonroad diesel engine standards and that commercial marine engines in this category would actually have to certify two years before nonroad engines.

Because recreational CI marine engines are similar to commercial marine engines and land-based nonroad diesel engines, the California ARB recommended that we not extend the effective dates beyond 2007. ARB has proposed emissions standards for all sizes of recreational marine diesel engines beginning in 2007. Sonex commented that the proposed lead time would give manufacturers time to consider using advanced technology that could achieve lower emissions levels than proposed. Bluewater Network commented that two years of lead time beyond the commercial marine standards provides sufficient lead time for all manufacturers to meet the proposed standards.

Our Response:

The intent of the implementation dates for CI recreational marine engines is to provide two years of additional lead time beyond the implementation dates for commercial marine engines and represents up to a five year delay beyond the land-base standards. We believe that 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 engines. Finally, this implementation schedule provides three to six years of lead time beyond the date of this final rule.

The issue with engines with less than 2.5 liters/cylinder and greater than 560 kW is an artifact of using per cylinder displacement rather than rated power to distinguish the subcategories of engines for the staggered implementation dates. For nonroad land-based applications, the subcategories are defined by rated power. However, this is not practical for marine engines which are generally derived from nonroad land-based engines. A given engine block is generally offered with much higher and much broader range of power ratings for marine engines than for land-based engines. In addition, additional cylinders may be added that cause the same basic engine to be included in more than one engine subcategory. Using per cylinder displacement to distinguish engine subcategories allows the phased-in implementation dates to better align with the phase in schedule for nonroad engines using the same basic engine block. In some cases, if a nonroad land-based engine is offered with different power ratings due to different number of cylinders, this engine may fall into subcategories above and below 560 kW, which have different implementation dates for nonroad land-based engines.

We believe that the same technology (and development work) can be used to reduce emissions regardless of the number of cylinders. In general, we believe that the lead time in the final standards gives manufacturers sufficient time to transfer emission control technology from land based to marine engines even under the scenario described by EMA. However, we recognize that some effort would be required to develop calibrations for different engine configurations and sizes. Therefore we are allowing manufacturers the option of delaying the implementation to 2008 of Tier 2 commercial and recreational CI marine standards. This delay would only be allowed for engines between 2.0 and 2.5 liters per cylinder with a rated power of greater than 560 kW in their land-based nonroad configuration. We are concerned that there would be a loss in emission benefits due to this flexibility. Therefore, we are requiring that engines certified under this option be certified to the nonroad land-based Tier 2 HC+NOx emission level of 6.4 g/kW-hr through model year 2012. We believe that this emission level will be achievable given the extra lead time for development. Testing would still be performed on the appropriate marine duty cycles. Based on our analysis in the Final Regulatory Impact Analysis for commercial marine engines, HC+NOx emissions measured over the marine duty cycles should be similar to those measured over the land-based nonroad duty cycle.

We received comments that the dates should be harmonized with other efforts. EMA commented that we should delay the standards until 2008 to give time for the European Commission to develop standards of equivalent stringency. As discussed in Section II.A.4, the standards we are adopting are based on technology that will be available in the lead time provided, are cost effective, and are otherwise appropriate under §213 of the Clean Air Act. A further delay would not be consistent with the requirements of §213(a). ARB commented that we should implement the standards for all recreational engines in 2007. If we adopted that approach, it would mean only one year of delay from the land-based equivalents for some engines. However, we believe it is appropriate to give manufacturers two additional years of lead time beyond the commercial marine standards due to technology transfer concerns. In addition, a 2007 implementation date would delay the standards by an additional year for 0.9-2.5 l/cyl engines which are the majority of the engines in this category. One commenter stated that we should use the same implementation dates for CI and SI recreational marine engines. As discussed in Section II.B.2, SI marine engines are not included in the scope of this rulemaking.

To be consistent with the proposed lead time discussed above, we are implementing the not-to-exceed (NTE) requirements (see Section II.F) for recreational engines two years after the dates for commercial engines. This is consistent with the approach we took for commercial marine engines with respect to the land-based standards. It will be valuable for research and development purposes for manufacturers to have an opportunity to collect more data before we implement the NTE requirements. For this reason, we believe it is appropriate for the NTE requirements to begin in 2009 for all sizes of recreational marine engines (2012 for post-manufacture marinizers). This provides three extra years of lead time for the design of most CI recreational marine engines. The 2012 starting date for post-manufacture marinizers is appropriate considering that the marinizer works with another manufacturer’s base engines and needs to conduct testing with more limited resources. We don’t believe that an additional three years beyond 2009 is necessary for larger engines, because manufacturers of these engines will already have six years of lead time to collect data.

3. Technical Feasibility

What We Proposed:

We based our proposed standards on emission reductions expected using a combination of land-based nonroad technology and marine aftercooling. This technology included some utilization of electronic controls, engine modifications, improved fuel injection systems, turbocharging, and separate-circuit aftercooling.

What Commenters Said:

NMMA, Regal Marine, and Carver Boat Corporation expressed concern that emission standards could cause engine manufacturers to compromise engine performance. They commented that if engines were larger, heavier, and less fuel efficient, it could require larger engine spaces and fuel tanks which could result in reduced living space on their yachts.

EMA commented that we did not demonstrate the technical feasibility of meeting the proposed standards with a naturally aspirated engine. As a result, they stated that EPA needs to relax the proposed standard for engines less than 0.9 liters per cylinder to account for the disparity of using small naturally aspirated engines in recreational marine applications. EMA also commented that, with the exception of these small engines, the technologies discussed by EPA can, and in many cases already have been, adapted to recreational marine engines and can be optimized to meet the proposed standards over the E5 duty cycle. They cautioned that significant research and development efforts would still be necessary and that the proposed standards are near the limit of technological feasibility.

Sonex submitted data on emissions reductions possible on a small (0.4 liter) naturally-aspirated direct injection diesel engine using their combustion system with and without exhaust gas recirculation. Their combustion system uses piston bowl geometry to optimize combustion which they stated has attained lower levels of emissions than the proposed standards. Sonex supported our statement that diesel engine technology development is in a period of rapid development and that this technology development will transfer to marine engines.

ARB commented that recreational marine engines are similar to commercial marine engines and their land-based counterparts. As a result, they commented that the same technology, such as electronic fuel management, turbocharging, and separate-circuit aftercooling can be used to meet the proposed standards and that these technologies are already used on many recreational marine engines.

MECA commented that the proposed standards are technologically feasible and that marine diesel engines can take advantage of the technological advancements made to reduce emissions from highway and nonroad diesel engines. In addition, MECA commented that emissions from marine diesel engines could be reduced using oxidation catalysts, particulate filters, and catalytic NOx controls, and that we should consider harmonizing future standards with current and future land-based diesel engine standards. OTC and NESCAUM also expressed support of the proposed standards, and expressed that we should consider future standards that would require the use of oxidation catalysts or particulate filters. Bluewater Network commented that we should finalize standards based on the use of particulate filters and lean NOx catalysts.

Our Response:

We believe that the same emission control strategies can be used on recreational marine engines as will be used on commercial marine engines to meet the emissions standards. These technologies include electronic fuel management, timing retard, improvements to fuel injectors, combustion chamber modifications, turbocharging, and separate-circuit aftercooling and are discussed in more detail in the preamble and Final RSD. Chapter 4 of the Final RSD presents exhaust emission data collected on 25 CI recreational marine engines which are uncontrolled for emissions. Several of these engines are already close to meeting the standards finalized today using the technology listed above. Given the three to six year lead time before implementation of these standards, we believe that all CI recreational marine engines can be designed and calibrated to meet the final standards.

Boat builders expressed concerns that the performance of CI recreational marine engines could be worsened due to emission control. Engine manufacturers often increase power output from a given engine by increasing the amount of fuel burned per combustion cycle. The fuel flow can be increased without a corresponding increase in air flow, but this quickly leads to high particulate and smoke emissions and an unacceptable compromise in engine durability. The alternative is to increase the air flow by increasing the boost capability of the turbocharger or increasing the cooling capacity of the aftercooler, or both. These systems can be optimized to achieve power at the expense of emission controls. Engine manufacturers, however, have many years of experience in balancing these technology changes to achieve good simultaneous control of NOx and PM emissions. We believe that engine manufacturers can also optimize their marine engines for emissions without significant sacrifices in performance by applying the technology outlined in Chapter 3 and 4 of the Regulatory Support Document. Because we do not expect the new standards to affect power and fuel efficiency, we do not expect negative impacts on the size, weight, or fuel economy of these engines.

EMA commented that we did not show the standards to be feasible for naturally aspirated engines and that we would need to relax the standards for smaller engines because of this. However, EMA did not make it clear why they believe that smaller engines must be naturally aspirated. In our cost analysis for this rule, we assumed that all engines meeting the standards would be turbocharged. We are not aware of any reasons that turbochargers could not be applied to smaller engines. Due to advancements in materials and turbocharger designs, small turbochargers can now be manufactured with low enough inertia to be efficient on even the smallest engines that will be covered by this rule. In fact, at least one manufacturer makes a turbocharged diesel engine that is at the low end of the size range of engines that would be subject to the CI recreational marine engine standards.[33] This engine has a per cylinder displacement of 0.61 liters and offers rated power ranging from 26 to 74 kW. In any case, if there were a case where a manufacturer chose to produce a naturally aspirated engine that wasn't designed to meet the standards, this manufacturer would have the option of using averaging, banking, or trading of credits to offset the deficit. In addition, Sonex presented data on a 0.4 liter per cylinder, naturally aspirated, engine in their submission stating that their technology could be used to meet the new standards.

Several commenters stated that further reductions could be achieved using advanced technology such as particulate filters and lean NOx catalysts or other aftertreatment devices to reduce NOx. We anticipate that highway engines will use particulate filters and NOx adsorbers to meet the 2007 heavy-duty on-highway engine standards. The use of lean NOx catalyst to reduce NOx emissions from marine recreational diesel engines would provide only a modest reduction in NOx emissions when new (typically well below 20%) while dramatically increasing PM emissions due to conversion of sulfur in the fuel to sulfate PM especially with the very high level of sulfur found in nonroad fuel, including marine fuel. The limited NOx benefit realized when new would be further degraded by poisoning of the lean NOx catalyst by sulfur in the fuel over the lifetime of the engine.

Particulate filters and lean NOx adsorbers are also not feasible for nonroad applications because they require very low sulfur fuel which is not available for nonroad applications at this time. As a practical matter, the only source of engines for marinization are commercial marine and nonroad land-based engines which is how the industry is structured. This is especially true with the advent of aftertreatment standards for on-highway engines which will not be fully implemented until 2010 which is after the recreational marine standards will be implemented.

[33] "Industry News: Deere Enters Small Diesel Business," *Diesel Progress; North American Edition*, March, 2002.

The transfer of technology from land-based nonroad and commercial marine engines is an important factor in our determination that the CI recreational marine engine standards are feasible. Most marine diesel engine models also serve in land-based applications. Sales of land-based versions of these engines are usually much greater than those of the marine counterpart versions, so manufacturers typically focus their primary technology development efforts on their land-based products. Manufacturers then modify these engines for use in marine applications. These changes can be extensive, but they rarely involve basic R&D for new technologies. Developing aftertreatment for recreational marine engines without prior experience on land-based engines would result in a dramatic increase in costs. Therefore, we do not believe that it would be appropriate to implement standards, at this time, that would require the use of advanced technology that has yet to be developed for the higher volume land-based diesel engine market. We would, however, consider this technology in the future for setting further tiers of marine engine emission standards. In addition, the aftertreatment technology discussed above is not considered to be available for use on these engines because the low sulfur fuel is not available. This rulemaking is under the engine setting authority of section 213, not under section 211, EPA’s authority to regulate fuel content such as sulfur levels in diesel fuel. As discussed elsewhere, EPA is currently planning to initiate a rulemaking that will address the sulfur level in nonroad diesel fuel. Future rulemaking under section 213 would then be the appropriate avenue to address more stringent standards for these marine engines, based on that fuel available to enable the emissions reductions associated with advanced after treatment technology.

4. Harmonization

What We Proposed:

The proposed standards are based on our assessment of the technology that will be feasible within the time frame of the proposed dates taking into consideration cost and other appropriate factors. Although we discuss the proposed European standards in the NPRM, our analysis of the technologies that will be available, and their cost and other factors, led us to propose the standards in the NPRM.

What Commenters Said:

EMA commented that we should harmonize our exhaust emission standards for CI recreational marine with the emission standards proposed by the European Commission. They claim that the cost-effectiveness of the proposed regulation and the small contribution of this source to national emissions inventories support a strategy of harmonization with the proposed European Commission standards. They claimed that this would foster further harmonization in other segments of the nonroad engine and vehicle emissions inventory and would reduce costs. They stated specifically that harmonization with the proposed European Commission standards would be more important than harmonizing with existing U.S. standards for commercial marine engines.

Hatteras Yachts expressed concern that if the standards were to negatively affect the weight, size, or performance of boat engines, then U.S. yacht builders would be at a competitive disadvantage in the world market with foreign manufacturers. Carver Boat Corporation expressed a similar concern stating that larger engines could result in expensive boat modifications that would reduce living space and that less fuel efficient engines would affect mileage. Regal Marine commented that reductions in engine performance could result in larger fuel tanks, increased fuel usage, and reduced living space which, combined with the costs of NTE testing, could put them at a competitive disadvantage in other markets.

NMMA expanded on the concerns expressed by Hatteras and Carver stating that U.S. manufacturers will have to certify one engine for the European Union and one for the U.S. which would be costly. In addition, they expressed concern that foreign-built boats that do not meet the standards could be purchased in other countries such as the Bahamas and then used in the U.S. unless a strong enforcement program were in place.

ICOMIA commented that it is important for recreational marine emission standards to be harmonized between the European Union and the U.S. They recommended that we align our proposed standards with the proposed European Union standards in the near term, then work closely with the European Commission to achieve harmonized Tier 2 standards.

Our Response:

We do not believe that the proposed European standards are appropriate under the applicable Clean Air Act criteria. The Clean Air Act directs us to set standards that will "achieve the greatest degree of emission reduction achievable through the application of technology" considering factors such as lead time, cost, energy, noise, and safety. As discussed above, the technology to achieve the standards will be available and this technology is cost-effective. In addition, as discussed in Section II.A.1, setting standards at this level could result in increased emissions because many engines already perform better than the proposed European Commission standards. As discussed in Section II.A.6, we have made the determination that this source contributes to air pollution. Also, based on our cost and emission reduction calculations, which are presented in the Final RSD, we believe that the standards are cost-effective.

We recognize that there are advantages to harmonized emission standards with other countries. For this reason we will continue to work with the European Commission to develop future emission standards that will meet the requirements of both the Clean Air Act and the European directives. Any engine that meets our standards would also meet the European standards. Regardless of the level of standard, manufacturers would likely need separate certifications for the U.S. and for Europe.

Although the European Commission is not proposing NTE requirements, we believe this sort of program is necessary to ensure that emissions reductions are achieved in use. We are harmonizing other certification requirements to the extent possible by using similar duty cycles and test procedures. The NTE provisions in the final rule are an essential tool for us to achieve our Clean Air Act mandate to achieve emission reductions from these engines.

Compared to the price of a yacht, the projected cost of emission control is negligible. This is discussed further in the Final RSD. Also, as discussed in Section II.A.3, we do not believe that the standards will negatively impact engine performance. Therefore, we do not believe that the emission standards would result in competitiveness impacts between vessels with engines designed to meet our standards and uncontrolled engines. In addition, we do not believe our standards would create an incentive for U.S. consumers to purchase their yachts overseas for use in the U.S. Even if they did, imported vessels would still have to meet our standards.

5. Voluntary Standards and Consumer Choice Labeling

What We Proposed:

We proposed emission levels that would define a threshold for manufacturers to earn a designation as a low-emitting ("Blue Sky Series") engine. These target emission levels are about 45 percent below the proposed standards. To maximize the potential for other groups to create incentive programs, without double-counting, we did not allow manufacturers to earn marketable credits for their Blue Sky Engines.

We requested comment on alternative consumer choice labeling concepts in addition to the proposed voluntary Blue Sky program. These concepts included labeling engines for varying degrees of emission control beyond the proposed standards and the use of an informational label which would display the engine's certification emission levels.

What Commenters Said:

EMA, Sonex, ARB, and MECA all expressed support of the proposed Blue Sky voluntary emission standards.

MECA, Sierra Club, and Bluewater all encourage EPA to implement a consumer labeling program so that consumers can make informed decisions on emission levels when purchasing engines. Sierra Club and Bluewater commented that the consumer labeling program must be mandatory rather than voluntary or there is no guarantee that it will be used by industry. Bluewater commented that a single tier label would not provide enough information on the relative emissions levels of different clean engines, so a multi-tiered label should be used. MECA and Bluewater recommended a program similar to the one used in California.

EMA commented that it opposes consumer choice labeling because emission data is already available to customers and because it is not required in other mobile source programs. The also commented that they oppose the inclusion of the certified emission levels on the labels because they would have to redo the label every time a running change is made that affects the engine emission levels and because the certification emission level may not necessarily represent emissions for some types of operations. They commented that if this were required, a supplemental labeling system would be needed which would unduly burden manufacturers.

Our Response:

Several factors are involved in developing a successful program of voluntary low emission engine standards. First and most important, the program should avoid complexity as much as possible to prevent confusion and avoid administrative disincentives to participation. Second, there should be a clear qualifying threshold that presents a significant challenge beyond the mandatory emission standards. Third, recognition of levels of control that go beyond the minimum required to qualify as a low-emitting engine are desirable but must be balanced with the need for simplicity.

In keeping with the need to create a simple and manageable program, we believe it is best to establish a single qualifying threshold for the Blue Sky Series engines. We are not at this time formalizing a plan to recognize a level of emission control going beyond the single qualifying level. Successful implementation of a simple program is seen as a necessary first step before addressing the possibility of multiple levels of voluntary standards or indexed controls. In the near term, even with only one level of voluntary low emission engine standards, engine manufacturers will have some incentive to design a system that will qualify as a Blue Sky Series engine through the transition to more stringent emission standards. Notwithstanding this initial simplicity of the federal program, states or other organizations may do well to design incentive programs that include recognition of varying degrees of superior emission control levels. Finally, we require that the engine's certification emission levels be on the engine label for certified engines. We do not believe that changing labels with corresponding engine changes is a significant burden.

6. Legal Authority

What We Proposed:

As discussed in the NPRM, we made an affirmative determination on June 17, 1994 that nonroad emissions are significant contributors to ozone or CO in more than one nonattainment area and that these engines make a significant contribution to PM and smoke emissions that may reasonably be anticipated to endanger public health or welfare. Under section 213 of the 1990 Clean Air Act Amendments, we are required to set standards that require the greatest degree of emission reduction achievable using technology giving appropriate consideration to cost, lead time, noise, energy, and safety factors for classes or categories of nonroad engines that cause or contribute to such air pollution.

What Commenters Said:

EMA commented that the December 7, 2000 finding that certain spark-ignition engines may cause or contribute to air quality nonattainment did not include CI marine engines. In addition, they commented that our earlier findings, dated December 29, 1999, regarding marine engines' contributions to nonattainment did not focus separately on CI recreational marine engines. They commented that the statutory considerations of cost effectiveness and the "de minimis" contribution of CI recreational marine engines to ambient concentrations of ozone, particulate matter, and carbon monoxide would support less stringent standards. They claimed that recreational marine engines do not significantly contribute to air pollution and therefore do not meet the criteria for regulation under CAA section 213(a) (U.S.C. § 7547).

Mercury commented that the proposed standards for CI recreational marine would contradict the Clean Air Act because high costs would be incurred without any significant environmental benefits due to the small contribution of CI recreational marine engine exhaust to national pollution. NMMA also commented that CI recreational marine engines are not a significant contributor to overall emissions from nonroad engines. They commented that we have not shown that these engines contribute to any area's non-attainment status.

Our Response:

We conducted a study of emissions from nonroad engines, vehicles, and equipment in 1991, as directed by the Clean Air Act, section 213(a) (42 U.S.C. 7547(a)). Based on the results of that study, we determined that emissions of NOx, VOCs (including HC), and CO from nonroad engines and equipment contribute significantly to ozone and CO concentrations in more that one nonattainment area (see 59 FR 31306, June 17, 1994). Given this determination, section 213(a)(3) of the Act requires us to establish (and from time to time revise) emission standards for those classes or categories of new nonroad engines, vehicles, and equipment that in our judgment cause or contribute to such air pollution. We have determined that CI recreational marine engines, rated over 37 kW, along with commercial diesel marine engines, contribute to such air pollution (64 FR 73300, December 29, 1999). No new evidence suggests any reason to change our finding.

Where we determine that other emissions from new nonroad engines, vehicles, or equipment significantly contribute to air pollution that may that may reasonably be anticipated to endanger public health or welfare, section 213 (a)(4) of the Act requires EPA to establish (and from time to time revise) emission standards for those classes or categories of new nonroad engines, vehicles, and equipment that cause or contribute to such air pollution. We have determined that CI recreational marine engines rated over 37 kW contribute to such air pollution (64 FR 73300, December 29, 1999). No new evidence suggests any reason to change our finding.

Manufacturers have claimed that CI recreational marine engines as a whole do not emit enough pollution to contribute significantly to air pollution. However, this regulation is just one step in a comprehensive nonroad engine emission control strategy envisioned in the Act. To date we have finalized emissions standards for CI nonroad land-based diesel engines, CI commercial marine engines, small SI engines such as used in lawn and garden applications, SI recreational marine engines, and locomotives. We have recently proposed standards for recreational vehicles and marine vessels (67 FR 53050, August 14, 2002).

7. Crankcase Emissions

What We Proposed:

We proposed to require that marine engines be built with closed crankcases to eliminate crankcase emissions, with one exception. We proposed to allow turbocharged engines to be built with open crankcases, provided the crankcase ventilation system is designed to allow crankcase emissions to be measured. For engines with open crankcases, we would require crankcase emissions to be either routed into the exhaust stream to be included in the exhaust measurement, or to be measured separately and the measured mass added to the measured exhaust mass. For other engines, we proposed to allow manufacturers to close the crankcase by permanently routing the crankcase gases into the exhaust. This proposal was consistent with our previous regulation of crankcase emissions from such diverse sources as commercial marine, highway engines, and locomotives.

What Commenters Said:

ARB and MECA expressed support of the proposed crankcase requirements. EMA commented that it supports this proposal with respect to certification, but engine manufacturers do not provide vessel exhaust systems. They commented that vessel manufacturers would need to provide the capability to include crankcase emissions in in-use exhaust samples and that this should be done in a manner that does not result in over-pressurization of the engine crankcase or cause back-flow of exhaust into the crankcase.

Our Response:

We are finalizing the crankcase provisions as proposed. We agree that the in-use vessels should not be configured in such a way as to cause crankcase over-pressurization or back-flow of exhaust into the crankcase. We believe that this would not pose a significant challenge for boat builders. The requirement to be able to measure crankcase emissions does not necessarily involve any change to the way engines route crankcase vapors. A vessel manufacturer could arrange for measurement of crankcase vapors in the existing vent configuration, or the vessel manufacturer may simply route these vapors into the exhaust stream. The crankcase vapors would also be vented in the existing configuration, then routed temporarily into the exhaust stream for measurement.

B. Scope of Application

1. Definition of Recreational

What We Proposed:

To distinguish between recreational and commercial marine diesel engines for the purpose of emission controls, we need to define what recreational marine diesel engines are. We proposed the following definitions:

> Recreational marine engine means a Category 1 propulsion marine engine that is intended by the manufacturer to be installed on a recreational vessel, and which is

permanently labeled as follows: "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 CIVIL PENALTY."

Recreational marine vessel means a vessel that meets the definition of a "recreational vessel" under 46 U.S.C. 2101 (25), but excluding "passenger vessels" and "small passenger vessels" as defined by 46 U.S.C. 2101 (22) and (35) and excluding vessels used solely for competition. In general, for this part, "recreational marine vessel" means 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, excluding the following vessels:

(1) Vessels of less than 100 gross tons that carry more than 6 passengers.
(2) Vessels of 100 gross tons or more that carry one or more passengers.
(3) Vessels used solely for competition

In the above definition, "passenger" has the meaning given by 46 U.S.C 2101 (21) and (21a) which generally means that a passenger is a person who pays to be on the vessel.

The above definitions represent a few changes to the existing definitions in 40 CFR 94. First, we proposed that recreational marine engines must be Category 1 engines (displacement of less than 5 liters per cylinder). We also requested comment on allowing manufacturers to define the upper limit of the recreational category as long as it was between 2.5 and 5.0 liters per cylinder. Second, we revised the label to remove the text stating that this engine does not comply with federal standards. Third, we revised the definition of recreational marine vessel to specifically reference the U.S. Code rather than relying on our own definition. This third change does not change the intent of the definition of recreational vessel that already exists in 40 CFR 94.

What Commenters Said:

EMA commented that they believe that recreational and commercial marine engines should be regulated separately. However, they commented that the label on a recreational marine engine should not include a statement saying that it cannot be used in commercial applications. They claimed that the rationale for such labeling is unsound because the engines should be labeled for what they can be used in rather than what they cannot be used in. As an example, they noted that the engine is not labeled that it cannot be used in locomotives, highway trucks, airplanes, and so forth. They also commented that the definition of recreational should be based solely on vessel type and not on engine characteristics such as cylinder displacement or engine size. EMA stated that it would support the proposed definition of a recreational vessel if the three exclusions were removed from the proposed definition. They commented that such vessels would operate the same regardless of the number of passengers on board.

EMA also commented that there should not be an upper size limit on the definition of a recreational marine engine. They stated that this would result in insufficient lead time for recreational marine engines greater than 5 liters/cylinder because these engines would have to certify to the commercial marine rule in 2007. Finally, they commented that allowing manufacturers to determine the upper size limit for recreational marine engines could result in manufacturers gaming the definition for competitive advantages.

NMMA and Hatteras commented that the definition of a recreational vessel should be based on what the boat is intended for rather than how it is used. They commented that they would support a definition based on their design intent, but not one which would require them to guarantee that a boat will only be used for recreational purposes. NMMA recommended the definition of a recreational vessel as one:

> *1. which by design and construction is intended by the manufacturer to be operated primarily for pleasure, or 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.*

Carver commented that they oppose the proposed definition because they would not be able to guarantee or document any potential end use of a recreational boat. Regal Marine commented that they oppose any plans to require boat manufacturers to guarantee or document any potential end use of a recreational boat.

Mercury marine commented that any CI marine engines with sterndrive packages should be considered recreational marine engines. They commented that sterndrives are used in a small planing boat market niche where a high power to weight ratio is necessary. This niche includes recreational type boats and light duty commercial applications.

Our Response:

In general, commenters on this rule seem to agree with us that it is appropriate to distinguish between commercial and recreational marine engines for the purpose of establishing requirements under §213 of the Clean Air Act. Concerns focus on how we define which engines are subject to which set of standards. We define a recreational marine engine as a propulsion marine engine that is intended by the manufacturer to be installed on a recreational marine vessel.

We believe that it is appropriate to define recreational marine vessels using the Coast Guard definitions contained in 46 U.S.C. 2101. Specifically, we are defining recreational vessel 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. We continue to believe that it is necessary to put some boundaries on this definition, because certain vessels that are used for pleasure may have operating characteristics that are, in fact, similar to commercial marine vessels. For example, engines installed on excursion boats should be grouped with the commercial marine engines because they are used much more intensely (more hours, higher load) than engines on a similar vessel operated exclusively for one's pleasure. Therefore, we are drawing on the Coast Guard's definition of passenger vessel to further delineate what will be considered to be a recreational vessel for the purposes of this rulemaking.

A vessel will be considered recreational if the boat builder intends that the customer will operate the boat consistent with the recreational vessel definition. Relying on the boat builder's intent is necessary because manufacturers need to establish a vessel's classification before it is sold, whereas the Coast Guard definitions apply at the time of use. The final 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 will always consider that a recreational vessel regardless of how the owner (or a subsequent owner) actually uses it. We will monitor this issue to ensure that neither boat builders nor buyers abuse this provision. We also expect that boat builders will make a good faith effort to ensure that buyers purchase the correct class of boat. For example, boat builders may ask for written assurance from the buyer that a boat will be used recreationally, especially in cases where the builder believes that commercial use is possible. NMMA and Hatteras suggested limiting the definition of recreational vessel based on whether it is constructed in a dry dock, graving dock, or marine railway. However we believe that it is more appropriate to use the Coast Guard definitions which are more directly related to the vessel construction and use.

We believe it is appropriate to limit the definition of recreational marine engines to Category 1 engines (less than 5 liters per cylinder), because engines larger than this are generally designed with characteristics similar to commercial marine engines. For example, these engines are not generally used in planing vessels. Vessels using engines of this size generally require engines that can operate longer at higher power than typical recreational boats; therefore, these engines generally have a lower power density and are not offered in a "recreational" rating. As a result, we do not believe that larger engines considered by manufacturers to be “recreational” would need additional lead time beyond the commercial marine requirements. In any case, standards beginning in 2007 still provide more than 4 years of lead time which should be sufficient given the close similarity of these engines to those already subject to the commercial marine standards.. Because manufacturers were concerned that having the option of choosing their own upper limit for “recreational” between 2.5 and 5.0 liters per cylinder could result in gaming, and because we did not receive supporting comments, we are not finalizing this provision.

Our intent with the labeling requirement is to make sure that boat builders and owners use the engine that corresponds to their vessel application once our standards take effect. We believe it is most effective to label the recreational engine, because the prohibition concerns installing recreational engines on commercial vessels. If recreational engines were not labeled, boat builders and owners would have no way of knowing that the engine was intended to only be installed in a recreational vessel. There is no practical likelihood of marine engines being used in land-based applications, hence the focus of the label on marine applications is appropriate.

It should be noted that here is no prohibition against installing a certified commercial marine engine on a recreational vessel. A manufacturer selling engines used in both commercial and recreational applications would have the option of certifying all of their engines as commercial marine engines for the purposes of complying with emission standards. The primary difference between the commercial and recreational requirements is that the useful life for Category 1 commercial marine engines is a 10,000 hours while the useful life for recreational engines is 1,000 hours. However, the manufacturer may request to apply a useful life as low as 1,000 hours for commercial marine engines provided that they can document the that these engines will rarely operate longer than the alternate useful life. Manufacturers would be likely to apply for this lower useful life definition for light-duty commercial applications anyway. To use this option, a manufacturer would need to apply the shorter useful life to the whole engine family and add the useful life to the engine label. Therefore, an engine manufacture wishing to certify all of their sterndrive engines under one rule could certify all of their engines as light-duty commercial and the engines could still be used in recreational as well as commercial applications.

2. Competition Between SI and CI Engines

What We Proposed:

The proposed standards apply only to CI recreational marine engines. Exhaust emission standards for spark-ignition (SI) outboards and personal watercraft were finalized in 1996 and are phased-in from 1998 to 2006. We have not yet proposed exhaust standards for SI sterndrive and inboard marine engines.

What Commenters Said:

EMA commented that the effective dates for standards for CI recreational marine engines need to be aligned with the effective dates for SI recreational marine engines to prevent any anti-competitive effects between CI and SI marine engines. Cummins specified that their concerns for competition are between SI sterndrive and inboard marine engines and CI engines below 1.5 liters per cylinder, especially in the 150 to 400 hp range. Cummins also recommended that EPA set requirements for SI marine engines that are of similar stringency as what we implement for CI recreational marine engines.

Cummins stated that the most significant area of competition between SI and CI is for applications in the range of 150 to 400 horsepower. Above this range, most engines are CI and below this range, most engines are SI. They commented that any cost increases or performance impacts could affect their ability to compete in this power range.

Our Response:

Because we did not propose standards for SI sterndrive and inboard marine engines, we cannot finalize standards for them at this time. However, we are planning future emission control strategies for exhaust emissions from these engines. Outboard marine engines in this size range are already required to achieve about a 75 percent reduction from baseline in HC+NOx. Also, we recently proposed evaporative emission standards from all boats using SI engines. The standards for CI recreational marine engines is part of a comprehensive program intended to control emissions from all nonroad engines and vehicles.

Although CI and SI engines appear to be reasonably interchangeable in the 150 to 400 hp range, factors other than performance tend to be of primary consideration when deciding which type of engine to purchase. There is a large price difference between a diesel engine and a gasoline engine of the same power, with consumers already willing to pay twice as much for a diesel engine than a gasoline engine. The advantages of the diesel engine include better fuel economy, safety, durability, and lower insurance costs.[34] Because of the advantages of diesel engines perceived by consumers, we do not

[34] "Competitiveness Between SI and CI Engines in Recreational Boat Market," Internal EPA memo from John Mueller to CI Marine Team, June 16, 1998.

believe that the new standards will affect the competitiveness between SI and CI recreational marine engines.

3. Meaning of "New"

What We Proposed::

To help define which engines would have to meet these emission standards, we proposed to use the approach set out in section 213 of the Act and require that the standards cover all new recreational marine diesel engines and new marine vessels that use those engines. We proposed to use the term "new" as it is used in our other nonroad programs, including commercial marine. Under this definition, an engine is considered new until its legal or equitable title has been transferred or the engine has been placed into service. Because some recreational marine diesel engines are made by modifying a highway or nonroad land-based engines that has already been installed on a vehicle or other piece of equipment, we also stated in the NPRM that a marine diesel engine is placed into service (i.e., used for its functional purposes) when it is installed on a marine vessel.

What Commenters Said:

EMA commented that they support the intent of this proposal because it will help prevent engines from being imported that do not meet the proposed standards. However, they commented that EPA should just require that imported engines should meet the applicable standards, such as in the commercial marine regulations, rather than defining them as "new."

Our Response:

We are finalizing the requirement for engines that have been used in non-marine applications to be certified to marine emission standards if they are installed on a vessel. This is achieved in the regulations with the definition of a new marine engine. Defining imported engines as "new" is consistent with the commercial marine engine requirements.

4. IMO Applicability to Recreational Engines

What We Proposed:

The NPRM includes a discussion of the NOx limits adopted by the International Maritime Organization (IMO) in Annex VI to the International Convention on the

Prevention of Pollution from Ships (MARPOL 73/78). These standards apply to any engine with a power output of more than 130 kW installed on a vessel constructed on or after January 1, 2000. To go into force internationally, Annex VI NOx must be ratified by 15 states the combined merchant fleets of which constitute 50 percent of the world's merchant shipping tonnage. Until then, ship owners and vessel manufacturers are expected to install compliant engines on the relevant ships, since the standards are expected to be applied retroactively. To date, 6 countries with a combined merchant tonnage of 15 percent have ratified the Annex VI. The Annex VI NOx limits are based on engine speed. For engines with a rated speed of greater than 2000 rpm, this NOx standard is 9.8 g/kW-hr. For slower speed engines, this limit increases as a function of rated power ($45 \times kW^{-0.2}$) with an upper limit of 17 g/kW-hr. In addition to certifying the engine, engine manufacturers must supply a Technical File with each engine. Vessel operators are required to maintain a Record Book of Engine Parameters to record all parameter changes that may affect engine NOx emissions.

What Commenters Said:

EMA commented that we should make it clear that IMO Annex VI standards, once ratified, will be applicable to recreational marine engines until today's standards take effect. EMA also commented that all foreign flagged vessels must at least comply with the IMO Annex VI, once ratified, to be brought into this country for personal use.

Cummins commented that, once ratified, the IMO standards would apply retroactively to all recreational and commercial domestic marine engines above 130 kW; therefore, they already serve as a first tier for recreational CI marine engines and should continue to apply. Cummins recommended that the technical files should not be required to be provided with each engine for domestic engines below 5 liters per cylinder because this is a costly requirement for mass-produced engines that would not provide any environmental benefit.

Our Response:

As we explained in the preamble for this rule, the Annex VI NOx limits will become enforceable once the Annex goes into effect. The standards are expected to be applied retroactively to vessels constructed on or after January 1, 2000, and will continue to apply until the standards we are finalizing in this rule go into effect. As part of the U.S. Annex VI ratification process, implementing legislation will be prepared that address these provisions.

The Annex VI NOx limits will apply to any engine above 130 kW installed on any vessel, including foreign vessels that enter the United States. Consequently, foreign vessels that are brought into this country for recreational use are expected to comply.

We understand Cummins concerns about providing a technical file for each recreational engine. We are also concerned about whether recreational boat owners will be able to maintain the Technical File and Record Book of Engine Parameters as required by Annex VI and the NOx Technical Code. However, the NOx Technical Code currently requires that a Technical File be provided with each engine, and each engine manufacturer is currently required to submit information about that Technical File as part of the application for a Statement of Voluntary Compliance. Until this issue can be resolved at IMO, we recommend that engine manufacturers continue to supply this document with each engine.

C. Certification and Compliance Issues

1. Averaging, Banking, and Trading

What We Proposed:

We proposed an emissions averaging, banking, and trading (ABT) program which would allow the certification of one or more engine families within a given manufacturer's product line at emission levels above the applicable standards, provided that the increased emissions are offset by one or more engine families certified at levels below the applicable standards. The proposed program would also allow for the banking of credits for use in future model years as well as the trading of credits to other manufacturers.

The proposed program is voluntary and only available for HC+NOx and PM emissions. We proposed that an engine family could not generate credits on one pollutant while using credits on another. The proposed credit calculations were based on sales-weighted average power, production volume, and useful life. We proposed that the credits have an infinite life with no discounting over time; however, we noted that if we were to revisit the standards at a later date we would have to reevaluate this issue in the context of spillover of credits in the new program. We also proposed a maximum limit on FELs (same levels as for commercial marine) and that credits would only be able to be exchanged with other recreational CI marine engines. As an alternative to FELs defined by the manufacturers, we requested comment on using a "bin" structure for determining credits where we would create emission levels for credit/debit generation based on step changes in technology.

We proposed two options for early banking of emission credits. The first option is to generate undiscounted credits relative to the proposed standard. The second option is to generate credits, discounted at ten percent, based on the pre-control emission levels. This option would require testing to determine the baseline levels and the engine would still have to meet the proposed standards to generate the credits. We also requested comment on alternatives to early banking that would allow a smooth implementation of the standards. The example given in the NPRM would be "family-banking" where if a manufacturer were to certify an engine family 1 year early, they could certify a smaller engine family one year late.

What Commenters Said:

CARB commented that they support the ABT provisions as proposed.

EMA and Cummins recommended that cross-trading of credits should be allowed between commercial and recreational CI marine engines. They commented cross-trading should have no negative impact on the environment because commercial and recreational engines have similar designs, the total CI marine market is small, and the credits could be designed to compensated for differences in operation and useful life. EMA stated that small companies making only recreational or commercial engines could trade with other companies to exchange credits within the full range of their marine engine families. Cummins commented that their marine business is operated as a whole and that decisions on development and production are made based on how the entire business is impacted. They stated that the sales of marine engines is small compared to land-based engines, so restricting ABT separately to recreational engines would severely limit flexibility which they need for these markets to remain viable.

EMA commented that a single family should be able to generate and use credits for different pollutants. They expressed opposition to the proposed caps on FELs because it limits flexibility; however, they commented that if caps are applied, they should be based on the IMO NOx standards and land-based Tier 1 PM standards so that the caps will essentially represent the prior emission standards for these engines. EMA also commented that they support the FEL structure and that it should be used rather than a bin structure because it would give manufacturers maximum flexibility.

EMA expressed its support for the concept of early banking and the availability of both of the proposed options for generating early credits. However, they commented that no credits should be earned under the second option for baseline emissions above the IMO Annex VI limits. Finally, EMA commented that is supports the concept of family banking because it would allow engine manufacturers to spread their product line development over multiple years and it could help vessel manufacturers transition to using regulated engines. In a later meeting with EMA, they stated that they would not need this option provided that they could generate early credits.[35]

Our Response:

In general, commenters supported the availability of an averaging, banking, and trading program. However, manufacturers expressed that they believe we should remove several restrictions on the generation and use of credits. While we understand that the proposed restrictions make the program less useful to manufacturers than it would be in the absence of those restrictions, we believe that our rationale for the restrictions is sound and that an ABT program with restrictions still provides significantly more flexibility that no ABT program at all.

We are not allowing credits to be exchanged between CI recreational marine engines and either commercial marine engines or land-based engines. The standards we are adopting are premised on an evaluation of the emissions reductions achievable from recreational marine engines, through the application of emissions control technology to recreational engines, taking into consideration the averaging, banking, and trading provisions adopted. To allow credits generated from outside this group of recreational engines to be used to show compliance with the recreational standards is inconsistent with this basis for the standards. Allowing the use of such credits would not be appropriate as we did not take the availability of such credits into consideration in setting the standard. In addition, we are concerned that manufacturers producing land-based and/or commercial marine engines in addition to CI 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. If a manufacturer were to do this, we do not believe it is likely that they would sell emission credits at a price that would be economical for small manufacturers. In addition, emissions from land-based, commercial, and recreational marine engines are measured over different duty cycles and have different useful lives. Although corrections could be generated for these effects, they would add complexity and uncertainty to the value of the credits. In the future, we may consider combining the recreational and commercial categories through the development of potential Tier 3 standards which could remove the issue of cross-trading between recreational and commercial marine diesel engines.

Consistent with requirements for land-based and commercial marine diesel engines, we are not allowing simultaneous generation of HC+NOx credits and use of PM credits

[35] "Record of Meeting Between EMA and EPA on May 24, 2002 to Discuss Proposed Standards for CI Marine Engines," Memo from Mike Samulski, U.S. EPA to Docket A-2000-01, May 24, 2002.

on the same engine family or vise versa. This is necessary because of the inherent trade-off between NOx and PM emissions in diesel engines.

We are applying the same maximum value of the Family Emission Limit (FEL) as for commercial marine diesel engines. These maximum FEL values are based on the comparable land-based emission credit program and will ensure that emissions from any given family certified under this program not be significantly higher than the applicable emission standards. We believe these maximum values will prevent backsliding of emissions above the baseline levels for any given engine model. Also, we are concerned that the higher emitting engines could result in emission increases in areas with waterways that may have a need for PM or NOx emission reductions. EMA commented that FEL caps limit flexibility; however, if they are applied the caps should essentially represent prior emission standards for these engines. Because our FEL caps are derived from Tier 1 land-based nonroad engine emission standards, and because CI marine engines are generally derived from land-based nonroad engines, we believe that our rationale is consistent with EMA's recommendation.

We believe early banking of credits has some value to ease the transition to the new standards. This is especially true for the larger CI recreational marine engines, which are required to meet the standards in 2009. Allowing early banking would give manufacturers of those engines an opportunity to gain experience with those engines prior to the effective date of the not-to-exceed requirements. Also, most marine engines being regulated here are derived from land-based and commercial marine engines, and because the lead time we are providing for these engines is 2 years after the implementation date for commercial marine engines (and longer after land-based engines), early banking of emission credits may allow for a smoother implementation of the recreational marine engine standards.

EMA commented that credits should not be generated under the early banking program for the portion of NOx reductions above the IMO standard. We believe that this approach is reasonable. Therefore, if manufacturers use the second option allowed in the early banking program, any baseline NOx levels determined to above the IMO standard must be adjusted to the IMO standard for the purpose of determining early credits.

We are not finalizing a family banking program that would allow manufacturers the option of phasing in their product lines from the year prior to the standard to the year after the standard because manufacturers would be able to spread the introduction of their product lines over several years without any loss in emission reductions through the use of our early banking program. We believe early banking would be especially useful for a manufacturer who would otherwise need to introduce several new product lines in a single year. By certifying an engine family early, the manufacturer would be able to delay certification of another engine family through the use of banked credits.

2. Exemption Labeling

What We Proposed:

We proposed that we may require manufacturers (or importers) to add a permanent label describing that the engine is exempt from emission standards for a specific purpose. In addition to helping us enforce emission standards, this would help ensure that imported engines clear Customs without difficulty.

What Commenters Said:

EMA supports this proposal provided that the level of information required on the label is not too burdensome. They comment that it would be helpful to facilitate the importation of exempt engines.

Our Response:

We are finalizing this provision as proposed. We do not believe that the information required on the label (heading, corporate name/trademark, engine displacement and power, statement of exemption) is burdensome.

3. Imported Engines

What We Proposed:

Consistent with our approach for commercial marine vessels, we proposed that engines imported into the United States would be considered new engines and would be subject to these standards. However, there would be some instances where imported engines would be exempt from the recreational marine engine standards. For recreational marine diesel engines, we proposed to apply the same exemptions for imported engines as for commercial marine. Engines that are not certified to our standards could be imported temporarily for repairs/alterations, testing, or display or imported permanently for purposes of national security, competition, or if they are incomplete and are going to be modified to meet our standards.

What Commenters Said:

EMA commented that it would support the import exemptions proposed for gasoline recreational vehicles being applied to CI recreational marine engines. These exemptions include permanent exemptions for identical configuration to certified engines, personal use (one time only), antique engines, and temporary exemptions for repair or alterations, or for diplomatic or military purposes. EMA supported the personal use exemption with the condition that it should be made clear that this exemption is not renewable, only is allowed once per vessel, and that the exempt engine must at least comply with IMO Annex VI requirements once IMO is fully ratified. These exemptions are in addition to those we proposed for CI recreational marine engines.

EMA also commented that they support the intent of the proposal to apply the standards to imported marine engines. They stated that it will close a loophole that could be used to circumvent the regulations and disadvantage domestic manufacturers. However, they commented that we do not need to define imported engines as "new" to close the loophole; we should just state that imported engines, not otherwise covered by an exemption, must meet EPA standards.

NMMA expressed concern that non-compliant engines would be imported into the U.S. if we do not create a strong enforcement mechanism. They commented that this would put domestic manufacturers at a competitive disadvantage with foreign manufacturers if non-compliant boats were purchased in other countries and brought to the U.S. The NMMA comments cite instances were Americans were encouraged to purchase boats in the Bahamas in 1991 to avoid the 10 percent luxury tax that was in place at that time.

Our Response:

From EMA's comments, it appears that they misconstrued the proposed import exemptions for recreational vehicles proposed in part 1068 as applying to CI recreational marine vessels as well. We are not finalizing the personal use exemption for any of the categories covered by this rule. Especially for recreational marine engines, we believe that this sort of an exemption could be used to circumvent the emission standards because of the long life of yachts and because it would be difficult to track the exemptions. However, we are extending all of the import exemptions applicable to commercial marine engines to CI recreational marine engines.

We do not believe that the new standards would create an incentive for consumers to purchase their boats elsewhere and import them illegally into the U.S. While the luxury tax resulted in a 10 percent increase in the price of a yacht, we anticipate that these standards will result in about a 0.1% increase in the price of a yacht. In addition, consumers are getting a return on the price increase of better technology while the tax did not give this return. In any case, importing a noncompliant engine would be illegal and would be enforced by the Customs office of the U.S. Department of Treasury similar to other imports. Our designation of imported engines as "new" is consistent with other engine and vehicle emission standards already in place.

4. Rebuilding/Recordkeeping

What We Proposed:

We proposed to extend the commercial marine rebuild requirements to recreational marine diesel engines. Under these requirements, rebuilders of engines subject to emission standards in this rule generally must, when rebuilding an engine, restore the engine to its original configuration from an emissions standpoint. This requirement is based on the statutory prohibition against tampering with regulated engines.

What Commenters Said:

EMA commented that they generally support requirements designed to ensure that engines are rebuilt to their original configuration.

Our Response:

As supported by the comments, we are finalizing the proposed rebuilding requirements. Note that this includes out-of-frame rebuilding which is commonly referred to as remanufacturing. Also note that if the rebuilt marine engine is installed in another existing vessel, our replacement engine provisions would apply. If it is used to provide power to a new vessel, we would treat the rebuilt engine as a new engine.

5. Defect Reporting

What We Proposed:

We proposed to require engine manufacturers to report to us if they become aware of a significant number of emission-related defects. This number is 25 for families with annual sales of 10,000 and increases proportionately with sales volume beyond 10,000 annual units. For catalyst-related defects, the threshold would be approximately one-half of the frequency of non-catalyst related defects to trigger a defect report.

What Commenters Said:

EMA commented that they did not oppose this proposal.

Our Response:

We are finalizing the defect reporting requirement as proposed. We believe that there is value in having manufacturers report the defects they detect. On the other hand, we believe that it could become burdensome to require manufacturers to report every defect. The numbers chosen represent a compromise, and are the consistent with those used for Category 1 commercial marine engines and comparable land-based engines. It is also important to emphasize that these limits apply to the occurrence of the same defect, and are not constrained by engine family or model year. For example, if a manufacturer becomes aware of an emission-related defect in a specific fuel injector design that has been used in three different engine families for four model years, then the manufacturer must report the defect if the combined numbers of occurrences in the three families and four model years exceeds the specified limit. Thus, these requirements can be meaningful for engine families with small production volumes.

6. Recall

What We Proposed:

Under CAA section 207, if we determine that a substantial number of engines within an engine family, although properly used and maintained, do not conform to the appropriate emission standards, the manufacturer will be required to remedy the problem and conduct a recall of the noncomplying engine family. We proposed that we would consider alternatives to recall nominated by a manufacturer provided that the alternative represents a new initiative, is related to the problem demonstrated, costs more than the foregone compliance costs, offsets the emission exceedance, and can be implemented effectively in a reasonable time.

What Commenters Said:

EMA supports this approach and believes that EPA should encourage manufacturers to propose alternative approaches to recall that would result in larger environmental benefits than recall.

Our Response:

We are finalizing this approach as proposed.

7. Emission Data Submission

What We Proposed:

We proposed to apply similar emission data submission requirements as already apply for commercial marine engines. Included in this proposal is the requirement that, when selecting emission-data engine for certification, manufacturers must choose the engine that would be most likely to exceed the emission standards (so called “worst emitter”). Furthermore, we proposed 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.

What Commenters Said:

Cummins commented that it would be overly burdensome for manufacturers to determine which engine would be the worst-case configuration considering all exhaust emission constituents and the wide range of installation options available to boat builders. In addition, they commented that they would have to reevaluate the worst-case configuration every time a running change was made. The recommended that we require that the emission data engine be the engine in a family that has the highest fuel rate per stroke at rated power. This is similar to the highway and land-based nonroad requirement of determining the emission data engine based on highest fuel rate per stroke at rated torque.

EMA commented that it would be too burdensome to include in their certification application all emission results from their test engines including any diagnostic measurement data and data from invalid tests. They further commented that they are not required to do this for any other applications.

Our Response:

We believe that it is necessary to base the emission data engine on the engine that would most likely exceed the standards to ensure that all of the engines in the engine family are complying with the emission standards. In making the selection of worst-case, the manufacturer should consider the proximity of each engine’s expected emissions over its full useful life for each constituent with the applicable standards. The engine producing the regulated constituent which is closest to the applicable standards compared to all other regulated constituents (i.e., most likely to fail an emission standard) should be chosen as the worst-case engine. In making that determination, the manufacturer would use good engineering judgment considering all of he engine configurations and power ratings in an engine family and the range of installation options allowed. In many cases, the engine with the highest fuel rate per stroke at rated power may not necessarily be the worst-case engine. By relying on good engineering judgement, a manufacturer has the discretion to select the appropriate engine for emission testing. This is appropriate because the manufacturer is liable for ensuring that all engines comply with the standards.

Manufacturers may request the separation of engines with dissimilar calibrations into different engine families. This may be appropriate, for example, if a manufacturer feels that an engine family is grouped too broadly so that it is overly burdensome to identify the worst-case configuration, or that the worst-case emission data engine underestimates the emission credits available under the ABT provisions.

The current requirements for the certification application for commercial marine engines state that each application shall include "all test data obtained by the manufacturer on each test engine" (§94.203(d)(10)). We are extending this requirement to CI recreational marine engines because a complete set of test data ensures that the valid tests that form the basis of the manufacturers's application are a robust indicator of emission control performance, rather than a spurious or incidental test result. However, the regulations also state that we may modify the information data submission requirements in §94.203(d) provided that manufacturers keep this data in their records and make it available it us upon request (§94.203(g)). In other programs, we have generally only required manufacturers to submit valid test data on their certification test engines in their certification application; however, we may require that the invalid test data and diagnostic data be included as well.

8. Production Line Testing

What We Proposed:

We proposed a production line testing (PLT) program to ensure that production engines actually meet the emission standards they were certified as meeting. Under the proposed PLT program a manufacturer would be required to conduct an emission test on a percentage of its annual production at the conclusion of the production process or assembly line. We proposed that each manufacturer would have to test one percent of its engines per year, with the test engines being randomly selected and representative of annual production. We proposed that no testing be required if a manufacturer's sales were less than 100. We did not propose a maximum number of tests.

If any engine tested under the proposed PLT program exceeds the emission standard for any pollutant, the manufacturer would be required to test two more engines of the production from the next two days or the next fifteen engines produced in that engine family. If the average of the three test results was greater than the standard for any pollutant, the manufacturer has failed the PLT for that engine family. EPA could suspend or revoke a manufacturer's certificate of conformity within 15 days of the failure. Regardless of the outcome of the testing, we proposed that any engine failing an individual test under the PLT program be required to be brought into compliance with the standards.

We proposed to allow a manufacturer to submit for our approval a plan for an alternative PLT program that would better suit its needs. Such a request would be required to include an explanation of the need for an alternative, as well as details such as sample size and engine selection criteria, and provisions regarding what constitutes a failure of an engine family under the alternative plan.

The proposed PLT program was developed as an alternative to our traditional selective enforcement audit (SEA) approach due to the low production volumes of recreational CI marine engines. However, we also proposed that we retain the authority to do an SEA of a manufacturer's production.

What Commenters Said:

EMA commented that requiring production line testing is overly burdensome if EPA can still perform selective enforcement audits and recommended that PLT testing not be required. In the case that PLT was required, they commented that we should limit the number of tests required for a given engine family to five, stating that for some large engine families, the number of required tests would be as high as fifteen. They argued that five engines would be sufficient to demonstrate compliance with the standards.

Our Response:

The Clean Air Act gives us the authority to require or conduct SEA testing, so it would not be appropriate to waive this authority. The PLT requirements in this final rule do not affect our ability to do SEA testing if we see the need to conduct an audit.

Given the sampling rate we are adopting, and the typical production volumes of these engines, we believe that a manufacturer generally won't be faced with having to perform more than five tests on a given engine family. This would only seem likely in cases where a manufacturer has fairly high production volume and a very few engine families. Furthermore, there isn't a statistical reason for capping the number of tests for each engine family regardless of the data collected. We believe a one percent sampling rate sufficiently limits the testing burden for these engines.

However, if there were a statistical reason for capping the number of tests at five engines (or less), then we believe that additional tests would be unnecessary. An example of such a scenario would be if the engines tested had consistent emission results and were below the family emission limit. Therefore, we are providing the option of using the Cumulative Sum method for determining PLT sample sizes. This method is described for recreational vehicles in 40 CFR 1051, subpart D. For marine engines, PM would need to be included in this methodology. Under the Cumulative Sum method, a statistical analysis is applied to the PLT test results which may limit the number of engines tested to less than 1 percent of the production volume. We are finalizing this option for both commercial and recreational CI marine engines. This is not a significant change in the commercial marine PLT provisions because manufacturers already have the option of using alternative production line testing programs with EPA approval (40 CFR 94.503 (b)).

9. Selective Enforcement Auditing

What We Proposed:

In the proposal, we stated that Clean Air Act section 206(b) gives us the authority to perform selective enforcement auditing (SEA) of production engines. In an SEA we would choose an engine family and give the manufacturer a test order detailing a testing program to show that production-line engines meet emission standards.

What Commenters Said:

EMA commented that if we are going to reserve the right to perform SEAs, we must propose for comment what would be involved in an SEA, how it would be conducted, what would constitute a pass or fail, and how a fail would be addressed. They stated that we did not include these details in the NPRM.

Our Response:

The Clean Air Act authorizes us to require or conduct SEA testing regardless of whether we have specific regulations in effect. Should we decide to perform an SEA, we would use the SEA program for land-based nonroad engines (40 CFR Part 89, subpart F) for guidance.

10. Useful Life

What We Proposed:

We proposed that engines be required to comply with the standards for a useful life period that ends when either 1,000 hours are reached, or after 10 calendar years, whichever occurs sooner. Engines designed to last more than 1,000 hours would be subject to a longer useful life.

What Commenters Said:

EMA commented that they did not oppose the proposed useful life requirement. ARB commented that they supported the proposed useful life definition.

Our Response:

As supported by comments, we are finalizing the proposed useful life of 1,000 hours/10 years. Engines designed to last more than 1,000 hours would be subject to a longer useful life.

11. Durability Demonstration

What We Proposed:

We proposed to apply the commercial marine durability demonstration requirements to recreational CI marine engines. In the NPRM, we stated that this demonstration would be based on good engineering judgement, and that the manufacturer would generally need to test one or more engines for emissions before and after 1,000 hours of operation. This discussion points to alternatives to this testing such as using data from different engine families or from different model years. In addition, we direct the reader to the requirements specified in 40 CFR §§94.211, 94.218, 94.219 and 94.220.

What Commenters Said:

EMA commented that it should be adequate for manufacturers to perform testing over a representative fraction of the engine's useful life, such as 400 hours, and use this information to determine appropriate deterioration factors.

Our Response:

Although we did not state it specifically in the NPRM, manufacturers would be able to demonstrate durability with operation of less than 1,000 hours under 40 CFR § 94.220(b)(1). This section states: "End of useful life emission levels and deterioration factors may be projected from durability data engines which have completed less than full useful life service accumulation, provided that the amount of service accumulation completed and projection procedures are determined using good engineering judgment."

12. Engine Labeling

What We Proposed:

We proposed similar labeling requirements as are already applicable to commercial marine engines. One requirement is that the label on the engine be readily visible after the engine is installed. For equipment with gasoline engines covered by this rule, we proposed that if equipment manufacturers needed to obscure the label, then a duplicate label would need to be added to the equipment.

What Commenters Said:

EMA commented that they support a requirement of engine labeling for compliance similar to the labeling requirements for commercial marine engines. They also commented on applying to CI recreational marine a duplicate label requirement which we proposed for gasoline recreational vehicles. According to that provision, equipment manufacturers would have to add a duplicate label to the equipment if the engine label is obscured. EMA stated that they would not oppose requiring duplicate labels if the label on the engine is obscured for recreational vessels. However, EMA commented that we would need to specify that any duplicate labels made by the equipment manufacturer cannot include the engine manufacturer's trademark and that if the engine manufacturer were to provide the label to the vessel manufacturer, the engine manufacturer should not be held liable for misuse of the label.

Our Response:

We do not believe it is necessary to create a provision for recreational vessel manufacturers to apply duplicate labels on their vessels. Generally, the engines are contained in an engine room or compartment that is not visible during normal operation. However, access is generally provided to all parts of the engine for the purposes of maintenance. Therefore, we believe that it is possible to position the label on a CI recreational marine engine so that it is readable once the engine compartment is opened or from inside the engine room.

D. Special Compliance Flexibility

1. Engine Dressers

What We Proposed:

We proposed to extend the commercial marine diesel engine dresser exemption to recreational marine diesel engine manufacturers. That exemption is available to engine manufactures that produce a marine diesel engine from an engine that had already been certified to highway, nonroad, or locomotive engine emission standards, provided that the dresser makes no changes to the certified engine that could reasonably be expected to increase emissions, and provided that the majority of engines (from all manufacturers) were not produced for marine applications. In addition, the original label must remain on the engine, and an additional label must also be affixed stating the engine is marinized without affecting its emission controls. The goal of our engine dressing provisions is to eliminate the burden of certification and other compliance requirements where we have confidence that engines already certified to comparable standards from other programs will meet marine engine emission standards. Anyone using this exemption would be required to notify us and their customers of their activities.

What Commenters Said:

ARB commented that they support the proposed regulatory flexibility extended to engine dressers. EMA commented that it did not oppose this provision.

Our Response:

We are finalizing the proposed engine dresser exemption.

2. Small Volume Engine Marinizers

What We Proposed:

To address the special circumstances of small businesses, and particularly small volume marinizers, we proposed a set of flexibility provisions that were discussed by the Small Business Advocacy Panel assembled for this rule. These provisions include broadened engine families, waiving production line testing, waiving deterioration testing and allowing these manufacturers to use an assigned deterioration factor, streamlined certification, delaying the effective date of the standards for five years, hardship provisions, and design-based certification. We also proposed to expand the engine dresser exemption to cover small-volume marinizers, and allow them to install water-cooled turbochargers to a certified engine as long as the performance of the non water-cooled turbocharger is matched.

What Commenters Said:

EMA commented that it believes that the proposed flexibility for small volume engine marinizers would put large volume manufacturers at a competitive disadvantage. They recommended that large volume manufacturers should be able to apply the special provisions proposed for small volume manufacturers to up to 1000 engines per year.

Bluewater Network commented that the five-year delay proposed for small-volume manufacturers is unnecessary given the proposed hardship relief provisions. They believe that standards must be implemented as earlier.

CARB and Sonex commented that they support the proposed relief for small volume engine marinizers. Sonex further stated that these provisions create a favorable environment for the introduction of new technology.

Peninsular commented that they are a small volume marinizer producing about 200 engines per year. Although the emission contribution of their engines would be small compared to total emissions from this source, they commented that they will pursue emission reductions with timing adjustments. However, they commented that the certification process alone would require a large expenditure for testing equipment and that they do not have engineers on staff to equip and test new components. They also commented that any additional costs could hurt their ability to export engines (40% of their production).

Our Response:

The purpose of the small volume marinizer provisions is to provide additional flexibility to businesses that do not have large resources to absorb fixed costs such as research and development and certification testing or have the ability to quickly redesign their products. Peninsular’s comments provide a good example of the difficulties that would be faced by a small marinizer. Therefore, we believe that the small volume marinizer provisions, including the five year delay of the standards, are necessary to give small businesses the opportunity to comply with our standards.

We do not believe it is appropriate to extend the flexibility provisions for small volume engine marinizers to large businesses where there are no clear technology or cost reasons to do so. In addition, most of these small companies produce much less than 1000 engines.

Although we proposed to allow certification to the standards by design, we were unable to specify any technology options for diesel engines that could be used for a design-based certification. We requested comment on such designs and received no comment. Therefore, we are not finalizing a design-based certification option. However, we are finalizing the engine dresser provisions and expanding these provisions to include water-cooled turbocharging. This will essentially allow some engines to be exempt from the standards based on design.

3. Hardship Provision for Boat Builders

What We Proposed:

Boat builders can be dependent on engine manufacturers to supply certified engines in time to produce complying equipment by the date emission standards apply. Therefore we proposed to allow boat builders to request up to one extra year before using certified engines if they are not at fault for not being able to use a certified engine and would face serious economic hardship without an exemption.

What Commenters Said:

CARB and EMA commented that they support this provision.

Our Response:

We are finalizing this provision as proposed. We believe that it would be appropriate in situations where the boat builders receive the certified engine too late to accommodate changing engine size or performance characteristic.

E. Test Procedures

1. E5 Duty Cycle

What We Proposed:

We proposed to base the emission standard on the E5 duty cycle developed by the International Standards Organization for diesel engines used in boats less than 24 meters in length. This is a five mode steady state cycle, including an idle mode and four modes lying on a cubic propeller curve.

What Commenters Said:

EMA commented that this duty cycle produces slightly higher emission results for most engines than the ISO E3 duty cycle used for commercial marine engines. They also commented that, for naturally aspirated engines, HC+NOx would be 30% higher and CO 85% higher on the E5 versus the E3 duty cycle. The data behind this claim was not included in their comments. However, EMA supports the use of this test procedure because it is representative of recreational marine operation and because it will help facilitate harmonization with European regulations. ARB commented that they support the use of this duty cycle.

Our Response:

We are finalizing the E5 duty cycle for use in measuring emissions from recreational marine engines. It is more representative of recreational marine operation. In addition, in our analysis of the technical feasibility and costs of this rule, we included the assumption that every engine would need to be turbocharged to meet the standards. Even if naturally aspirated engines were designed to meet the proposed HC+NOx and PM standards, we do not believe that test procedure effects on CO would be an issue because exhaust emissions from diesel engines are already several times lower than the CO standard. For some of the recreational engines we used in our data analysis, the E5 duty cycle produces slightly higher emissions than the E3 duty cycle; however, this is not the case for all of the engines we have data on. Also, these engines were uncontrolled for emissions. Once the engines are calibrated for low emissions over the E5 duty cycle this would not likely be the case.

2. Test Fuel

What We Proposed:

We proposed to use the same test fuel as we have used previously testing Category 1 marine diesel engines, which is a standard nonroad test fuel with moderate sulfur content.

What Commenters Said:

EMA expressed support of this requirement because it will allow the same fuel to be used for marine and land-based nonroad engine testing.

Our Response:

We are finalizing the test fuel specifications as proposed.

3. Maximum Test Speed

What We Proposed:

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

What Commenters Said:

EMA commented that the proposed method for determining maximum test speed creates a loophole that could be used to circumvent the emission regulations. They stated that a manufacturer could alter an engines power curve by extending the maximum engine speed beyond the rated speed to a point where the power is less than it is at rated speed. The E5 duty cycle would therefore be based on a different theoretical power curve than would be expected to be seen in use. EMA's comments included an illustration to help present this concept (see Figure II.F.4). Their conclusion was that a manufacturer could calibrate their engines to meet the emission standards over the E5 duty cycle while calibrating their engines for performance where they believe their engines would actually operate in use. EMA recommended that we allow the manufacturer to define the rated speed as the speed at which rated power is observed and use this value for the maximum test speed. They commented that this is consistent with ISO protocol and would foster harmonization with European regulations.

Our Response:

In proposing this definition of maximum test speed it was our intent to specify the highest speed at which the engine is likely to be operated in use. Under normal circumstances this maximum test speed should be close to the speed at which peak power is achieved. However, we agree that our the definition of maximum test speed could return a speed higher that the speed at which an engine develops its highest power. That was intentional in the definition because a high torque-rise engine has a particularly low speed at which it develops its highest power, and by defining rated speed at that low speed, a significant high-load area of the torque versus speed map is left untested. This area happens to be an area in which engines are likely to operate because diesel engines operate most efficiently at high-speed and high-load conditions. This is also a region where, depending upon engine design, either NOx or PM limits might be exceeded. In addition, as discussed in the final rule for the commercial marine rule (64 FR 73300, 73311), extensive testing of this definition indicates that the definition never returns a speed at which power is less than 90 percent of the maximum power of the engine. Furthermore, for engines that do not have a high torque-rise, our proposed definition of rated speed is within 1 percent of an engine's maximum power speed.

We believe the maximum test speed definition will maximize the testable area within the NTE zone, which lies within the torque versus speed area under the power curve. Any other definition of rated speed, and especially one that allows individual manufacturers to arbitrarily declare rated speed, might not maximize the testable area under the power curve. An engine manufacturers has control over an engine's power curve and an engine's speed governor characteristics, which define the upper bounds of speed and load under which an engine might possibly operate.

Under our definition of maximum test speed, the manufacturer still has control of an engine's maximum test speed, but the manufacturer must also design the engine's rated speed into the power curve and governor droop characteristics instead of picking a rated speed that may not be accurate. Thus, our definition of maximum test speed ensures that an engine will never operate above or beyond the steady-state points of the E5 duty cycle or the NTE zone. Furthermore, because our definition of maximum test speed uses a manufacturer's selection of power curve and governor droop, it naturally maximizes the NTE zone under the bounds of these curves. This in turn maximizes the effectiveness of the NTE requirements.

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

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

4. Sample Port for In-Use Testing

What We Proposed:

For marine engines that expel exhaust gases under water or mix their exhaust gas with water, we proposed to require manufacturers to equip engines with an exhaust sample port where a probe can be inserted for in-use exhaust emission testing. The location of this port would have to allow a well-mixed and representative exhaust sample.

What Commenters Said:

EMA commented that the exhaust systems that manufacturers supply in their engine packages typically end at the turbocharger outlet. Therefore, they are unable to provide a sample port that provides adequate sample mixing. EMA requested that we clarify that this requirement applies to the vessel builder and not the engine manufacturer.

Our Response:

In cases where the engine manufacturer does not supply enough of the exhaust system to add a sample port, the engine manufacturer would be required to provide installation instructions for a sample port. Vessel manufacturers would be required to follow this and any other emission-related installation instructions.

F. Not-To-Exceed Standards and Related Provisions

1. Effect on Stringency of Standards

What We Proposed:

To ensure that emission reductions are occurring during actual vessel operation, we proposed a “not-to-exceed” (NTE) emission standard. The NTE standard, in conjunction with the other standards, is intended to ensure in-use emissions reductions through an objective standard and an easily implemented test procedure that can be employed in an in-use test program. We proposed that testing could be done at any point within an NTE zone, which is defined by the power curve of the engine up to rated speed. Within the NTE zone, we proposed specific emission limits for different areas within the zone for each of the regulated pollutants (HC+NOx, PM, and CO). These proposed NTE requirements are similar to those for commercial marine engines.

What Commenters Said:

EMA commented that EPA has not established the feasibility or cost-effectiveness of the NTE requirements. They stated that engine manufacturers would need to design their engines for the operation under the NTE zone that would be expected to have the highest emissions which may not occur very often during actual operation. As a result, they commented that the NTE requirements would require additional technology and development beyond standards based only on the E5 duty cycle. Cummins stated that they were concerned by the NTE requirements and stated that they support EMA's comments.

Mercury Marine commented that the NTE requirements will result in more than doubling of the cost and stringency of the emission standards without any additional environmental benefit. They pointed to information that they submitted during the commercial marine comment period that showed data on a baseline engine tested within the commercial marine NTE zone. The data on this engine showed that in the worst case area of the NTE zone, the PM emissions were more than double than measured over the E3 duty cycle.

NMMA commented that the NTE requirements increase the stringency of the standards because more testing would be required and because of variations in emission levels under the NTE zone. They stated that there was a lack of information on the costs or emissions benefits associated with the NTE requirements and that, for recreational marine engines, the NTE requirements are unworkable and cannot be easily implemented. NMMA presented data on the same engine as Mercury Marine, also including HC+NOx, and CO results. The relationship between worst case NTE conditions and E3 weighted emissions were similar for this engine for HC+NOx and CO as for PM.

Hatteras Yachts commented that the NTE testing is too burdensome and expressed concern that an engine designed to meet the NTE limits would suffer in performance. They stated that they have had problems with the engine management system on an emission controlled engine not being properly calibrated to bring a boat to plane. Carver Boat Corporation expressed concern that testing and certification to the NTE requirements would be more costly than done for non-marine engines.

MECA expressed their support of new test requirements that are more representative of real world operation. Although they believe that the NTE requirements would add to the challenge of designing the emission control system, they state that it is important that test procedures represent real world operation as much as possible. They also commented that they believe the standards as proposed are technologically feasible and cost-effective.

Our Response:

With any standard we set, our goal is to achieve control of emissions over the broad range of in-use operation and ambient conditions, not to just reduce emissions over a specific operating cycle under laboratory conditions. No single test procedure can cover all real world operations. For instance the E5 duty cycle only contains five operating points based on an assumed propeller curve. Meeting the duty-cycle emission standard alone does not provide assurance that emission reductions will be achieved in use, especially for engines that do not operate on the assumed propeller curve. The NTE concept provides objective design criteria while still covering a wide range of conditions that would be seen by marine engines in use. In this context, the defeat device prohibition is an important supplement to both the NTE standards and the steady-state duty cycle standards.

As described in Section II.F.3 below, the same technology that can be used to meet the standards over the E5 duty cycle can be used to meet the NTE caps in the NTE zone. We therefore do not expect these standards to cause CI recreational marine engines to need more advanced technology that is used by the nonroad and commercial marine engines from which they are derived. We do not believe the NTE concept results in a large amount of additional testing. The largest cost of testing is for equipment and engine set up. Testing additional modes within the NTE zone will not add a large additional cost. Data in Chapter 4 of the RSD suggest that recreational marine engines built today would largely comply with an NTE zone based on their baseline average E5 level. The same technology used to reduce emissions over the E5 duty cycle can be used to reduce emissions throughout the NTE zone. Therefore, as with the primary standards, we do not believe that the NTE requirements will affect the performance of the engine. Our cost analysis accounts for some additional testing, especially in the early years, to provide manufacturers with assurance that their engines will meet the NTE requirements.

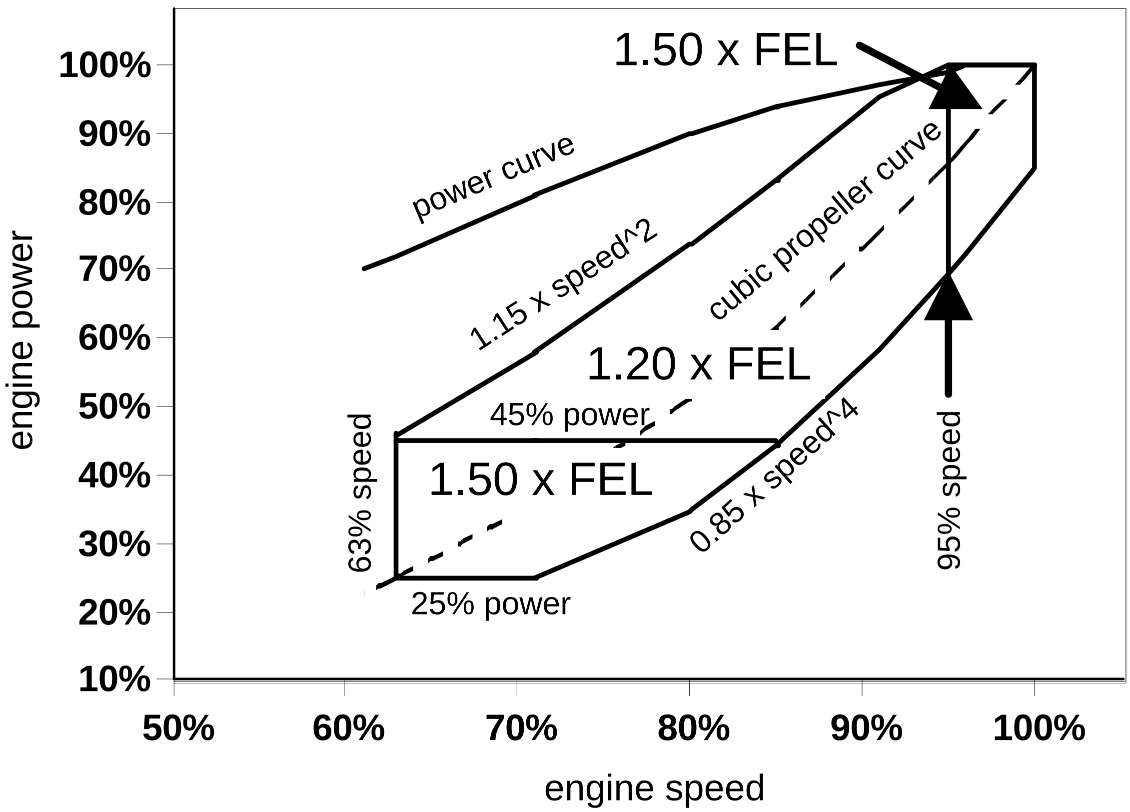
We believe the NTE standards, in combination with the steady-state duty cycle standards, are necessary and appropriate ways to ensure the in-use benefits of the standards. The NTE requirements, along with the defeat device requirement, will help to ensure that engines will be designed for low emissions under all real-world conditions.

2. Shape of NTE Zone

What We Proposed:

The shape of the proposed NTE zone is presented in Table V.C-1 of the October 5, 2001 proposal (66 FR 51098). This zone is based on a range around the cubic propeller curve used in the ISO E5 duty cycle and is shown in Figure II.F-1. All operation below 63 percent of maximum test speed and all operation below 25 percent of maximum test power are excluded from this zone. In addition this NTE zone is split into three subzones with different emission limits. Only steady-state operation is included.

Figure II.F-1: NTE Zone for Recreational CI Marine Engines



What Commenters Said::

EMA commented that the NTE zone is unnecessary because the “vast majority” of recreational marine engine operation is along or close to the theoretical cubic propeller curve used as the basis of the E5 duty cycle. However, in their comments on the proposed maximum test speed, they provide an illustration how a manufacturer could exploit the definition of the maximum test speed to circumvent the emission regulations. EMA presents an illustration that shows how the E5 test points, which are based on a theoretical propeller curve, could be much different than the propeller curve that an engine would see in use. EMA also commented that they agreed that transient operation should not be included in the NTE zone because very little CI recreational marine engine operation is transient and because development and testing of these engines to ensure transient NTE compliance would be nearly impossible and would not be cost-effective.

NMMA commented that the NTE zone does not represent the way recreational marine engines are operated in use. They stated further that we have not presented sufficient evidence that the E5 duty cycle unrepresentative of actual operation or that in-use engines operate off this duty cycle. Mercury Marine commented that boats typically operate on a propeller curve so reducing emissions off of this curve would not improve air quality. Both NMMA and Mercury Marine cite an intra-agency EPA memo summarizing data on marine operation which states: “The data indicated and an engine coupled to a fixed pitch propeller typically operates along the prop curve at steady state...” as evidence that engines operate on the cubic propeller curve. In addition, they both argue that we should not cite Pounder’s Marine Diesel Engines (Sixth Edition) as evidence of variation in propeller curves because it focuses on large ocean-going vessels rather than recreational vessels.

Hatteras Yachts commented that there is not enough information to establish boundaries for a NTE zone. They stated that there are too many variables that affect how an engine operates in use. These variables include length and beam of the boat, hull design, weight, and the depth of the water.

Our Response:

The purpose of the NTE zone is to place limits on the areas of operation under the torque curve where the engine must meet the NTE limits. This zone excludes areas of low power where brake-specific emissions would be inherently high (dividing by a small power gives a large result). All speeds below 63% (mode 4 of the E5 duty cycle) are excluded from the NTE zone as well as speed and power combinations sufficiently distant from the theoretical propeller curve. The NTE requirements are further limited by excluding transient operation.

We are not making any modifications to the shape of the proposed NTE zone. We have designed the NTE zone to cover areas of operation that can reasonably be expected to be seen in use. However, we recognize that, in some rare occasions, there could be engines that are not designed to operate in some portion of the NTE zone. This is why we proposed to allow manufacturers to petition to adjust the size and shape of the NTE zone for certain engines if they can show us that the engine will not see operation outside of the revised NTE zone in use. In addition, if a manufacturer designs an engine for operation outside of the NTE zone, we proposed that the manufacturers would be responsible for notifying us so that their NTE zone can be modified appropriately for that engine. Our specific responses to individual comments are described below.

Assumption of a Cubic Propeller Curve

EMA claims that all recreational marine vessels operate on a cubic propeller curve under steady-state operation and they claim that the vast majority of operation is steady-state. A cubic propeller curve means that normalized power is equal to the normalized engine speed raised to the power of three. This propeller curve is generally determined by the geometry of the propeller and how well it is matched to the boat.

We agree that the majority of recreational marine diesel engine operation is steady-state and that, for a fixed-pitch propeller, steady-state operation often occurs on some sort of propeller curve. However, these propeller curves generally range from speed squared to speed to the fourth. In addition, the propeller curve for a given vessel may change based on vessel loading or on exposure to wind and wave. Therefore, we used a speed squared curve for the upper bound of the NTE zone and a speed to the fourth curve for the lower bound of the NTE zone.

NMMA and Mercury Marine commented that we should not use Pounder's Marine Diesel Engines (Sixth Edition) as a source of information on propeller curve relationships because in focuses on larger vessels. However, this text book states that the "propeller law index is not always 3, nor is it always constant over the full range of speeds for a ship. It could be as much as 4 for short high-speed vessels." An example of an application that would have a propeller approaching a speed squared geometry would be for a planing hull vessel where the designer wanted low end torque to push the boat up out of the water. Mercury Marine's own data on a 20 foot recreational vessel shows a propeller curve relationship of about 2 at speeds that would be included in the NTE zone.[36] In addition, further data in this document show a scattering of operation around the average propeller curve. Although these vessels used gasoline engines, the propeller curve is a function of the design of the propeller and of the vessel and not a function of the fuel used in the engine.

The Spears Memo

NMMA and Mercury cited an internal EPA memo[37] as stating that "the data

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[36] Morgan, E., Lincoln, R., "Duty Cycle for Recreational Marine Engines," Society of Automotive Engineers Paper 901596, 1990.

[37] "Data Collection and Analysis of Real-World Marine Diesel Transient Duty-Cycles," EPA memo from Mat Spears to Mike Samulski, October 15, 1999.

indicated that an engine coupled to a fixed pitch propeller curve typically operates along the prop curve at steady-state" as evidence that marine engines operate on a cubic propeller curve. However, as shown in Figures II.F-2 and 3, the propeller curves for the vessels discussed in the Spears memo that operate on propeller curves are not the theoretical cubic propeller curve. The statement in this memo was just making the point that boats generally operate on a propeller curve under steady-state operation and does not make any statement of what different propeller curves would look like for different boats. As with the discussion in Pounder's Marine Diesel Engines (Sixth Edition), operation is not always along the theoretical propeller curve used in the E5 duty cycle.

Figure II.F-2: Operational Test Data for Planing Hull Vessel

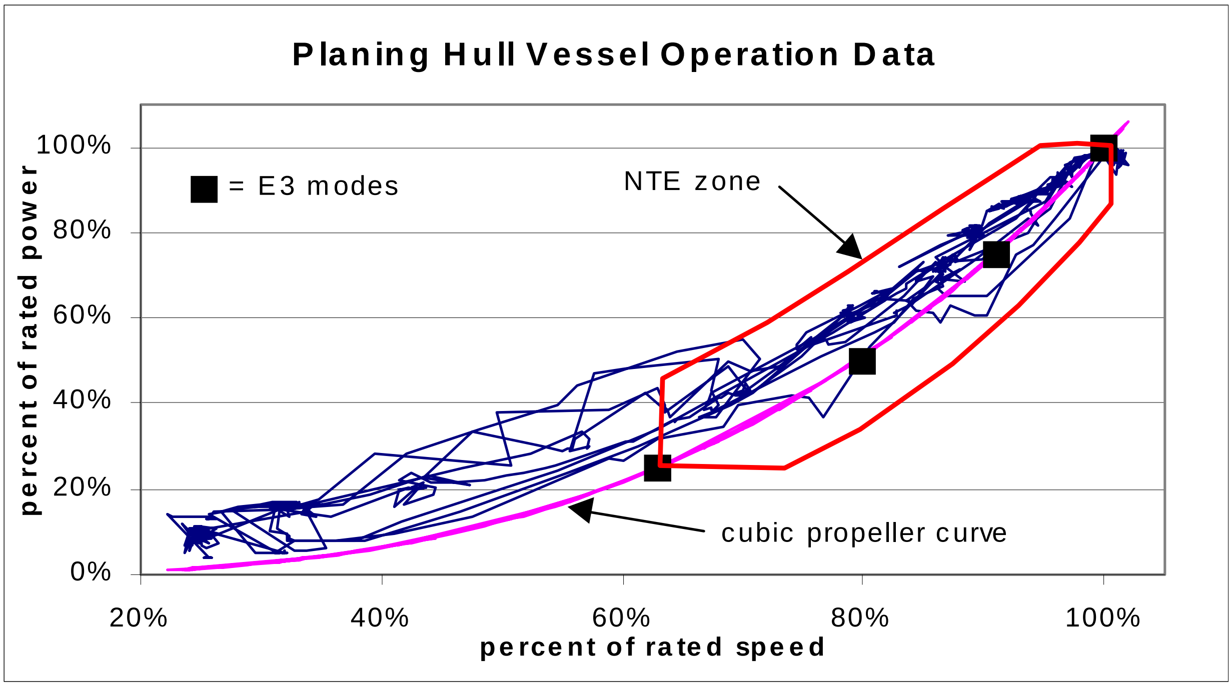
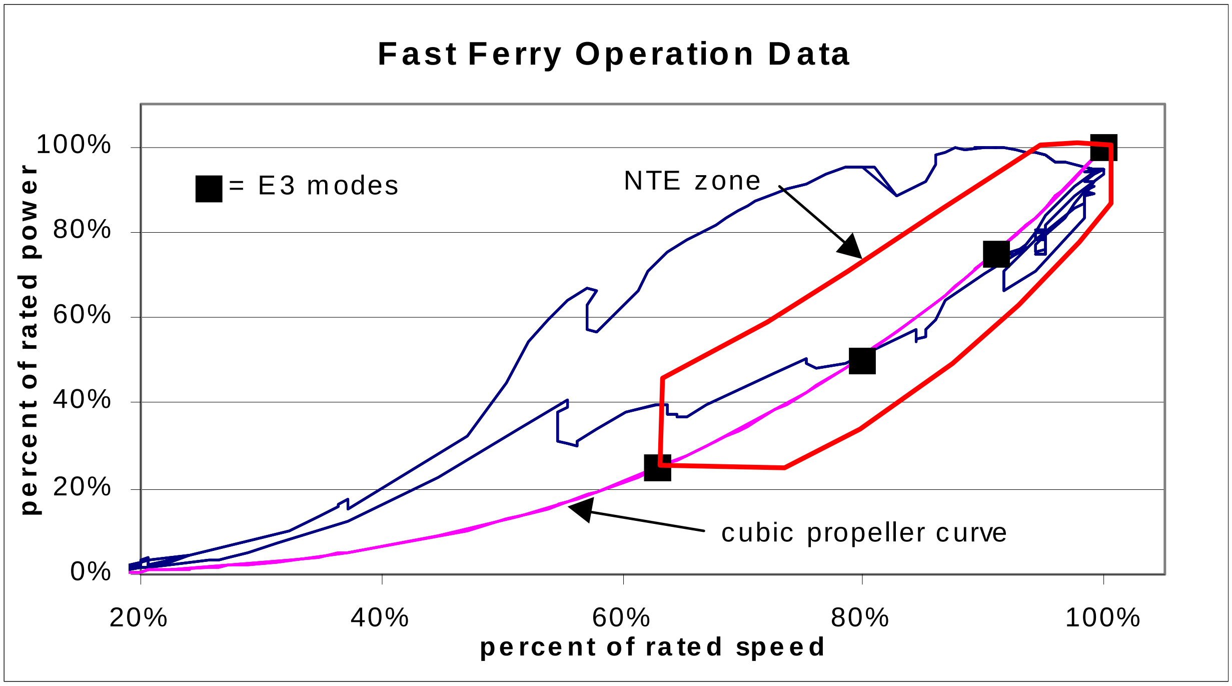


Figure II.F-2: Operational Data for Fast Ferry



Propeller Matching

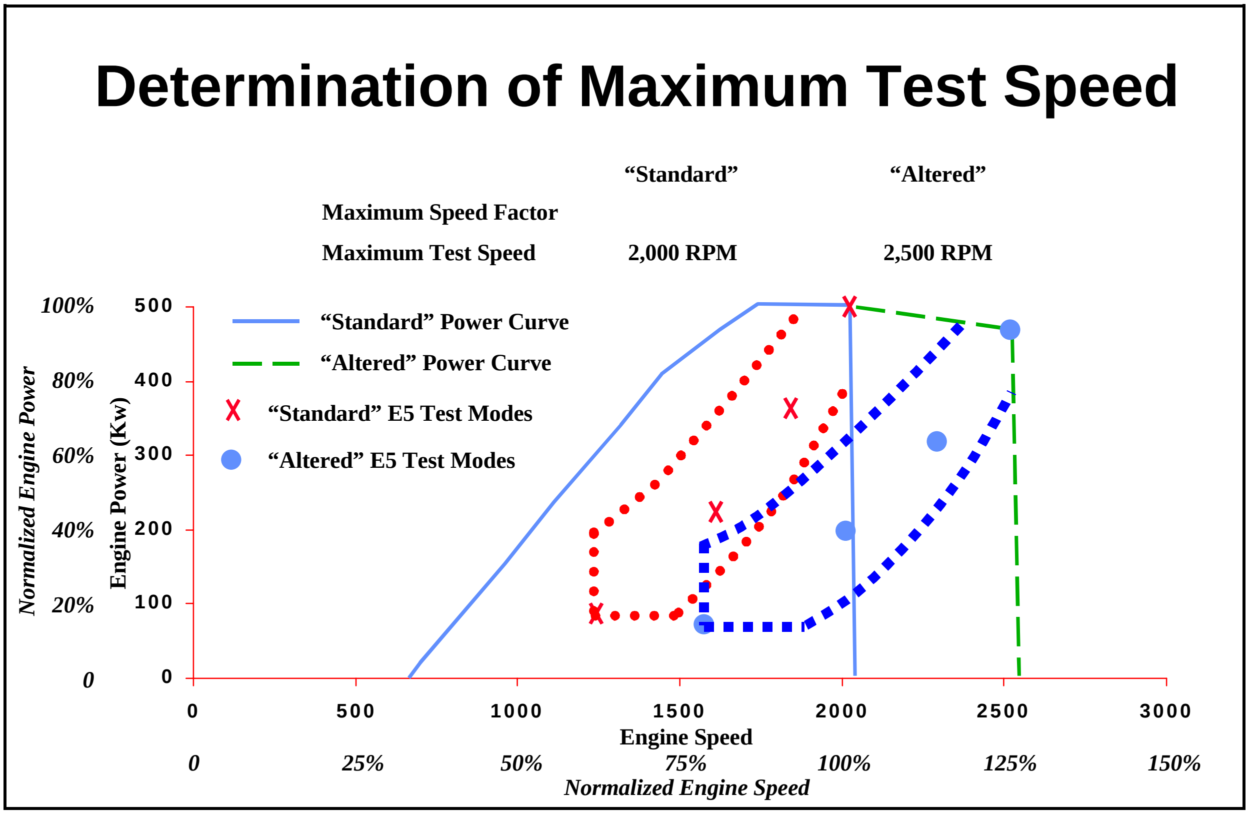
When a propeller is properly matched to a boat, the propeller curve will pass through the rated power point of the engine's power map. Matching is performed by using the appropriate propeller geometry to generate the proper load at the rated speed. If the engine is overloaded, it will reach peak load before ever reaching rated speed. If the engine is oversped, it will reach rated speed without having to generate full power. In either case, the boat never uses the full power of the engine. Although it is usually to the operators benefit to match the propeller correctly, anecdotal evidence from manufacturers and boat builders have suggested that users do not always make optimized decisions from an engineering standpoint.

The NTE zones shown in the figures above assume proper propeller matching. Because the NTE zone is based on the maximum power of the engine, the NTE zone would need to be shifted to the right if this data were based on a boat in which the engine was overloaded. In this case the peak power possible from the engine would actually be at a higher speed than seen in this application If the engine were oversped, the NTE zone would be shifted up because the peak power possible from the engine would actually be higher at rated speed than seen in this application.

Even if the propeller were ideally matched for typical operation of a vessel (selecting the proper propeller type, size, and pitch for a given vessel form and size), changes in vessel loading and weather can affect the actual loading of the engine. The loading of the vessel can affect the actual propeller curve in two ways: changing the effective pitch of the propeller in the water and affecting the boat's resistance in the water. Weather can affect the propeller curve through wind and waves acting on the vessel. When propellers are matched to a vessel, they are designed to operate on a specific angle in the water; changing this angle by changing the angle the boat sits in the water will affect propeller loading at a given speed. The condition of the propeller can affect its operating characteristics. Also, changing the resistance on the boat can affect the propeller curve by changing the load on the propeller at a given speed. This is supported by the discussion of variables that affect engine operation discussed in comments made by Hatteras Yachts. Thus a vessel can be expected to operate differently than predicted by a single propeller curve associated with that vessel.

EMA's own discussion on defining the maximum test speed supports the need for including expanded operation beyond the theoretical propeller curve. They stated that a manufacturer could circumvent the standards by using a different maximum test speed than the recommended rated speed for the boat builder. This also provides an illustration of how the engine operation on a vessel could be sensitive to improper matching of the propeller and engine with a vessel. Figure II.F-4 shows the illustration submitted by EMA. We added the NTE zones for the two maximum test speeds to this illustration. Although this is likely a worst-case scenario, it supports the need for a NTE zone that is expanded beyond a theoretical propeller curve.

Figure II.F-4: Illustration from EMA Comments (NTE Zones Added)



3. NTE Limits

What We Proposed::

The proposed emission standards for the NTE zone represent multipliers times the weighted test result used for certification. For operation in the NTE zone either below 45 percent of maximum power or above 95 percent of maximum test speed, the proposed standard was 1.50 times the family emission limit. For the rest of the NTE zone, the proposed standard was 1.20 times the family emission limit. As an alternative, manufacturers may certify to the NTE zone using a standard of 1.25 times the family emission limit for the entire zone. These limits are similar to those for commercial marine engines except that a higher limit is added near rated power for recreational engines. These sub zones and limits are shown above in Figure II.F-1.

What Commenters Said:

Mercury Marine collected emissions data on a D7.3L engine over worst-case conditions found in the NTE zone for that engine. On this engine, the PM, HC+NOx, and CO emissions were 67%, 91%, and 85% higher, respectively, than the weighted average over the E3 duty cycle. Including worst case ambient conditions, they reported that the emissions were even higher. Based on this data, Mercury Marine concluded that the NTE limit should be 2.0 over the entire zone. NMMA also cites this data. NMMA and Mercury Marine state that the test engine is certified for BSO[38] Stage 2 emissions which NMMA calls the most stringent marine diesel regulation in the world.

NMMA and Mercury argue that the data collected by EPA was not sufficient to set emission limits within the NTE zone. NMMA and Mercury commented that the testing performed on four CI marine engines at Southwest Research Institute (SwRI) for EPA was inadequate for determining the limits because it only varied one of the ambient conditions (water temperature to the aftercooler) and because this testing did not try to find the worst case test points. Mercury further commented that the remaining engines used to determine the NTE limits were not adequate for this analysis because they did not include expanded ambient conditions, mostly did not include PM, mostly were not tested on the E3 duty cycle, and did not focus on a wide range of modes spread throughout the NTE zone.

NMMA and Mercury argue that the sub zones and limits are arbitrary based on the assumption that the weighted average of the sub zones must equal 1.25. They claim that for our logic to be consistent, the weighted average should be 1.25 because this is the alternative standard for the whole zone. They performed a weighting of the sub zone limits based on the weighting factor of E5 mode or modes contained in each sub zone and derived a weighted average of 1.31 which is different than 1.25.

Our Response:

According to the emission data presented in Chapter 4 of the RSD for uncontrolled engines tested over the E5 duty cycle most of the engines are below 1.25 times the E5 average for the four modes that lie within the NTE zone. Using the adjusted multipliers of 1.50 at below 45% of rated power, 1.50 above 95% of rated speed, and 1.20 elsewhere, all but one of the uncontrolled baseline engines meet the limits across the four E5 modes for HC+NOx and PM. We also tested a mechanically controlled and an electronically controlled engine (with the kind of technologies we expect could be used to meet these standards), using the baseline engine calibration, throughout the NTE zone. This data, which is presented in Chapter 4 of the RSD, shows that most of the emission points are already within the NTE limits (as a function of the baseline E5 level). We believe that those few points above the NTE limit could be reduced to meet

[38] International Bodensee Shipping Commission, “Bodensee-Schrffahrts-Ornug,” refers to standards set for vessels used on Lake Constance in Europe.

the limit with minor engine calibration.

Baseline CO levels are well below the proposed CO standard; therefore, we believe that it will be straightforward for manufacturers to design engines which are well below the NTE cap for marine engines, especially given that the CO standard is just a cap and does not need new technology to comply. Given the lead time for the NTE standards and the application of emission control technology such as electronically controlled fuel management, we believe that manufacturers can comply with this requirement on all their engines.

For the most part, we are using the NTE subzones and limits that are in place for commercial marine engines. In developing these limits we believed that the greatest challenge in meeting the emission standards would be to reduce NOx emissions. We therefore divided the subzones primarily based on the data we have for NOx emissions. The data show a relatively constant NOx level with increasing speed around the 45 percent power line. The data for PM and CO show a different degree of variation across the zone. For recreational marine engines, we added another subzone with a cap of 1.50 at speeds above 95 percent of maximum test speed. The goal of this additional subzone is to help ensure that performance will not be affected at peak power. Our understanding is that, although recreational marine engines do not spend much time at this power rating, it is crucial that they can achieve peak power to bring the vessel to plane.

The data available today support the conclusion that engines will be able to comply with all the emission requirements at the levels we are finalizing. In some cases, the primary emission standards is controlling and the NTE caps serve to prevent unexpected variations and can be met with the same emission control approach used to meet the primary standards. In other cases, we are aware that the NTE caps may be controlling, especially for certain pollutants in certain areas of engine operation. In those cases, minor changes in calibration can be made to the emission control approach used to meet the primary emission standards to achieve compliance with both the NTE and primary emission standards.

The principal emission control technologies anticipated for complying with the CI recreational marine emission standards are described in detail in the Final RSD. These technologies provide the manufacturers with tools that can be used together to reduce emissions. Even without NTE emission standards, engine manufacturers need to conduct sufficient development with each of their engine ratings to be sure that engines perform properly throughout the anticipated in-use operating range. Integrating the emission-control technologies into the engine design enables the manufacturer to make engines that perform well in use with the additional feature of reduced emissions.

Some of these technologies can be manipulated to achieve a greater or lesser degree of emission control at different operating points. For example, a manufacturer may be able to adjust the turbocharger mapping to increase boost pressure at an operating point were PM emissions are unacceptably high. Also, as described in the cost analysis in the Final RSD, manufacturers can use timing retard selectively to reduce NOx emissions in those areas where it is most difficult to meet the emission standard. This would most likely be necessary at lower loads, where manufactures have a greater ability to retard timing without compromising over fuel consumption values. Likely, areas of the engine map with high PM would likely have low NOx and visa versa. In any case, strategies for air and fuel management could be combined to reduce both PM and NOx. We therefore believe that manufacturers will not need to add technologies to comply with the NTE standards that they will not already be adopting to comply with the duty cycle standards. The technology that we anticipate will be used to reduce emissions on the E5 duty cycle can also be used in the same manner to reduce emissions equally throughout the NTE zone based on adjustments in calibration.

Mercury Marine supplied us with data showing the effects of the worst-case parameters in the NTE concept in the form it was proposed for commercial marine engines. This engine uses electronically controlled fuel management but is not designed for emission control. NMMA and Mercury Marine stated that the engine is certified for BSO Stage 2 emissions as evidence that this is a low emission engine. However, for an engine of this size, the BSO Stage 2 emissions standards are considerably higher than average baseline emissions (see Table II.F-1). To determine the baseline emissions, we used the data presented in Chapter 4 of the Final RSD on CI recreational marine engines for which we had both NOx and PM emission data.

Table II.F-1: International Bodensee Shipping Commission (BSO)
Stage 2 Emission Standards for a 200 kW CI Marine Engine
Compared to Average CI Recreational Baseline Emissions

Pollutant	BSO Standard g/kW-hr	Baseline Emissions g/kW-hr
NOx	10	8.9
PM	no standard	0.2
HC	1.3	0.3
CO	20	1.3

The Mercury Marine data shows a wide variability in emissions in the proposed

NTE zone, especially when a range of ambient conditions are considered. However, worst-case water temperature testing was performed at 32°C (90°F) while the NTE requirements would only be uncorrected up to 27°C (80°F). This higher temperature probably explains why Mercury saw a significant impact on emissions due to ambient conditions. Mercury reports two worst case test points of 1.67 times the weighted average for PM and 1.38 times the standard (1.91 times the weighted level). We are not sure why Mercury saw such high results in their testing. Likely these were for only a few test modes which could have their emissions lowered through calibration. We contracted with Southwest Research Institute to collect emission data on a similar Mercury Marine engine. This uncontrolled engine showed much less sensitivity to operational or temperature variation than was reported in the Mercury testing. This test program also included testing on a John Deere engine. The SwRI data, available in the docket and discussed in the Final RSD, show that the inherent variability of emissions over the range of operating and ambient conditions is consistent with the NTE standards in the final rule. In any case, none of these engines were calibrated for emission control. Manufacturers can use the anticipated control technologies, with calibration adjustments as needed, to reduce emissions to meet our standards over the broad range of operation expected from in-use engines.

4. Ambient Conditions without Correction

What We Proposed:

We proposed that the NTE standards apply under all atmospheric conditions experienced in normal operation and use, and that no corrections be allowed within specified ranges of ambient air temperature (13-35°C) and humidity (7.1-10.7 g water/g dry air). For testing outside of these ranges, the measurements would be corrected to the nearest boundary of the range. We also proposed that ambient water temperature must be within the range of 5-27°C during NTE testing. These ranges are the same as already exist for commercial marine engines.

What Commenters Said:

EMA commented that correction factors should be applied to account for the effect of ambient conditions on emissions from CI recreational marine engines. They recommended that ISO 8178-1 NOx and PM corrections for air humidity, temperature, and pressure be used. EMA gave examples of where the ISO corrections could vary emissions over the range of ambient conditions by 8-16 percent. They expressed concern that engines tested under favorable conditions would have an advantage over engines tested under unfavorable conditions if the emissions aren't corrected to a single set of ambient conditions. In addition, without the corrections, EMA comments that manufacturers would have to design for worst case conditions that would never be seen in use such as high load in 90°F water at high altitude such as Lake Tahoe.

Cummins stated that they were concerned by the requirement to comply over a wide range of ambient conditions.

Mercury Marine commented that the inclusion of a range of ambient conditions would increase the cost and complexity of development and testing. They stated that standard ambient conditions have been used in the past and have been accepted as generating sufficient results for generating accurate emission inventories.

The data collected by Mercury and presented by NMMA also includes the effect of worst case ambient conditions with worst case operation on emissions. The combination of these two effects for this engine resulted in increases of 129% PM, 106% HC+NOx, and 155% CO when compared to the weighted E3 results.

Our Response:

Our goal with the range of ambient conditions is to ensure real world emission control over a broad range of conditions. Although test-to-test repeatability can be valuable in developing engines, this is not the goal of the NTE provision. Several manufacturers commented that the proposed range of ambient conditions affects the stringency of the proposed standards. We believe that the ambient conditions we are including in the NTE zone are reasonable and do not have a large effect on uncorrected emissions. The range of uncorrected ambient conditions are well within normal operation, and compliance in this range will not require significant additional technology development or testing. Therefore, the calculations of IMO corrections do not apply here. We discuss the rationale for the final ambient condition ranges below.

<u>Water Temperature</u>

Under the NTE requirements, the engine may be tested at water temperatures ranging from 5 to 27°C (41 to 80°F), not 32°C (90°F) as mentioned in NMMA and EMA comments and in the Mercury data. This range of temperatures is hardly extreme. In fact, this range represents water temperatures marine engines typically experience in the U.S. For instance, 27°C is a typical summer water temperature off the coast of Florida. We are aware that at least one CI marine engine manufacturers uses a water temperature of 32°C (90°F) in their durability testing. Ambient water temperature is primarily an issue for engines with aftercooling because the water is used as a cooling medium. However, we project that most, if not all, diesel marine engines will use aftercooling to meet the standards. The Mercury Marine test data on the effect of ambient conditions on emissions uses worst case water temperatures of 32°C (90°F) which is much hotter than is included in the NTE provisions. This is probably a large part of the reason that the Mercury Marine data shows such sensitivity to ambient conditions.

The high end of this temperature range is the more significant variable from an emissions design standpoint. At higher temperatures, it is more difficult to minimize charge air temperatures; therefore, less air can be forced into the cylinder. This makes it harder to design for low emissions because there is less oxygen available for combustion. However, the upper end of the temperature range is representative of typical operation. In fact, normal engine testing practice recommended by the Society of Automotive Engineers (SAE J1937) is to test aftercooled engines using a water temperature of 20-30°C (68-86 °F).[39] Therefore, this "extreme" temperature used for the upper limit of the NTE range is within recommended practice. Also, in this temperature range, SAE J1937 states that a 5°C increase in cooling medium temperature will only result in small changes in emissions on average: 1.8% decrease in HC, 0.6% increase in NOx, and 0.1% increase in PM. The emissions control technology available to manufacturers can be calibrated with this in mind.

The low end of the temperature range is less significant because engine manufacturers only need to restrict the water flow to offset the effects of the cooler temperature. This can be done with a simple thermostat. In some cases, engine cooling systems are designed to only operate in cool water. An example would be a fishing boat intended to be used only in Alaska. Under these circumstances, the engine would not function properly if the boat were used in a warmer climate. We would only perform in-use testing on engines where they operate. Boat builders would be required to design their vessels to meet the engine manufacturer's specifications in areas where their boats are intended to operate.

<u>Air Temperature</u>

We require that, for NTE testing performed between 13 and 30°C (55-86°F), emissions not be corrected for temperature. The upper end of this range is based on temperatures recorded during ozone exceedances, except that it is adjusted for the cooling effect of a body of water on the air above it.[40] If the engine draws intake air

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[39] SAE J1937 Reaffirmed JAN95, "Engine Testing with Low-Temperature Charge Air-Cooler Systems in a Dynamometer Test Cell."

[40] Memorandum from Mark Wolcott to Charles Gray, "Ambient Temperatures Associated with High Ozone Concentrations," U.S. EPA, September 6, 1984, (Docket A-97-50;

from inside the engine compartment (which is often over 40°C), the upper limit of this range is expanded to 35°C (95°F). For temperatures outside this range, emissions would be corrected to the nearest end of the range.

This temperature range for uncorrected emissions is hardly extreme. On-highway engine testing is performed in the temperature range of 25±5°C (68-86 °F) without correction for temperature (40 CFR 86, Subpart N). As with cooling water temperature, the high end of the range is the most significant for emissions design. The modal certification test required for CI marine engines uses a function of both pressure and temperature to determine appropriate test conditions. This function is also centered on 25°C and no correction is allowed for temperature in this range. Although the range is slightly higher for engines drawing air from the engine compartment, it is conservative given the high temperatures that may actually be seen in use.

In any case, these ranges of ambient temperatures actually only have a small effect on emissions. For marine diesel engines using aftercooling, the charge air temperature is insensitive to ambient air temperature compared to the cooling effect of the aftercooling. SwRI testing found that when the ambient air temperature was increased from 22 to 32°C (71-90°F), the cooling water to the aftercooler of a commercial marine engine only needed to be reduced by 0.5°C (0.9°F) to maintain a constant charge air temperature.[41] Therefore, the technology used to control emissions can be employed throughout this temperature range and can provide adequate emissions reductions for NTE compliance.

Humidity

The humidity range for the NTE requirements in which no corrections may be made is 7.1 to 10.7 grams water per kilogram of dry air which reflects normal operation and use. This only affects NOx because the E5 test only allows correction for NOx to 10.7 gH_2O/kg air. According to this NOx correction factor (40 CFR 89, Subpart E), there is only a ±3% variation in NOx in the NTE humidity range.

Altitude

NMMA commented that emissions would be affected by changes in air pressure due to operation at altitude. We did not propose and are not including an NTE range for

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document II-B-2).

[41] Southwest Research Institute, “Marine Diesel Engine Testing,” prepared for U.S. EPA, September 1999, (Docket A-97-50; document IV-D-5).

ambient air pressure. This is consistent with the test requirements for on-highway heavy-duty engines which do not include a correction for air pressure.(40 CFR 86, Subpart N). For turbocharged engines, which are relatively insensitive to altitude, the E5 duty cycle testing for CI marine engines considers the range of 99 to 102 kPa to be an appropriate test range at 25°C (77°F). At lower temperatures that would likely be seen at higher altitudes, the lower end of this pressure range would be expanded. For instance, at 16°C (60°F), a pressure as low as 90 kPa would be considered acceptable under current practice. This suggests that not correcting for pressure under NTE requirements adds no significant additional burden beyond what would be required under E5 testing alone.

5. Practicality of NTE Testing

What We Proposed:

Our goal for proposing the NTE standards was to achieve control 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. In the proposal, we specify the test procedures that would have to be followed under the NTE requirements. We stated that manufacturers would have to comply under all conditions that may reasonable be expected to occur in normal vessel operation and use. The manufacturer would be able certify based on reasonable testing and other information which could be used to support a statement of compliance that is consistent with good engineering judgement.

What Commenters Said:

EMA commented that we did not specify clear, definitive, and repeatable test procedures for establishing whether an engine complies with the NTE requirements. Therefore, they concluded that manufacturers will have to guess how to design their engines to meet the standards. They also commented that we did not develop specific in-use test procedures that we would use for enforcement and that we did not demonstrate that in-use test equipment or facilities are available that are capable of performing this testing. EMA recommended that NTE requirements not be applied until definitive test procedures and equipment have been developed and sufficient experience with NTE testing has been gained. Mercury Marine also commented that there is no test procedure for NTE so it is of no use as a certification tool.

EMA cited an example of how in-use measurements may have significant error by claiming that engine brake power is difficult to measure directly in use. They stated that indirect estimates of engine power could have uncertainties of 20-30% or more. EMA further commented that they could potentially support in-use testing as a screening tool only, but that the equipment for the screening tests would need to be defined and validated. Finally, EMA commented that engines that are not properly maintained and used should be excluded from NTE testing, arguing that manufacturers should not be held liable for treatment of engines outside their control.

NMMA, Mercury Marine, Regal Marine, and Carver Boat Corporation commented that the NTE requirements are extremely burdensome because it would require testing over an infinite number of speed and load points at a combination of ambient conditions.

Our Response:

Before manufacturers produce engines, they apply for certification based on a showing that their engines comply with all the standards that apply, including the standards based on duty cycle testing and the broader not-to-exceed standards, throughout the useful life of the engines. We are interested in testing in-use engines to confirm that they are emitting within these standards. We could do this testing one of two ways. First, we could remove the engine from the vessel and test it on a laboratory dynamometer, much like the manufacturer's certification testing. However, the cost of removing and testing engines this way would be extremely high and an operator may be unwilling to allow us to remove the engine from service for emission testing. We've defined the NTE zones, limits, and ranges of ambient conditions and test fuels. NTE testing would be performed over typical in-use operation that is nominally steady-state. This could be performed in the laboratory, on a vessel under normal operation, or on a trip made specifically for testing. The test procedures for measuring emissions under any mode in the NTE zone are the same as those for the modes in the E5 duty cycle.

Onboard testing is a second type of in-use emission measurement. Being able to conduct emission testing onboard the vessel can make in-use testing more accessible because onboard testing eliminates the need for engine removal and minimizes the disruption of vessel use. The goal is for us to accurately assess the emission performance of these engines when they are in service. We recognize that the level accuracy and precision of in-use testing is one of the key factors to take into account when making any such evaluation or determination of compliance. We believe such systems and procedures would provide a significant benefit to both the agency and the industry.

Manufacturers claimed that, under the NTE requirements, they would have to test over “infinite” testing conditions or guess how to design their engines. Under the same argument, the E5 duty cycle has “infinite” testing conditions as well. There is a function relating the range of ambient temperature and pressure in the E5 testing requirements which creates a range of ambient conditions acceptable without correction (40 CFR 89.331). This range is comparable to the NTE temperature range. For each test mode, the load may be anywhere within ±2 percent of maximum load and the speed may be anywhere within ±2 percent of that speed (40 CFR 89.410). Using the manufacturers’ argument, this is also an “infinite” number of test conditions.

By testing a reasonable number of steady-state operation points, manufacturers can determine where they need to focus when calibrating for emissions. Areas between the test points would be expected to logically follow a continuous curve which would allow for interpolation within a predictable margin of error. Engine manufacturers will be able to use reasonable engineering judgement and rely on interpolation between known points when calibrating their engines. If this were not the case, engines would stall out whenever they hit one of the infinite modes of operation not specifically tested when manufacturers develop their fuel injection calibrations. In addition, test data in Chapter 4 of the RSD show that for most areas within the NTE zone, even today’s calibrations will meet the NTE limits.

The NTE test procedures are clear and definitive. The regulations spell out the elements of a proper NTE test, including the size of the zone, the minimum sampling time, the ambient conditions, the restriction on normal operation and use, and the restriction on steady state operation, They are repeatable as well, to the extent the operation and use and ambient condition are repeatable. EMA’s and others comments derive from the fact the NTE test procedure includes multiple possible “duty cycles,” within the NTE zone, bounded by normal operation and use and other NTE testing conditions. The objection appears to be that EPA has not defined a single NTE duty cycle, or specified a set of discrete NTE duty cycles, that can be used by themselves to define and demonstrate overall compliance with the NTE requirements. However, the purpose of the NTE standard and its related test procedure is to cover all normal operation and use with the specified parameters, and not be limited to a single or a set of specified NTE duty cycles. Compliance or noncompliance with the NTE can be readily determined for each specific NTE test that is run, just as with the E5 duty cycle. In addition, a reasonable amount of emissions testing, combined with good engineering judgement, can be used to design for and certify compliance overall with the NTE standards.

The technology used to meet the NTE standards works adequate within the entire

NTE range of operation, and EPA has demonstrated that with a reasonable level of emissions testing and engineering judgement based on that testing, manufacturers can readily design and calibrate their engines for compliance across the full range of NTE conditions. The emissions control technology used on marine recreational engines can be designed to work under all NTE conditions, and reasonable engineering judgments can be used to design and calibrate the engines for operation not specifically included in developmental emissions testing. NTE testing does not need to be performed on every possible combination of NTE conditions to reasonably predict and design compliance with the NTE, just as E5 duty cycle testing does not to be performed on every possible combination of conditions allowed under the E5 duty cycle to reasonably predict and design compliance with the E5 standards.

EMA commented that in-use measurement errors, such as power measurement uncertainty, would increase the stringency of the standards. We would account for any error in measurement during testing in the field; therefore, this does not affect the stringency of the standards. As in-use measurement improves in the future, we expect this to be less of an issue.

Under 207(c) of the Clean Air Act, manufacturers are not liable for noncompliance caused by improper maintenance in use. Therefore, if an engine was improperly maintained, we could only consider its emission levels for the purposes of section 202(c) if it was relevant to determining the emission levels of properly maintained engines.

6. Alternative Approaches

What We Proposed:

The proposal outlines the NTE concept and details our rationale in developing these requirements. We asked for comments on every aspect of this approach.

What Commenters Said:

EMA commented that they strongly oppose the NTE requirements but recognize EPA's concerns regarding defeat devices. Therefore, they have developed two options that they recommend as alternatives to the proposed NTE provisions. The first option would be to shrink the NTE zone to a narrow zone around the propeller curve from 63 to 100 percent of rated speed. The emission limit would be 1.1 times the speed based interpolation of the measured values of the two nearest modes. They commented that EPA could require testing at 3 steady-state test points in this zone during certification or SEA testing and that all testing would be corrected for standard conditions. The second option would be to use the NTE provisions for guidance purposes only and not as strictly enforceable limits. Manufacturers would run a predetermined map of steady-state modes and measure emissions corrected to standard ambient conditions. At time of certification, manufacturers would be required to explain and justify any exceedances which EPA could approve if the exceedances were not due to defeat devices.

Mercury commented that they do not support these alternative options and that the only proven procedure for repeatable results is the E3 test cycle.

Our Response:

We believe that, due to the constrained size of the NTE zone and the caps above the standard, the manufacturers can comply with the NTE requirements with the same technologies needed for the E5 duty cycle standards. The constrained size ensures that the same emissions control technology used over the E5 duty cycle can be used to reduce emissions over the entire NTE zone. The caps allow for modal variation above and below the average so that the average emissions do not necessarily need to be reduced to meet the NTE requirements.

The NTE requirements are primarily intended to help ensure that the standards are met over a wide range of operating conditions. The defeat device prohibition is also designed to ensure that emissions controls are employed during real world operation and not just under laboratory or test procedure conditions. However, the defeat device prohibition is not a quantified standard and does not have an associated test procedure, so it does not have the clear objectivity and ready enforceability of a numerical standard and test procedure.

We believe the NTE program is appropriate for all of the regulated constituents because our goal is to gain real world reductions in each. Also, there are tradeoffs in designing for NOx versus PM reductions; controlling NOx only could lead to increases in PM emissions. We believe that in-use testing will advance in the coming years such that measurement errors will be further reduced. In any case, we would consider the quality of the emission measurements in any compliance determinations.

The operational data we collected suggests that much of the operation seen by these vessels would occur outside of the narrow zone suggested by EMA. Also, basing the cap on the modal emissions only could result in the emissions at some modes being much higher than the standard. This would especially be a problem for an engine that spends most of its time in these high emission zones when in nonattainment areas. We believe that the cap of 1.50 times the average at power levels below 45 percent of rated provides enough headroom to account for increases in brake-specific emissions at low power. We also believe that the similar cap near rated power gives manufacturers sufficient ability to maintain performance at rated power.

7. Legal Authority for NTE Requirements

What We Proposed:

The Clean Air Act authorizes us to implement the NTE requirements.

What Commenters Said:

EMA commented that they believe EPA failed to develop a detailed set of regulations establishing clear, objective and definitive test methods. As a result, they commented that EPA does not have the authority to implement the NTE requirements because it would be a violation of CAA section 206, 42 U.S.C. § 7525. They also commented that they do not believe that EPA presented data for even a single engine showing the feasibility of the NTE requirements over the broad range of applicable conditions. Therefore they commented that we did not give substantial evidence of the feasibility, cost-effectiveness, or need for the NTE requirements which they claim would be a violation of CAA section 213, 42 U.S.C § 7547. Also, EMA commented that we did not propose in-use testing methods which they claim is in contravention with CAA section 207(b)(1), 42 U.S.C. § 7541.

Our Response:

We are required by section 213(a)(3) of the Clean Air Act to set standards which will “achieve the greatest degree of emission reduction achievable,” considering relevant statutory factors. These standards apply to the useful life of the engine, as determined by us under section 213(a)(3). Section 206, made applicable to marine engine standards in section 213(d), authorizes us to prescribe compliance testing and certification procedures. Other compliance and enforcement provisions are also based on section 213(d). As explained in the preamble to the final rule, in the Final RSD, and elsewhere in this document, we believe the combination of elements in the final rule, including the duty-cycle emission standards, not-to-exceed provisions, certification requirements, and other compliance provisions, together satisfy and are authorized by these statutory provisions. We believe we have authority under the Clean Air Act to set standards to control emissions from new marine engines and vessels over the broad range of in-use speed and load combinations that can occur on a vessel, achieving real-world emission reductions, rather than just controlling emissions under limited laboratory conditions. Our authority for the not-to-exceed standards and test procedures thus is the same as our authority for the duty-cycle standards and test procedures.

EPA's NTE regulations comply with section 206. The NTE regulation clearly establishes the methods and procedures for performing the NTE emissions tests, as discussed earlier. In addition, EPA has discretion in determining how much NTE or other test data and engineering analysis needs to be submitted for purposes of certification. In this case, it is appropriate to provide manufacturers with the flexibility to exercise their engineering expertise to determine initially how much NTE or other testing is necessary to support their application for certification. EPA does not mandate that a precise number of specified NTE tests be run, but expects that manufacturers can develop a reasonable basis in emissions testing and engineering judgement to reasonably project compliance across the NTE range. This does not make the NTE test procedure regulation any less tangible or lawful, but instead reflects the different kinds of situations and engineering factors that different engine families will confront. Instead of a single size fits all recipe for NTE testing to support an application of certification, EPA believes the best approach is to first allow the engine manufacturer to exercise their engineering expertise in determining the appropriate amount of testing and engineering analysis needed to support their certification application. This is an appropriate exercise of discretion under section 206 with respect to the amount of testing and other information needed at certification.

In response to the comment that we did not make various findings before imposing an in-use testing program involving manufactures, we note that although we have authority to do so under the Clean Air Act, this final rule does not impose any in-use testing requirements on manufacturers. Instead, we are requiring manufacturers to meet certification and production line testing requirements under sections 213 and 206 of the Clean Air Act. Our authority to establish standards and related test procedures that apply to in-use engines is discussed above. Our authority to conduct in-use testing is the same for CI recreational marine engines as for other nonroad or on-highway programs, and is not subject to the kind of findings discussed in the comments. Further, in response to the comment that we are contravening section 207(b), we reply that we are not exercising authority either to establish as state inspection and maintenance program or to impose a warranty under section 207(b). The NTE provisions involve federal emissions standards and their related test procedures, under our authority to set standards and test procedures in sections 213 and 206. We have not exercised our authority under section 207 to establish state inspection and maintenance tests, or to require the related warranty under section 207(b). Section 207 does not limit our authority under sections 213 and 206, the basis or our adoption of the NTE provisions.

As noted above and in the RSD, EPA has a substantial amount of engine test data showing the capability to meet the NTE limits broadly across the engine map. EPA has also discussed the reasonable engineering steps and analysis needed to design for compliance with the NTE zone and under the range of NTE test conditions.

8. State and Local Benefits

What We Proposed:

The NTE requirements are intended to ensure real world emission reductions. In addition, the NTE zone will facilitate in-use testing. These benefits may be advantageous for states and local areas working to reduce air pollution.

What Commenters Said:

CARB expressed support of the proposed NTE requirements for CI recreational marine engines. OTC and NESCAUM commented that EPA should continue collecting data and performing analyses that will lead to better test cycles that more accurately measure in-use emissions from these engines.

Our Response:

We agree that the NTE standards will be beneficial to state and local areas.

G. Regulatory Impact

1. Emissions Impact

What We Proposed:

We believe that CI recreational marine engines are significant sources of air pollution. In the Draft RSD, we present our analysis of the estimated emission reductions anticipated from regulating these engines. This emission impact analysis is also summarized in the Notice of Proposed Rulemaking.

What Commenters Said:

EMA, NMMA, Regal Marine, and Carver Boat Corporation commented that CI recreational marine engines make a negligible contribution to ambient concentrations of ozone and carbon monoxide. EMA and NMMA concluded that recreational marine engine emissions do not significantly contribute to air pollution and do not meet the criteria for regulation under the Clean Air Act section 213(a). Mercury Marine commented that we have met the CAA requirements for reducing emissions from CI marine engines by regulating commercial marine engines which make up 97 percent of all CI marine engines. They commented that a regulation for recreational marine engines would not provide any environmental benefit. Peninsular commented that they produce so few engines, that they have very little emissions impact.

CARB commented that they still require further reductions in ozone precursors to meet Federal and State Air Quality Standards for ozone and that nonroad mobile sources are a significant source pollution which account for over 40 percent of mobile source emissions of HC+NOx. STAPPA/ALAPCO commented that the proposed standards will help reduce the harmful health effects of ozone, CO, PM, and toxic air pollution. Further, they commented that the Clean Air Act requires us to regulate these source categories to the greatest extent possible. Bluewater Network commented that our inventory projections with the proposed rule would still result in a large increase in PM emissions from this source by 2030 and that we need further reductions. Sierra Club commented that these engines have been unregulated for too long, that they emit massive amounts of pollution, and that they we need to reduce their share of the national emissions inventory. MECA also commented that they believe the engine categories in this rule are important contributors to ambient pollution and that they also adversely impact the micro-breathing environment of the equipment users.

Our Response:

No one commented on our methodology for estimating the emission inventory for CI recreational marine engines or for projecting estimating emission reductions from this rule. Manufacturers commented that the inventory contribution from CI recreational marine engines is too small to regulate. As discussed in more detail in Section II.A.6, we believe that CI recreational marine engines are contributors to air pollution and meet the criteria under the Clean Air Act for regulation. This assessment is supported by several of the commenters.

2. Economic Impact

What We Proposed:

In the draft RSD, we present our analysis of the estimated economic impact of the proposed CI recreational marine engine standards. This economic impact analysis is also summarized in the Notice of Proposed Rulemaking.

What Commenters Said:

EMA, NMMA, and Mercury Marine commented that the NTE testing would add cost of the proposed standards because it increases the stringency of the standard, the testing burden, and uncertainty of compliance. EMA’s estimate is that the NTE requirements would increase the costs per engine “exponentially” for each marine engine rating, especially because there are low production volumes over which they can spread the costs. Mercury Marine commented that the test equipment required to operate at the ambient conditions contained in the NTE requirements would cost $500,000. Mercury Marine commented that their analysis of the proposed standards estimates that the cost effectiveness of the proposed rule would be more than $18,000/ton of HC+NOx reduced. EMA commented that because the EPA estimate of $580/ton of HC+NOx reduced is higher than the other engine categories in the NPRM, we should harmonize with the proposed European Union standards.

EMA and NMMA also commented that experience with the 10 percent federal luxury tax on boats costing more than $100,000 in the early 1990's suggests that a small price increase can have a large negative impact on the marine industry due to a high price elasticity. NMMA stated that this luxury tax resulted in an 80 percent decline in yacht sales and a loss of 25,000 jobs. NMMA also cited a specific instance of an individual using the U.S. luxury tax as an incentive for U.S. consumers to buy their yachts in the Bahamas.

Hatteras Yachts expressed concern that the cost of the proposal will outweigh the environmental benefit. Carver Boat Corporation commented that emissions standards would result in additional costs which include increased fuel consumption. Also, they would have to alter their yachts to accommodate larger, heavier, engines with worse fuel consumption and power. Peninsular commented that, as a small business, the cost of testing equipment for certification alone would be a large expenditure for them.

Sonex commented that they support the EPA estimates of the per engine costs associated with the CI recreational marine diesel engine standards. STAPPA/ALAPCO commented that the emission reductions from this rule would be very inexpensive. MECA commented that the proposed standards can be met in a cost effective manner. Sierra Club commented that the cost per ton of emission reduction for this rule is considerably less expensive than other EPA rules that have already been promulgated. For this reason, they concluded that we should target much more stringent standards. In addition, Sierra Club commented that industry has historically predicted the costs of regulation at least two times higher than actual costs, and that the cost of regulation is often even lower than what EPA predicts.

EMA, NMMA, and Regal Marine claimed that we did not take costs associated with the NTE requirements into account in our analysis of the cost-effectiveness of the standards and that we should conduct detailed studies on the costs and market implications of the standards. NMMA cited a September 24, 2001 letter from John Graham at OMB to Jeffrey Holmstead at EPA discussing the need for detailed economic evaluation prior to imposing a regulation.

Our Response:

We received no comments on the detailed hardware costs presented in the RSD. However, manufacturers commented that significant increases in fixed costs would be associated with developing engines that comply with emissions at any speed and load that can occur on a vessel. We believe it is not appropriate to include additional costs for manufacturers to comply with these "off-cycle" requirements beyond the fixed and variable costs estimated in the proposal. This is because we expect that manufacturers can manage engine operation and avoid unacceptable variation in emission levels by effectively using the technologies that will be used to meet the E5 emission limits, rather than by use of additional hardware. For example, manufacturers can adjust fuel injection parameters to avoid excessive emissions. The split-zone approach (illustrated in Figure II.F.1) is designed to accommodate normal variation in emission levels at different operating points. This approach involves no additional variable cost. The estimated R&D expenditures in the RSD reflect the time needed to address this. As discussed elsewhere, the NTE related compliance costs for testing have been accounted for, in light of the kind of additional design and calibration work expected to address NTE compliance using the same emission control technology as used for the primary standard. Because the same technology will be used to meet the NTE standards as the primary standard, no loss of fuel economy or performance is expected due to the NTE requirements.

Mercury Marine's analysis of the cost per ton was based almost exclusively on the cost impact of controlling emissions from spark-ignition engines, with no attempt to adapt the analysis to CI recreational marine engines. We were therefore unable to modify the proposed analysis to reflect this information. In addition, they provide no detail on why they believe that the range of ambient conditions included in the NTE requirements would result in a $500,000 increase in equipment costs. Water temperature can be controlled with inexpensive test equipment. The maximum air temperature in the testing range is similar to that in the E5 requirements, and cooler air could be simulated with by reducing the temperature of the water to the aftercooler.

EMA commented that the cost per ton of the CI recreational marine engine standards is higher than for other categories in this rule, so we should relax the standards to be consistent with the proposed European standards. As discussed in the Final RSD and noted by STAPPA/ALAPCO, the cost per ton HC+NOx reductions for this rule is considerably lower than recent standards finalized for highway diesel engines. In addition, as discussed in Section II.A.1, we do not believe that setting standards at the proposed European levels would achieve any emission benefits. Considering that there would be certification costs with no benefits, the cost per ton would be unattractive.

NMMA commented that the 10 percent luxury tax is an example of how sensitive the recreational marine engine market is to price increases. However, we do not believe that the new standards will significantly affect new boat sales. While the luxury tax resulted in a 10 percent increase in the cost of a yacht, we anticipate that these standards will result in about a 0.1% increase in the cost of a yacht. In addition, consumers are getting a return on the cost increase of better technology while the tax did not give this return.

For the final rule, we performed a detailed economic impact assessment that is consistent with NMMA's request. This economic impact assessment, described in the Final RSD, supports the new standard.

H. Other Issues

1. OB/PWC In-Use Testing Requirements

What We Proposed:

We proposed to clarify testing rates for the in-use testing program in place for outboards and personal watercraft. 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.

What Commenters Said:

Mercury Marine commented that the way the proposed revision is worded, that EPA would be able to take into account the total number of engine families produced by the manufacturer rather than the number of engine families identified by EPA as subject to in-use testing. Mercury recommended that "manufacturer's total number of engine families" be replaced with "number of engine families to which this subpart is applicable produced in that model year" in the proposed amended language for §91.803(a).

Our Response:

We agree with Mercury's comment which reflects the intent of the proposal. The final regulations reflect this change.

2. Low Sulfur Diesel Fuel

What We Proposed:

We did not propose standards for diesel fuel used in marine applications.

What Commenters Said:

CARB, STAPPA/ALAPCO, and Bluewater Network all commented that we should require fuel sulfur in nonroad diesel fuel to be capped to 15 ppm consistent with the highway diesel fuel requirements beginning in June 2006. They commented that this low sulfur fuel would enable the use of aftertreatment control technologies for nonroad engines that could result in equivalent emission reductions as will required for highway diesel engines beginning in 2007. CARB commented that even in the absence of exhaust aftertreatement, 15 ppm sulfur fuel would reduce PM emissions. CARB stated that by reducing sulfur from 141 ppm (current California fuel) to 15 ppm, they would expect PM to be reduced by about 0.004 g/bhp-hr over the highway Federal Test Procedure.

Our Response:

Regulation of in-use fuels is beyond the scope of What We Proposed:: in this rulemaking. We do not believe that compliance with the CI recreational marine engine standards will require the use of catalytic technologies, and thus, we believe that the standards will be feasible without the use of low sulfur fuel. We will evaluate the regulation of in-use fuel quality for marine diesel engines when we initiate future rulemaking on new land-based nonroad diesel standards.

Summary and Analysis of Comments: Recreational Vehicles

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V. Chapter 5: Recreational Vehicles

II General

1. Averaging, Banking, and Trading

What We Proposed:

A voluntary emission-credit program allowing manufacturers to certify one or more engine families at emission levels above the applicable emission standards, provided that the increased emissions are offset by one or more engine families certified below the applicable standards. The average of all engine families for a particular manufacturer's production must be at or below that level of the applicable emission standards. EPA proposed the adoption of separate emission-credit programs for snowmobiles, off-highway motorcycles, and ATVs. Further, the emission-credit program contains banking and trading provisions, which allow manufacturers to generate emission credits and bank them for future use in their own averaging program or sell them to another entity. We did not propose a credit life limit or credit discounting for these credits. We requested comments on opportunities for early credit generation. For ATVs, we proposed separate ABT programs for J1088 and FTP standards and separate programs for the J1088 standards above and below 225cc.

What Commenters Said:

ARB is not opposed to the proposed ABT program provided that there are safeguards to ensure against abuse. They support keeping separate emission credit programs for the different types of recreational vehicles. ARB believes that EPA should limit credit life to three years so that manufacturers cannot unduly postpone Phase 2 standards. However, ARB does not support the inclusion of engines certified to Voluntary Low-emission Standards program in the ABT program. They state that there is precedent to not include voluntary low-emitting engines in an ABT program, as shown with Blue Sky Engines in the 1998 nonroad CI engine rulemaking. With regard to land-based recreational vehicles, ARB believes that the air quality benefits associated with the use of these voluntary low-emission vehicles could be undermined by "averaging" the emission credits they generate in order to introduce additional high-polluting models into commerce.

Our Response:

The Final Rule retains separate programs for off-highway motorcycles, ATVs, and snowmobiles. We are finalizing multiple phases of standards only for snowmobiles.

Establishing a credit life limit is one way we could address concerns about manufacturers using credits to significantly delay compliance with Phase 2 or Phase 3 standards. However, we believe the credits program for snowmobiles has been finalized in such a way that California's concerns regarding unduly postponing the Phase 2 or Phase 3 standards are addressed without a credit life limit. As discussed below, early credits (credits generated prior to 2006) for Phase 2 may be generated only up to the Phase 2 standards. This limits the amount of early credits available for Phase 2 because the credits can only be generated between the FEL and the Phase 2 standards. Early credits may not be generated for use in Phase 3. Starting in 2006, manufacturers can earn credits for Phase 2 and Phase 3 but only if they are able to achieve emissions reductions beyond those required by those phases of standards. The Phase 1 standards, which begin in model year 2006, are going to be a challenge for manufacturers and they will be relying on their advanced technology sleds as part of their strategy to meet the Phase 1 standards.

We do not believe manufacturers will have credits available to significantly delay the Phase 2 or Phase 3 standards, given the challenges of Phase 1. We are expecting advanced technology sleds to continue to be introduced in an orderly manner over the next several years with their market penetration increasing gradually to meet standards. If a manufacturer were able accelerate the introduction of advanced technology in order to reduce emissions sooner and earn credits, we believe the overall program would benefit. In fact, this is one of the key outcomes ABT programs are designed to encourage. Credits have limited life in that their use is limited to the Phase for which they have been generated and credits become void if manufacturers to not use them prior to the beginning of the next phase of standards. This will prevent manufacturers from stockpiling credits for Phase 3 during Phases 1 and 2.

The Final Rule does not include Blue Sky standards or any other voluntary standards, and therefore we are not further considering for this rule how engines certified to such standards should be treated within the ABT programs.

What Commenters Said:

ISMA commented in support of an early credits program for snowmobiles. ISMA commented that such a program could ease the transition to the 2006 standards which they believe will be challenging. They also commented that the early credits program would give manufacturers early experience with the EPA program in such areas as certification and production line testing. It would also provide EPA with early information on the technologies being used to reduce emissions. ISMA supported an early credits program over other concepts put forward for comment by EPA and suggested that a three year credit life would be appropriate. In a supplemental set of comments, ISMA recommended that credits be based on the difference between the FEL and the final standards and that the credits should not expire.

We did not receive comments opposed to an early credits program for snowmobiles. We also did not receive comments for or against an early credits program for ATVs and off-highway motorcycles.

Our Response:

We have included an early credits program for snowmobiles in the Final Rule. We concur with comments both that the standards will be challenging and that it would be beneficial to gain experience with the program and new technologies prior to 2006. In cases where standards require the introduction of new technologies, early credits programs encourage the early introduction of those technologies. This is beneficial for manufacturers to gain experience with the technology and it is beneficial for the environment which sees gains earlier than would otherwise occur. Consumers also benefit by being able to select cleaner products that have been EPA certified and are required to be clean in-use.

When designing an early credits program, we must be careful not to give manufacturers credits for emissions reductions that would occur without significant effort on the manufacturer's part. We requested comments on this issue of "windfall credits". This would be an issue if, for example, we allowed credits to be generated against an average baseline level. In such cases, the baseline sleds that are below the average could earn credits without significant modification. We have avoided this issue in the design of the program. The Final Rule provides that manufacturers can earn early credits up to the Phase 1 standard for use in Phase 1. They can earn credits up to the Phase 2 standards for use in Phase 2. This approach is consistent with manufacturer recommendations for the early credits program. Early credits are not available for Phase 3.

Manufacturers that are able to certify below Phase 2 levels can keep those credits between the FEL and Phase 2 levels for use in meeting the Phase 2 standards in later model years when those standards go into effect. The credits may not be used for Phase 3. The approach we are adopting provides incentive to manufacturers to achieve the lowest possible levels. Allowing manufacturers to keep a portion of the early credits for Phase 2 provides more flexibility for Phase 2 and gives manufacturers an incentive to postpone the use of credits which provides a benefit to the environment. For these reasons, as well as those described in the previous response, we do not believe a credit life limit is necessary.

What Commenters Said:

In the regulatory text mark-up provided by ISMA, they indicated that they would like

EPA to remove the caps on the Family Emissions Limits. Their comments do not provide supporting rationale for wanting the caps removed from the regulations. However, ISMA members explained in meetings that the reason the caps were problematic is that manufacturers would need to modify most, if not all, engine families just to meet the caps. Manufacturers are concerned that efforts to meet the caps in 2006 would drain resources from their R&D program to develop new technologies. Manufacturers also said that the caps are a great concern for 2006 because they would only have a few years in which to change virtually their entire product line in order to comply with the caps.

Our Response:

Caps ensure a minimum level of control for each snowmobile certified under the program. We believe this is appropriate due to the potential for personal exposure to very high levels of emissions as well as the potential for high levels of emissions in areas where several snowmobiles are operated in a group. We proposed that these limits would be effective beginning in 2006. We recognize that this could be a significant issue in the early years of the program and could detract from manufacturers' efforts to develop much cleaner technologies. Thus, the Final Rule includes FEL limits only for the long-term, Phase 3 program, beginning in 2012. We believe that this helps resolve the lead-time and workload issues for 2006 and 2010 while maintaining the integrity of the long-term program. Also, the caps are likely to be much less of an issue for Phase 3 when manufacturer need greater emissions reductions to meet standards and are not likely to be able to afford within the averaging program to leave sleds at emissions levels that exceed the caps. We are concerned, however, that the lack of more stringent caps within the averaging program could make it more difficult for manufacturers to comply. If market conditions lead consumers to purchase more of the models that have higher emissions, manufacturers could find themselves with credit deficits at the end of the year. Manufacturers will need to manage their product line-up carefully in order to comply and we will also monitor the situation closely and may consider more stringent FEL caps in the future if they become necessary. EPA does not intend to signal any future decisions on compliance flexibility by allowing these generous FEL caps in this Final Rule.

What Commenters Said:

MIC provided a mark-up of the regulations as part of their comments and in it they commented that EPA should allow ATV averaging regardless of which test method is used to certify or which displacement call the engine is in, above or below 225 cc. MIC does not provide supporting rationale for why this is needed or how the program might work with such allowances. MIC does not respond to issues EPA raises in the NPRM regarding credit exchanges between the FTP and the J1088 standards, including the lack of correlation between the two test cycles.

Our Response:

On the issue of credits exchanges between test cycles, we remain concerned that there is no way to establish a valid methodology to exchange credits. Available data suggests there is little correlation between test cycles. In meetings with manufacturers, no new information or data was presented that would help establish a correlation or methodology to transfer credits. The J1088 option is transitional in nature and was included to ensure emissions reduction as soon as possible, because manufacturers could potentially carry-over much of their test data from the California program. We have little information on how the standards compare in stringency in a way that would provide a level of comfort that the credit transfers would be valid. Also, California has no provisions to allow credits to be transferred between programs and essentially all ATVs that are certified are certified to the J1088 standards. For these reasons, we continue to believe credits transfers between the FTP and J-1088 would not be workable and are unnecessary.

We continue to believe that it is appropriate to harmonize with California's approach to the J1088 program with regard to engines above and below 225cc. California has separate standards for above and below 225 cc and does not allow averaging between the two groups. It is our goal to harmonize with California in a way that allows manufacturers to meet standards in the near-term by carrying over California data. This allows standards to be met sooner than would otherwise be possible. We do not believe it is appropriate to adopt an averaging program that is inconsistent with California's given the objective of the program. Manufacturer's did not comment on how the California program restriction has been problematic for them. We are concerned, given the difference in stringency between those above 225cc and below 225cc, that credit may be easier to generate below 225 cc and would effectively make the standards less stringent for those models above 225 cc.

2. Evaporative Controls

What We Proposed:

The Agency did not propose a permeation emission standard in the NPRM.

What Commenters Said:

ARB, Environmental Defense, NTWC, and SRFN urge EPA to address the problem of evaporative emissions from recreational vehicle fuel tanks and plastic hoses and seek significant reductions in the final rulemaking. Further, Environmental Defense believes that the use of level 3 fluorination, or similar effective mitigation measures, will result in significant and cost-effective emission reductions. ARB suggests that EPA consider the use of fluorinated or sulfonated HDPE portable gasoline cans and specially treated fuel hoses which are very cost-effective methods to reduce evaporative emissions. ARB believes that the numbers generated by NONROAD for the proposal only considered diurnal and refueling emissions and are thus lower than actual levels and the NPRM did not propose reducing evaporative emissions.

Our Response:

In response to the numerous comments we received on the need for evaporative emission control for land-based recreational vehicles, we published a notice on May 1, 2002 that reopened the comment period for the proposed rule to seek comment on possible standards for controlling fuel permeation losses from plastic fuel tanks and rubber hoses for land-based recreational vehicles that would require low permeability fuel tanks and hoses on off-highway motorcycles, ATVs, and snowmobiles starting with the 2006 model year. The notice requested comment on a possible phase-in beginning for all three types of recreational vehicles at 50 percent in 2006 and 100 percent in 2007. For fuel tanks, we discussed in detail potential standards requiring a 95 percent reduction in permeation emissions. These reductions imply a tank permeability standards of 0.04 grams per gallon per day at 30°C or about 0.4 to 0.5 grams per square meter per day. We also requested comment on the form of this standard. For hoses, we considered a permeation standard of 5 grams per square meter per day at 23°C. This constitutes a 99 percent reduction in permeation when compared to the SAE R7 hose specification of 550 grams per square meter per day. We only focused on permeation emissions rather than broad evaporative emission standards for land-based recreational vehicles because the fuel tanks are generally small, resulting in diurnal and refueling emissions that we expect to be low. The use rates (hours of operation) of recreational vehicles are likewise low compared to other sources, and we expect that hot soak emissions will be low as well.

For a more in-depth discussion on our permeation standards and the issues raised by various commenters, refer to the Summary and Analysis of Comments: Recreational Vehicle Permeation section.

3. Blue Sky Standards

What We Proposed:

EPA proposed separate voluntary standards for snowmobiles, ATVs, and motorcycles. For the voluntary standards, manufacturers must meet the emission standards and all testing and reporting requirements. The proposed voluntary standards for model year 2002 and later are as follows:

snowmobiles- 45 g/kW-hr HC and 120 g/kW-hr CO,

ATVs- 0.8 g/km HC+NOx and 12 g/km CO,

off-highway motorcycles- 0.8 g/km HC+NOx and 15 g/km CO.

For snowmobiles, alternative voluntary standards for model years 2002-2009 of 75 g/kW-hr HC and 200 g/kW-hr CO were also proposed.

What Commenters Said:

STAPPA/ALAPCO, OTC, the State of New Hampshire, and MECA also submitted comments supporting our Blue Sky voluntary low-emission standards. MECA also stated that the standards should be based on early compliance with the mandatory requirements for engine certified at levels below the mandatory requirements. STAPPA/ALAPCO and OTC also stated a voluntary program should include mandatory consumer labeling.

ISMA and MIC were opposed to “voluntary standards” for recreational vehicles. They argued that the Agency would unintentionally increase the risk that states, parks or other jurisdictions could attempt to implement a more stringent level of control than that reflected in the Agency’s actual emissions standards. This result would occur, for example, if such a jurisdiction limited the use of snowmobiles, ATVs, or off-highway, motorcycles to those meeting the voluntary standard. They stated that Congress has prohibited states and other jurisdictions from directly or indirectly imposing any emissions standards on engines for which EPA has promulgated standards under section 213, other than those promulgated by EPA or properly adopted by California and for which EPA has provided authorization.

Our Response:

We proposed Voluntary Low-Emission Standards for recreational vehicles in the NPRM for two reasons: 1) to encourage new emission-control technology; and 2) to aid the consumer in choosing clean technologies.[pp] We believe that for all three recreational vehicle categories, the standards that we are finalizing will result in clean advanced technologies. For ATVs and off-highway motorcycles, our standards will result in well calibrated, clean four-stroke engines with pulse air injection on many models. We don’t anticipate much desire on the part of consumers for much cleaner engines at this time, as that would necessitate the use of electronic fuel injection or catalysts, at increased costs.

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

For snowmobiles, we believe our mandatory standards are technology enforcing and will result in a significant number of snowmobile models equipped with advanced technologies, such as four-stroke engines and direct fuel injection two-stroke engines. Because we are allowing for emissions averaging, manufacturers will need to introduce advanced technologies for many models in order to allow some more higher emitting and difficult to control models to continue to be built. Therefore, we believe that snowmobile manufacturers do not need the added incentive of voluntary low-emission standards to develop advanced, clean emission control technology.

The key to informing consumer decision is to provide them information on the relative emissions attributes of a given model. We believe this can be achieved through a consumer labeling program that does not include voluntary standards. Therefore, we are not finalizing a voluntary standard program for recreational vehicles. A discussion on our voluntary program can be found below.

We disagree with comments from MIC that the Blue Sky program could ever be seen as a mandatory standard or that it would impose significant consequences for noncompliance. The actions of other parties cannot transform EPA voluntary policies into EPA mandatory duties. Any actions by third parties regarding the use of recreational vehicles must stand or fall based on the justifications that such parties have for such actions.

4. Consumer Labeling Program

What We Proposed:

The Agency proposed the use of hang tags for recreational vehicles at the point-of-sale for consumer benefit and education.

What Commenters Said:

We received numerous comments from states, environmental groups, and private citizens supportive of establishing a consumer labeling program. While most of the comments were positive, several of the commenters had concerns about our proposed program. Environmental Defense stated that they believe hang tags are ineffective tools for consumer decision-making, as it allows dealers the opportunity to selectively remove hang tags as they desire. They believe that permanent labels assure that even second-hand consumers are aware of the environmental impacts of their purchase and that they would also help land managers to accurately estimate the environmental conditions resulting from snowmobile use on any given unit of public land. NESCAUM also believes that a mandatory labeling program should be established. They state that this could be based on early compliance or for engines certified to levels below the mandatory requirements and believe that this will help state efforts for green labeling programs and consumer education, and will allow parks to encourage or require the use of cleaner nonroad engines.

NTWC and SRFN are disappointed that the proposal does not include a user-friendly consumer labeling system. They believe that the labeling program included for recreational vehicles appears number-based and will not offer consumers information about the voluntary emissions levels. NTWC and SRFN suggest that EPA incorporate a labeling system similar to the one that California has developed for marine engines. NTWC also felt that labels could harness market forces to encourage the production of cleaner vehicles.

ISMA supports the concept of a voluntary consumer choice program though they are concerned that other stakeholders may try to abuse such a program by using it to pressure public land managers or states to impose usage restrictions (and Congress has prohibited states and others from imposing, whether directly or indirectly, any emissions standards on engines that EPA has promulgated standards under CAA Section 213. They believe that the structure of the proposal as it has been presented, increases the risk that a more stringent level of control may be implemented than is actually reflected in the standards. ISMA strongly believes that such a program should be structured in a manner that is least likely to be abused, and suggests that the following four elements should be considered essential for such a program: the program should be enacted as a stand-alone paragraph (not part of the emissions standards section of the rule), information for the consumer should be placed on a hangtag that is visible to the consumer in the showroom; the hangtag should include the baseline emissions performance level for engines, the applicable emissions standard, and the FEL for that particular model; and the rule should contain language clarifying the true nature of the program and discouraging misuse.

MIC supports the use of a voluntary hang-tag program that would set up a uniform format for emissions performance hang-tags that manufacturers could elect to display on showroom models.

Our Response:

While we understand the desire by many of the commenters to establish a mandatory labeling program, perhaps similar to California, we do not believe a mandatory label is necessary. Some of the commenters stated that mandatory labeling would encourage manufacturers to develop more advanced technologies, such as four-stroke engines. We feel this belief is overstated. As discussed above, all of our recreational vehicle standards will allow averaging. This will result in a mixture of emission control technologies. For ATVs and off-highway motorcycles, the main emission control technology will be the use of clean, well calibrated four-stroke engines, some also using pulse air injection. The difference between emission control technology and emission performance should be very minimal for these vehicles. While it makes sense to provide an emissions performance label for the consumer, there is no need for it to be permanent. Second-hand consumers will have the advantage of knowing that any ATV or off-highway motorcycles purchased after 2006 will be a clean machine that meets EPA standards.

For snowmobiles, there will be a broader variety of technologies available. However, in order to meet our standards, manufacturers will already have to use advanced technologies, such as four-stroke engines and direct fuel injection two-stroke engines. Any additional use of these advanced technologies across engine models will result from the necessity of meeting the standards, not the use of mandatory consumer labels. We believe most consumers interested in purchasing clean snowmobiles will be interested in knowing whether the snowmobile is equipped with a four-stroke engine or direct fuel injection two-stroke engine. Most of the manufacturers are already marketing their clean snowmobiles as using new, clean advanced technologies, with the word four-stroke of DFI (direct fuel injection) in the name of the model.

Therefore, we are finalizing a temporary consumer labeling program. The label must be fixed securely to the product prior to arriving at the dealership but does not have to be permanent and may be removed by the consumer when placed into use. The label can be in the form of a removable sticker or decal, or a hang tag affixed to the handlebars or fuel cap. If a hang tag is used, it must be attached by a cable tie that cannot be easily removed, except by the ultimate retail consumer. The label, at a minimum, must include the following information: *U.S. E.P.A.; Clean Air Index (appropriate pollutant, e.g., HC+NOx, etc.); manufacturer name; vehicle model with engine description (e.g., 500 cc 2-stroke with direct fuel injection); emission performance rating scale; explanation of scale; and notice stating that label must be on vehicle prior to sale and can only be removed by ultimate retail consumer*. In section 1051.135(g) of the regulations, titled "How must I label and identify the vehicles I produce?," we have developed several equations that determine what the emission performance rating scale will be for each category. The scale is based on a rating system of 1.0 through 10.0. A value of 1.0 would be assigned for the cleanest vehicle, while the dirtiest vehicle would get a rating of 10.0.

5. Tampering

What We Proposed:

EPA proposed that a device or element of a design that may affect an engine's emission levels may not be removed or disabled, and that this restriction applies both before and after the engine is placed in service. Further, an engine part who's main function is to bypass, impair, defeat, or disable the engine's control of emissions may not be knowingly installed, manufactured or sold.

What Commenters Said:

MIC believes that tampering with the necessary emission controls by vehicle owners would further reduce the effectiveness of the Phase 2 standards and further increase the cost-effectiveness ratio. They state that various studies (provided in and/with their comments) indicate that tampering is currently a significant problem. They further state that, if the exhaust system tampering rate remains at 50% under the standards, the ratios would double to over $27,000 and $20,000 per ton for catalyst forcing standards and those requiring re-calibration and pulse-air, respectively. MIC believes that exhaust system modifications will lead to increased tampering rates. They respond unfavorably to the idea of tamper-resistant emissions control systems, stating that it is not practical to prevent owners from tampering while still allowing for reasonable service to be performed. They raise three concerns with a tamper-resistant design: 1) this would require additional design, development/durability work, and retooling (and increased costs); 2) the cost of service or warranty work will increase; and 3) this concept may only marginally reduce tampering.

ABATE of Illinois commented that they are concerned about our anti-tampering provisions because they believe limiting the amount of customizing or modification an individual makes to their ATV or off-highway motorcycle would create an economic hardship on the aftermarket part industry. They also believe that anti-tampering products would discourage individuals from servicing their own machines and encourage them to go dealers, thus driving up the cost of simple maintenance tasks.

ATV Magazine and ATV Sport submitted comments stating that the utility and sport ATV markets are distinct. The claim that the utility market is not as concerned with all-out performance as is the sport market. They said that much like competition off-highway motorcycles, a sport ATV buyer wants the most performance out of their engine as possible.

Our Response:

The removal of stock engine components or the replacement of stock engine components with aftermarket components would only be considered tampering if the components removed were part of the emission control system or if the replacement component adversely affected emission performance. Thus, modifications can be made to any recreational vehicles as long as the modification does not adversely affect the emissions performance of the vehicle. While the fuel and exhaust systems are usually integral parts of a vehicle's emission control system, it may be possible to replace a stock carburetor of exhaust pipe without affecting emissions performance for some models. New vehicle owner's will need to check their owners manual to determine what type of emission controls their vehicle is equipped with and whether it's okay to make any modifications. The concern over tampering raised by the commenters appears to be directed at our proposed Phase 2 standards for ATVs. MIC's comments were focused on exhaust system tampering rates and the difficulty with developing "non-removable" catalysts. Their concern would only have relevance to our proposed Phase 2 ATV standard of 1.0 g/km HC+NOx would require the use of catalysts on some models and there could be a legitimate concern about ATV owners removing a stock exhaust system equipped with a catalyst and replacing it with an aftermarket model that does not have a catalyst. However, as discussed below in this document, we are not finalizing our proposed Phase 2 standard of 1.0 g/km HC+NOx. Instead, we are finalizing a single phase standard of 1.5 g/km HC+NOx, which we believe will not require the use of catalysts. Therefore, we believe the actual concern raised by the commenters over tampering, which is the removal of exhaust systems which contain catalysts, will not exist.

Although MIC seems to be focused on tampering with catalysts, there is still the issue of whether tampering with ATVs and off-highway motorcycles in general is prevalent and whether it should be a concern. In their comments, MIC submitted information they claim demonstrates that tampering with ATVs is a significant problem. First of all, since there currently are not any federal emission standards for ATVs and off-highway motorcycles, the information provided by MIC does not illustrate the number of owners that tamper with their emission control system; rather it illustrates the number of owners that make legal modifications to their machines. As discussed below, nothing in MIC's information indicates that the current practice of making engine modifications will continue once emission standards exist or whether it would be tampering with a certified emission control system. Second, the information that they provided consisted of survey information from several ATV magazines (including ATV Sport magazine), results from a survey performed by Honda, and data collected during sound testing of ATVs entering a California off-highway vehicle recreation area. MIC states that these various sources indicate a tampering rate of just under fifty percent. However, all of their sources are for "sport" ATVs and do not appear to include utility ATVs, which dominate the market (approximately 75 percent of sales).

We are not surprised to hear that many sport ATV owners make modifications to their machines. As the comments from ATV and ATV Sport magazines suggest, sport ATVs are very similar to competition off-highway motorcycles where performance is paramount. There is a large market for aftermarket exhaust systems and carburetors for sport ATVs. These modifications are some of the easiest and most effective modifications that ATV owners can make to their engine to improve performance. While quick accelerations and high speed are important to the sport ATV owner, they are not as important to the utility

ATV owner. According to ATV and ATV Sport magazines, the utility ATV market is not concerned about all-out performance. Rather, the desired attributes of utility ATVs are low-maintenance engines that are durable and reliable and that provide sufficient torque to perform tasks such as hauling loads, mowing lawns, plowing snow, and pulling stumps in addition to recreational operation. Most consumers who purchase utility ATVs buy them for their functionality and versatility rather than their high-performance capabilities. Thus, the likelihood of ATV owners replacing the stock exhaust system or carburetor with performance aftermarket parts is very low. Therefore, we believe that the MIC estimates of modifications are too high. They claim approximately fifty percent, but that fifty percent is based on sport owners, which constitute approximately 25-percent of ATV sales. If half of sport owners are making modifications and they only represent 25-percent of sales, then the actual number of ATV owners that make modifications, according to MIC, should be more like 12-percent.

Since there are no current federal emission standards for ATVs or off-highway motorcycles, it is not unlawful to remove the exhaust system or any other part of an ATV, thus there is no incentive for ATV or off-highway motorcycle owners to leave their machines in their stock configurations. However, once ATVs and off-highway motorcycles are regulated federally in 2006, they will be equipped with engine labels indicating that the machine is a certified product and that is unlawful to remove any emission control components. We can not estimate the impact this will have on ATV and off-highway motorcycle owners willingness to potentially replace emission control components, but the threat of possible legal repercussions may be enough to reduce they level of tampering. Moreover, given the level of standards being promulgated and the emission control strategies we expect to be used to meet the standards, we don't perceive tampering to be a significant issue, as the vast majority of emission controls will come from technologies (like four-stroke engines) that are not easily subjected to tampering.

MIC also suggested that we should include the cost of tampering into our cost analysis. However, since we do not believe tampering will be an issue, primarily because we are not finalizing standards for ATVs that will require catalysts, we do not agree that it is appropriate to include tampering into our cost analysis. If our standards were to require catalysts, then we agree that tampering could be more of a concern and it may be appropriate to include it in our cost analysis.

Finally, ABATE of Illinois commented that they are concerned about our anti-tampering provisions because they believe limiting the amount of customizing or modification an individual makes to their ATV or off-highway motorcycle would create an economic hardship on the aftermarket part industry. We disagree with this assertion, because as stated above, utility ATVs far outnumber sport ATVs. Since most utility ATV owners do not make modifications to their ATVs that would affect the emission control system, the vast majority of aftermarket parts for ATVs will be unaffected. The majority of engine modifications made to sport ATVs were for two-stroke machines, usually replacing the exhaust pipe. The number of new aftermarket two-stroke pipes for sale for ATVs probably will be diminished, but not due to anti-tampering provisions, but because two-stroke ATVs won't be capable of meeting the emissions standards. For off-highway motorcycles, the majority of engine modifications occur to competition machines. Recreational non-competition machines will experience very little in the way of engine modifications. Since the majority of off-highway motorcycle modifications are made to competition machines and they are exempt from emission standards, the impact on the aftermarket part industry should be minimal.

ABATE also stated that anti-tampering products would discourage individuals from servicing their own machines and encourage them to go to dealers, thus driving up the cost of simple maintenance tasks. This is not a concern since we are not requiring anti-tampering products.

6. Usage Restrictions

What We Proposed:

We did not propose any restrictions on the usage of recreational vehicle (snowmobiles, ATVs, and off-highway motorcycles.

What Commenters Said:

We received comments from private citizens stating that we should ban snowmobiles, ATVs, and off-highway motorcycles from National Parks and other public lands. In general, these commenters thought that such lands should remain clean, quiet and pristine.

Our Response:

We are not adopting any restrictions regarding the usage of any recreational vehicles on any public lands. Whether or not such usage restrictions are appropriate, EPA does not have the legal authority under CAA section 213 to impose such restrictions.

7. Competition Exemption

What We Proposed:

EPA proposed that the following features are indicative of off-highway motorcycles that are used solely for competition: the absence of a headlight or other lights, the absence of a spark arrester, suspension travel greater than 10 inches, and an engine displacement greater than 50 cc. Further, EPA proposed that vehicles not meeting the listed criteria would be excluded only in cases where the manufacturer has clear and convincing evidence that the vehicle will be used solely for competition.

What Commenters Said:

We received comments from MIC and numerous private citizens stating that they support a competition exemption, but that the exemption should be broader ensuring all types of competition recreational vehicles are covered. MIC commented we should relax our criteria for competition motorcycles and should treat ATVs the same as motorcycles. Specifically, they stated that motorcycles and ATVs should be considered as competition models if they do not have spark arrestors and manufacturer warranties. They argued that EPA should not require labels for competition models since "once a vehicle is determined to be a competition vehicle, the EPA has no authority to impose requirements on them." They also commented that if we finalize separate provisions for competition ATVs, then we should allow them to be sold in public dealerships. Finally, they commented that we should not finalize the provision that would prevent the exemption of models that meet the criteria, but that we know are used for non-competition purposes.

We received numerous comments from states, environmental groups, and private citizens on concerns over the competition exemptions. Several commenters expressed concern that the proposed approach to identifying competition motorcycles will allow a competition loophole that could result in the sale of highly polluting motorcycles that would not be generally available otherwise. They generally commented that proposed approach would inappropriately apply the competition exemption to vehicles that are not solely used for competition purposes, based on the characteristics listed. CARB suggested that EPA should use the same method for motorcycles that was proposed for competition ATVs and snowmobiles. NTWC commented that we should focus the definition on how the vehicle is used, in order to conform with the narrow exemption in CAA Section 216. New Hampshire and OTC commented that these motorcycles are typically only used for one to two years and then replaced, many of these motorcycles end up shifting to offroad recreational use, and in a few cases, on-highway use. NESCAUM and STAPPA/ ALAPCO urged EPA to ensure that competition motorcycles are not used for recreation by setting a decisive process to determine which engines are used for competition and commit to enforcing this policy. South Carolina expressed a concern regarding the need to clarify "competition" and "competition engines" in the rulemaking. They argued that this rule needs to make clearer the distinction between competition and recreational uses concerning offroad motorcycles and the designations of competition and competition engines. They suggested that using the approach used for marine diesel engines, which would exclude only those nonroad motorcycles used strictly for professional competition, would help to clarify "competition" and "competition engines" and provide a more feasible method of regulating the emissions from these sources. Earth Justice commented that EPA's proposed competition exemption would violate the CAA and the consent decree because it would exempt offroad motorcycles which are sold for competition, as opposed to the CAA which exempts vehicles that are used solely for competition. They argued that the four criterion that are used to define competition motorcycles cannot distinguish motorcycles that are used *solely* for competition from those that are not. Earth Justice suggested that EPA's regulations contain an exemption that applies only to dirtbikes used *solely* for competition. They also commented that EPA should take the following actions to ensure that the exemption is not unlawfully broad: prohibit the sale of competition motorcycles at dealerships that also sell recreational motorcycles, require competition dealers and purchasers to obtain licenses that they will sell/use motorcycles for competition purposes only, and establish stringent and enforceable penalties for any violation of these rules.

Our Response:

As stated in §1051.620(b) of the draft regulations, we proposed to "exempt vehicles that we determine will be used solely for competition." We did not propose to exempt vehicles that are not used solely for competition. We are finalizing this aspect of the exemption. Thus, we agree with those commenters who opposed exempting vehicles that are used recreationally. However, we do not agree with the comments that our proposed exemption would create a loophole to allow the widespread recreational use of exempted vehicles, since we included in the regulation a clear provision that we would not allow the exemption "in cases where other information is available that indicates that they are not used solely for competition."

Much of the concern related to this issue is due to the fact that, at the time of sale, it is not possible to know with absolute certainty that any individual vehicle will actually be used solely for competition throughout its entire lifetime. Such an absolute conclusion can only be made at the end of the vehicle's life. Therefore, we are faced with a choice between an approach that offers no exemption at the time of sale and an approach that makes a reasonable projection of those vehicles that will be used solely for competition. We believe that the first approach would result in the regulation of vehicles that Congress clearly intended to exclude, since manufacturers would not be able to sell a competition model vehicle without risking the possibility that they would be violating the regulations if someone would use it for some other purpose. Therefore we believe that we must use an approach that relies on reasonable projections.

We believe that our proposed regulatory guidelines for manufacturers explaining how we would determine which vehicles we believed would be used solely for competition is reasonable. We do not agree with MIC's comment that all, or even most vehicles lacking a spark arrestor and a warranty would never be used recreationally. We believe that the other criteria proposed must be included in the final regulation. However, since we recognize that no guidance can be perfectly applicable for this problem, the regulations will allow for manufacturers to make a case that their vehicles should be exempted under the Act on the basis of other information in those cases where a competition model would not qualify under our regulatory guidelines. We have also included a regulatory provision that would not allow the exemption "in cases where other information is available that indicates that they are not used solely for competition." Thus, we will retain the authority to review competition exemptions from both perspectives on a case-by-case basis to prevent the exemption provision from being used as a loophole, while still providing the allowance for competition vehicles intended by Congress.

We disagree with the comments that we should treat motorcycles in the same manner as snowmobiles and/or ATVs. Amateur motorcycle racing is much more popular than ATV or snowmobile racing. Sales of racing motorcycles are a substantial portion of sales for all off-highway motorcycles, and as such, sales routinely occur in dealerships also selling recreational off-highway motorcycles. Thus it is necessary to consider the special case of competition motorcycles separately. We also do not believe that the kind of exemption language recommended by Earth Justice and other commenters would be consistent with the CAA language. The Act does not limit its exclusion of competition vehicles to those that are sold at special dealerships or that are purchased by licensed operators. Rather, it excludes all engines and vehicles that are used solely for competition. We believe that many motorcycles that are used solely for competition are currently sold at normal motorcycle dealerships and are purchased by operators that do not have special competition licenses. We agree with MIC that companies should be allowed to distribute competition ATVs through normal dealerships, as long as they are not advertised or offered for sale at such dealerships. We believe that allowing such distribution is reasonable, and will not create any incentive for recreational users to purchase competition vehicles. Moreover, it is unclear, to say the least, that section 213 of the CAA provides EPA the authority to carry out Earth Justice’s recommendations regarding licensing of users and dealers.

While some commenters state that our definition of competition motorcycle should be strictly limited to those vehicles used for competition purposes, they do not take issue with the specific criteria we have provided to make that determination at the manufacturing stage, or do they provide evidence that vehicles meeting these criteria will not generally be used solely for competition. In addition, we agree with MIC that nothing in the CAA indicates that the competition exemption must be limited to professional competition.

Given that organized off-highway motorcycle racing is often amateur, it is inappropriate in this case to limit the competition exemption to professional racing.

Finally, it is also important to emphasize that the exemption provisions in §1051.620 only apply for vehicle manufacturers. It does not exempt operators. §1068.101(b)(4) prohibits anyone from using an exempted vehicle for non-competitive purposes, subject to large EPA penalties. This prohibition thus would prevent a secondary purchaser from purchasing an exempted vehicle for recreational use. It also would prevent a purchaser from buying an exempted vehicle and then purchasing aftermarket parts like spark arrestors and using the vehicles as a recreational vehicle. This prohibition should also enable states and localities to prohibit the recreational use of exempted vehicles in parks and other public lands. The permanent label required on these vehicles can help purchasers and federal, state, and local authorities to ensure that these vehicles are not used for recreational purposes.

We disagree with MIC's argument against the labeling of exempted vehicles. We believe the proposed labeling requirement is a necessary condition of the exemption that will allow us to monitor the use of exempted vehicles. It will also ensure that secondary purchasers will be aware of the restriction on the use of exempted vehicles. From a purely theoretical perspective, the Act does not give us authority to regulate any vehicle used *solely* for competition. However, as stated above, it is not possible to know with absolute certainty at the time of sale that any individual vehicle will actually be used *solely* for competition. Our exemption provision is a reasonable projection that a vehicle will likely be used *solely* for competition, rather than a statement of fact. By granting the manufacturer an exemption prior to sale, we are relieving the manufacturer of the potential liability that it would otherwise face for vehicles that were intended for competition but that are used for some non-competitive purpose in use. Without the exemption, a manufacturer would need to determine for itself which vehicles will be used solely for competition, and would be liable for any incorrect determination. We believe it is reasonable to apply the minimal labeling requirement to exempted vehicles in exchange for the regulatory certainty that our exemption provisions will provide manufacturers.

Finally, we note that we have fulfilled completely our obligations under the consent decree to promulgate standards for recreational vehicles. Earth Justice may disagree with our interpretation of the competition language of the statute, but that is a far cry from their claim that our interpretation amount to a violation of the consent decree.

B. Snowmobiles

1. Stringency of Standards

What We Proposed:

For snowmobiles, we proposed two phases of standards, applicable by model year. The proposed Phase 1 standards, effective beginning year 2006, are 100 g/kW-hr HC and 275 g/kW-hr CO. The proposed Phase 2 standards, model year 2010, are 75 g/kW-hr HC and 200 g/kW-hr CO. It must be shown in the certification application that snowmobiles meet these emission standards over their full useful life.

What Commenters Said:

Bluewater Network, Earth Justice, Environmental Defense, H. Scott Alehouse, NESCAUM, Sierra Club, and SRFN all stated that our proposed standards do not meet the legal criteria of the Clean Air Act. They specifically cited the section 213 provisions which require us to set air pollution standards that will achieve the greatest degree of emission reduction achievable with technology that will be available, giving appropriate consideration to cost, noise, energy and safety factors. Further, Earth Justice stated that our legal obligation under the Clean Air Act is to first consider standards equivalent in stringency to standards for comparable motor vehicles or engines regulated under section 7521.

Bluewater Network, H.Scott Alehouse, NESCAUM, OTC, and STAPPA and ALAPCO all suggested that meeting the our legal obligations under section 213 of the Clean Air Act means setting emissions standards for snowmobiles that require all snowmobiles to be equipped with four-stroke engines and catalysts. Several other commenters suggested that the standards should require four-stroke engines at a minimum, without mentioning catalysts. Some private citizens commented that we should ban two-stroke engines and require all snowmobiles to have four-stroke engines. Commenters pointed to the current offerings of four-stroke snowmobiles as proof that the technology is available and therefore legally required. Bluewater Network, Sierra Club and SRFN all pointed out that the current emissions levels of the Arctic Cat four-stroke engine are well below our proposed Phase 2 standards. Earth Justice commented that we failed to fully consider a variety of potential technologies for snowmobiles and the maximum available reductions that these technologies could achieve, resulting in unlawful emissions standards. Environmental Defense commented that we must adopt Phase 2 standards the require at least 75 percent reduction in HC and CO, or adopt Phase 3 standards to require these reduction by 2012.

MECA and others believe that the proposal should have included an analysis of the possible application of catalyst technology to two and four-stroke snowmobile engines. MECA recommended that the feasibility of such technology be evaluated for the final rule.

MECA acknowledged that the application of catalysts to these vehicles presents the greatest challenges, however they believe that these can be addressed by utilizing the experience gained from automotive catalyst technology such as the application of catalyst coatings to the interior surfaces of the exhaust system. MECA believes that low-efficiency catalyst technology with a 30 percent total HC reduction capability could be applied to two-stroke snowmobile engines with improved fuel delivery systems, cooling air routed to the exhaust, and a properly designed catalyst/muffler system. They also believe that for such a system, 60 to 80% reductions could be achieved for four-stroke snowmobile engines.

Bluewater Network suggested that we need to include individual engine emissions caps that preclude the use of two-stroke engines altogether. H. Scott Alehouse and SRFN suggested that we should require fine PM traps on any new two-stroke engines that are produced in the interim before all snowmobiles are required to have four-stroke engines. Bluewater Network and SRFN expressed concern that the proposed standards would still allow for the production of some conventional two-stroke engines. DES and SRFN suggested that the final snowmobile standards should be comparable to those we adopt for ATVs and off-highway motorcycles. The Pennsylvania DEP suggested that highway vehicle emissions have fallen 97 percent since the early 1970's and that the technology exists to expect that similar reductions could be made for snowmobiles as well. Bluewater Network, CARB, NESCAUM, OTC, and STAPPA and ALAPCO all commented that we should consider technology transfer from other recreational categories such as personal watercraft, outboard motors, ATVs and off-highway motorcycles in determining what technologies are feasible and available for use on snowmobiles. Commenters pointed out that the engines used on these recreational vehicles have much in common with snowmobiles.

In pointing out that we should not rely on two-stroke direct injection technology, Bluewater Network, NESCAUM and SRFN commented that PM emissions from two-stroke DI engines are very high. Further, Bluewater Network suggested that two-stroke DI technology is unproven, unsafe and not durable. Bluewater network pointed to concerns we voiced with respect to two-stroke DI durability in dirtbikes and ATVs as well as problems OMC had in introducing this technology in personal watercraft engines. H. Scott Alehouse and James Edward Ashe pointed to several current products which are successfully utilizing two-stroke DI technology as evidence of its feasibility. Further, Mr. Ashe suggested that the difficulties OMC had in introducing the technology had much more to do with company mismanagement (introducing technology before fully tested, etc.) than with any shortcomings in the actual technology.

We received several comments on the relevant factors that we should and should not consider when setting snowmobile emissions standards under section 213 of the Clean Air Act. Bluewater Network commented that emissions reductions are the primary consideration under the Clean Air Act, and that we are to give cost, noise, energy and safety coequal consideration as secondary considerations. Earth Justice also pointed out that cost, noise, energy and safety are coequal considerations. SRFN commented that these other relevant factors argue for more stringent standards than those we proposed. Both Bluewater Network and SFRN stated that four-stroke engines are a proven safe technology, and Bluewater Network stated that this makes them safer than unproven two-stroke DI technology. Earth Justice and SRFN both commented that there doesn't appear to be any safety issues associated with the possible increased weight of snowmobiles, pointing out that a few extra pounds would not make it significantly more difficult to pull a roughly 500 pound snowmobile out of deep snow. H. Scott Alehouse suggested that potential safety issues regarding the weight of snowmobiles need to be examined carefully. Bluewater Network, Environmental Defense and SRFN all stated that four-stroke engines are quieter than two-stroke engines, and that a consideration of noise would argue for standards based on four-stroke technology. Bluewater Network and SRFN commented that energy concerns also argue for standards based on four stroke technology, pointing out that four-stroke engines are 35 percent more fuel efficient than two-stroke engines. Bluewater Network commented that styling and aesthetics are not relevant considerations under the Clean Air Act. Finally, Earth Justice commented that, even if four-stroke engines did impact performance, this impact is irrelevant under the Clean Air Act and should not be considered.

ISMA believes that the use of 2-stroke engines is ideal for snowmobile design because of reliability in extremely cold temperatures, excellent power-to-weight ratio, simplicity, low cost, and durability. They can also sustain high power steady state operation over long distances and transient operation over wide varieties of engine speed and load conditions, and can start reliably at lower temperatures than 4-stroke engines (important for consumers that use snowmobiles in remote areas in cold temperatures/inclement weather). Complicated control technologies reduce cold weather performance and require frequent and/or extensive maintenance. ISMA commented that we must consider safety tradeoffs associated with any new technologies. ISMA also commented that the technologies we considered for use on snowmobiles (enleanment of air/fuel mixture, improved fuel atomization, four stroke, engines, two-stroke DI, catalysts) may be appropriate for specific engine families and specific applications, but are not universally appropriate. ISMA pointed out that snowmobiles are already calibrated on the lean side due to fuel economy concerns, and that the emissions reductions expected from enleanment are minimal. ISMA commented that there is little CO benefit to be gained from improved fuel atomization or with the use of catalysts, if used without secondary air. Thus, ISMA believes that it is best if a corporate-wide reduction target of 100 g/kW-hr HC and 275 g/kW-hr CO with voluntary certification for model years 2004-06, and full compliance by 2007, is established. They believe that this will encourage prompt introduction of low-emissions technology in appropriate models while not jeopardizing smaller-volume or high performance models. Finally, ISMA does not believe that there is any basis for a Phase 2 standard.

We received comments from some private citizens stating that we should not regulate emissions from snowmobiles, and that we should not ban two-stroke engines from snowmobiles.

Our Response:

We believe that the snowmobile emissions standards we are setting represent the most stringent standards achievable. We believe that our standards represent the application of the most advanced technology that we anticipate being available in the foreseeable future and in amounts consistent with the snowmobile industry's ability to successfully apply it. As will be discussed in the following paragraphs, we considered a variety of factors in developing our snowmobile emissions standards, including what technologies are being used in other applications, including recreational vehicle applications such as outboard and personal watercraft engines, as well as ATVs and off-highway motorcycles. We determined that the standards we are adopting are the most stringent feasible in the time frame for which we confidently believe we can predict both the availability of technology and the industry's ability to successfully implement it.

We do not believe that snowmobile engines are comparable to motor vehicle (i.e., automobile) engines. Compared to the typical motor vehicle engine, a typical snowmobile engine has a much smaller displacement, is designed to operate at significantly higher engine speeds, and has a significantly shorter expected life. While we considered setting emissions standards equivalent in stringency to those currently in place for motor vehicles, we believe these differences and other factors discussed below make standards equivalent to automobile standards infeasible for snowmobiles at this time. The statute does not require us to promulgate such stringent standards.

We agree with ISMA that there are many characteristics of two-stroke engines that make them excellent snowmobile powerplants. While we believe that two-stroke engines are well suited to snowmobiles, and that the application of advanced emissions control technologies such as direct injection (DI) can significantly reduce emissions from two-strokes, we also believe that four-stroke engines are equally viable for use in snowmobiles. Every major snowmobile manufacturer has introduced or is planning to introduce at least one four-stroke powered model. While some of these have been lower powered models designed for moderate trail riding, the new four-stroke snowmobile being introduced by Yamaha is clearly intended to be a high performance sled designed for very aggressive riding. Early reviews of this snowmobile model in the industry press have been extremely favorable, indicating that four-stroke engines can be expected to be used successfully not only in lower performance applications, but in the high performance segments of the market as well.

It is important to note that, in the case of the Yamaha four-stroke snowmobile, a considerable amount of effort and resources went into designing a new snowmobile from the ground up specifically to accommodate the size, weight and power characteristics of a four-stroke engine. For example, a completely new chassis was designed which allowed the somewhat heavier engine to be placed lower and further back than is typical for two-stroke snowmobiles. This was necessary to maintain the kind of handling characteristics required of a high performance snowmobile. While a stock four-stroke engine can be placed into an existing snowmobile model and made to work, as can be seen in the Polaris and Arctic Cat four-stroke offerings, such designs are only practical for lower powered touring snowmobiles. Since the vast majority of the snowmobile market is in higher performance sleds, we believe that the conversion of all snowmobiles to four-strokes would require that the vast majority of current snowmobile models be discontinued and replaced with new models designed from the ground up. This would be an enormous undertaking for the snowmobile industry given the number of models it offers and niche markets it currently serves.

While four-stroke technology certainly appears to be both technologically feasible and available for use in snowmobiles, there are also technologies available to significantly reduce emissions from two-stroke engines. The most notable of these technologies are direct and semi-direct injection systems. These systems have shown HC reductions that are substantial, although not as great as four-stroke technology. However, two-stroke DI technology has been shown to reduce CO emissions as well as, and in the case of higher powered engines, much more effectively than four-stroke technology.

The available data on PM emissions from spark-ignited recreational engines is limited. We are only aware of one study which measured PM emissions from conventional carbureted two-stroke, DI two-stroke, and four stroke engines.[qq] This study looked at PM emissions from three different personal watercraft engines. While it is true that the conventional carbureted two-stroke engine in this study had much higher PM than the four-stroke engine, the DI two-stroke engine reduced PM emissions by almost 80 percent compared to the carbureted two-stroke engine. This study obviously represents a limited set of engines, and it is not clear whether these results could reasonably be extrapolated to all other personal watercraft engine models, let alone snowmobile engines. Nonetheless, if this data is representative of snowmobile engines we believe that it demonstrates that DI

[qq] "Airborne Particle Emissions from 2- and 4-Stroke Outboard Marine Engines: Polycyclic Aromatic Hydrocarbon and Bioassay Analysis," N. Kado, J. Karim, P. Kuzmicky and R. Okamoto, Environmental Science and Technology, Vol 34, No.13, 2000.

two-stroke engines offer significant PM reductions over carbureted two-stroke engines and should not be discounted as a viable emissions control technology on the basis of PM emissions. In addition, while two-stroke DI technology is a relatively new technology, it has been used successfully in personal watercraft engines for the last few years. To suggest that it is an unproven technology and therefore a potential safety concern is simply not true. We are not aware of any PM filter technology that has been developed or is under development specifically for use with two-stroke gasoline-fueled engines. However, we expect that the development of such technology for snowmobiles would face many of the same technological hurdles as would the development of successful catalysts for snowmobiles, as discussed later in this section. Thus, we do not believe that the application of PM filters to snowmobiles is feasible at this time.

Regarding ISMA's claims that CO standards more stringent than our Phase 1 standards are not technologically achievable, clearly the technology to meet more stringent CO standards is feasible. We expect that simpler two-stroke technologies such as engine modifications and improved carburetion can achieve CO reductions of up to 40 percent and 20 percent, respectively. Further, two-stroke direct injection technology can be expected to reduce CO by 50 to 70 percent, while four-stroke engines can be expected to reduce CO by 20 to 80 percent, depending on the power output of the engine. Further refinements of four-stroke technology could increase these reductions even further. The expected emissions reductions from these technologies are discussed in the feasibility chapter of the RSD. Clearly, technologies exist that can, on average, easily bring snowmobiles into compliance with standards more stringent than our Phase 1 standards.

It is not obvious to us that either of these advanced technologies is better than the other or more suited to broad application in the snowmobile market. Each has its strong points regarding emissions performance, power, noise, cost, etc. For example, two-stroke engines equipped with direct fuel injection have the potential to have greater CO emission reductions than a comparably powered four-stroke engine, although they would have less HC reductions. For those applications where a light, powerful, compact engine is desired, a direct injection two-stroke engine may be preferred. However, for applications where pure power and speed is desired, a high-performance four-stroke engine may be preferred. Given the broad range of snowmobile model designs and applications it is apparent that one of these technologies could be preferable to the other in some situations. Further, given the broad range of snowmobile types offered, a mix of advanced technologies would provide the best opportunity for substantial average emission reductions while still maintaining customer satisfaction across the entire range of snowmobile types. Thus, we believe it is most appropriate to set emission standards for snowmobiles that are not based entirely on the use of either direct injection two-stroke technology or four-stroke engines, but rather a mix of the two, along with some other technologies in certain applications.

We agree with MECA that the application of catalysts to snowmobiles presents great challenges, especially in the case of two-stroke engines. Two stroke engines, by the very nature of their rich fuel/air mixture, have exhaust that is very rich in HC and CO. The development of catalysts capable of operating under such conditions would require considerable effort to overcome the technological hurdles. In addition to the issue of the rich exhaust and the likely need for air injection to provide sufficient oxygen to oxidize the HC and CO, the limited amount of space in a typical snowmobile engine compartment presents unique challenges both with respect to packaging and heat rejection. Given the small size of the snowmobile market, there have been no significant efforts to date to overcome these technological challenges and develop catalysts capable of successfully operating in a snowmobile environment. We believe that with sufficient resources and time a successful catalyst could likely be developed for snowmobiles. However, the effort required is great enough that it is difficult to predict at this time whether such catalysts would ultimately be successful, let alone when they might be available. Thus, we will continue to monitor any developments in the area of snowmobile catalyst technology, and will consider the use of catalysts in the context of any standards we consider beyond the Phase 2 standards we are adopting effective with the 2010 model year.

Regarding concerns that our snowmobile standards would still allow for the sale of two-stroke equipped snowmobiles with no emissions controls, our final snowmobile emissions standards are averaging standards. Under the averaging program it is theoretically possible that a very small number of essentially “uncontrolled” snowmobiles could be produced. However, for the Phase 3 standards we have set a cap for the family emissions limit (FEL) which is the level of the current average uncontrolled baseline. Thus, under the Phase 3 program no snowmobiles can be produced and sold which are dirtier than the current average snowmobile. More importantly, the amount of credits that would be required to produce significant numbers of snowmobiles with no emissions controls would be such that a large number of very clean snowmobiles emitting at levels below the Phase 3 standards would have to be produced to make up for the uncontrolled snowmobiles. We do not believe that it is in the best interest of the snowmobile manufacturers, from a financial perspective, to approach their production in this manner. Rather, we expect that all snowmobiles will have some degree of emissions control technology on them, but that the level of technology on a particular model will depend on a variety of factors. For example, manufacturers may elect to choose less advanced technologies for their snowmobiles models where it would be advantageous to do so, such as on certain models, like mountain or deep-snow models, where manufacturers may have particular hesitance to use advanced technologies, or on entry level models in order to keep the price down, or on very low volume models where the development costs would be spread over low production volumes. However, we believe that it is very unlikely that any snowmobiles with no emissions controls will be produced and sold once the Phase 3 standards take effect.

We did consider the other relevant factors (cost, noise, energy and safety) when determining the final snowmobile standards. Cost impacts are considered elsewhere in this document. While four-stroke engines tend to have lower noise, in the absence of noise standards there is no guarantee that this will always be the case. One need only consider race cars and some on-highway motorcycles, both of which are powered by four-stroke engines, to realize that four-stroke engines, while generally quieter than two-strokes, are not inherently quieter. A discussion of our consideration of noise standards is contained elsewhere in this document. Regarding energy impacts, we agree that four-stroke engines offer significant fuel economy improvements over current carbureted two-stroke engines. However, two-stroke DI technology offers similar improvements in fuel economy similar to four-strokes. Thus, from an energy perspective we believe that four-stroke technology and DI two-stroke technology are equivalent. Finally, with respect to safety, we do not believe that any of the technologies we considered as being viable snowmobile emissions control technologies at this time present any significant safety issues. While it is true that two-stroke DI technology is relatively new, we are not aware of any specific safety concerns associated with. We reject the general notion that a technology is inherently unsafe simply because it does not have a proven track record to the contrary. We also tend to agree that the few pounds a four-stroke engine might add to a snowmobile that already weighs approximately five hundred pounds is unlikely to significantly impact one's ability to pull it from the deep snow, especially considering that the better fuel economy of a four-stroke compared to a basic two-stroke could allow for smaller fuel tanks. Concerns over cold starting for four-stroke engines have been raised because the typical four-stroke design uses an oil distribution system where the pump and oil are located in the crankcase (referred to as a "wet" sump). During extremely cold temperatures, the oil becomes thick and provides an additional load the engine must overcome when starting. However, by using a "dry" sump, where the oil and pump are located in a separate tank (not in the crankcase), the concern over cold temperature starting loads due to thickened oil in the crankcase are gone. The new Yamaha RX-1 four-stroke snowmobile uses a smaller fuel tank and lighter materials to reduce weight and a dry sump to help cold starting, so clearly these issues can be addressed.

We disagree with Earth Justice's comments regarding our ability to take performance into account in promulgating standards. While performance is not a primary factor, it is related to the feasibility of controls. Obviously, if an emission control strategy degrades performance to the extent that a vehicle cannot perform its intended function, this is related to the feasibility of the strategy in that application. While we agree that the preferences of a minority of users who prefer high performance should not prevent reasonable emission controls, we do not believe that more general performance capabilities can be ignored.

It is clear to us, based on considerations of lead time and the size of the task at hand with regards to converting the current snowmobile offerings to the use of advanced technologies, that manufacturers will need additional lead time to comply with the proposed Phase 2 standards, and that standards more stringent than our proposed Phase 2 standards are not feasible within the 2012 time frame. This is discussed at length in the following paragraphs. It is equally clear to us, however, that the technology exists to achieve emissions reductions well beyond those obtained through our Phase 1 standards given additional lead time beyond the 2006 model year. Thus, we do not agree that the Phase 1 standards represent the most stringent standards that are reasonably achievable, and we believe that adopting just the Phase 1 standards as our final snowmobile emissions standards would not be appropriate or meet the requirements of the Clean Air Act.

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

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

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

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

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

We believe that the 2006/2007 time frame is appropriate for the first phase of snowmobile standards because it allows for the near term introduction of moderate emissions control technology such as enleanment strategies, engine modifications and electronic fuel injection, as well as the small scale introduction of advanced technologies such as direct injection two-stroke, and four stroke technology. Further, we believe that the 2010 and 2012 model years are appropriate for the second and third phases of snowmobile standards because they allow an additional four to six years beyond the Phase 1 standards for the further development and application of advanced emissions control technology. We expect that the manufacturers will utilize some level of advanced technology in compliance with the Phase 1 standards, and this will give the manufacturers some time to evaluate how the advanced technology they have already applied works in the field as well as give them several years to work with the certification and compliance programs before more stringent Phase 2 standards take effect in 2010. We believe that by the 2010/2012 time frame manufacturers could, at least in theory, apply advanced technology across essentially their entire product lines. However, the manufacturers are resource constrained, and they will need to focus their efforts on compliance with the Phase 1 and Phase 2 standards prior to the 2010 model year. There is a need for significant technology development and manufacturing learning to occur, and there is concern that in this time frame such technology could not be performance, emissions, and safety optimized for each application given the number of engine and snowmobile model combinations that would require optimization. This would be especially challenging for those manufacturers who rely on outside suppliers for their engines. Rather, we expect that by the 2012 model year the manufacturers could both apply and optimize advanced technology to their larger volume families while applying clean carburetion and electronic fuel injection technology to the rest of their production. Under this scenario we expect that the manufacturers could apply optimized advanced technology on around 50 percent of their production by the 2010 model year, and an additional 20 percent of their production by the 2012 model year. We do not believe that having only two years lead time between the Phase 2 and Phase 3 standards presents any problems because compliance with the Phase 3 standards will be achieved through the broader application of technologies which will already be applied in compliance with the Phase 2 standards, rather than through the introduction of new technologies altogether.

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

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

Regarding commenters' claims that our standards have not met the requirements of section 213(a)(3), though we believe the standards we have promulgated will provide the greatest reduction feasible in the lead time provided, taking into account the factors noted in section 213(a)(3), we note that our promulgation of standards for exhaust HC in this rule should be governed by the language of section 213(a)(4), which does not contain the specific mandates of section 213(a)(3). Though snowmobiles are part of the recreational vehicles category, which does cause or contribute to ozone nonattainment, we have not claimed that exhaust emissions (of VOCs or NOx) from snowmobiles cause or contribute to ozone concentrations in nonattainment areas because snowmobiles are operated generally in cold weather, when ozone concentrations are unlikely to exceed the NAAQS. Generally the Act requires us to look at contributions from the category as a whole. However, we believe that the clear difference in use between snowmobiles and other recreational vehicles, and the relevance of that difference to contribution to ozone concentrations, allows us to promulgate standards only for emissions of those pollutants from those engines that actually may have some benefit to reducing the concentration of the particular form of air pollution in question. This in effect treats snowmobiles as a separate category for this purpose. (It is important to emphasize that the issue is not whether snowmobile emissions are "minimal" contributors, which is not relevant under section 213(a)(3), which requires regulation of any categories that cause or contribute to pollution, without reference to a determination of the significance of the contribution. The issue is whether exhaust emissions of snowmobiles contribute at all to relevant ozone concentrations - it does not appear that they do.)

We have justified our regulation of HC based not on its use as a surrogate for VOCs, to regulate ozone, but instead based on HC's use as a surrogate for PM, both direct and indirect, in regulating visibility impairment, particularly in Class I areas, and in controlling PM health concerns. We would thus be governed by the language of section 213(a)(4). While the criteria of section 213(a)(3) in promulgating these standards is helpful as a guide, it is not binding on the agency. The standards promulgated by EPA are reasonable and appropriate and comply with the requirements of the Act.

2. Lead Time and Phase In

What We Proposed:

We proposed that the Phase 1 standards be effective with the 2006 model year, and that the Phase 2 standard be effective with the 2010 model year. We did not propose a phase-in period or an early credits program for snowmobiles.

What Commenters Said:

Polaris considers phase-in to be a crucial aspect of the proposed regulations and believes that compliance would not be possible without it. For snowmobiles, they believe that the time between scheduled promulgation of the final rule and the initial compliance date is extremely short and therefore support the 2007 initial compliance date.

ISMA commented that the Phase 1 standards are not trivial and cannot be met simply by leaning out carburetor calibrations, but will require significant market penetration of new technology. ISMA is concerned that first-year compliance with the Phase 1 standards may cause manufacturers to rush new technologies to market. ISMA also pointed out that there was a discrepancy between the Phase 1 compliance date discussed in the preamble (2006) and the Phase 1 compliance date specified in the proposed regulatory language (2007). ISMA suggested that the 2007 model year was appropriate for the Phase 1 standards, and that this compliance date in conjunction with a credit program for early certification would ease the transitions to the new snowmobile standards.

Our Response:

In meeting with the major snowmobile manufacturers we have learned that some snowmobile manufacturers will need considerable time to prepare to meet standards and other requirements for these previously unregulated vehicles. We believe that not all of the snowmobile manufacturers could likely comply with the Phase 1 standards in their entirety by 2006. We believe that the Phase 1 standards represent a significant compliance burden for an industry that has been unregulated up until now. We do not, however, believe that it would be appropriate to delay the Phase 1 standards in their entirety. Rather, we believe that it would be appropriate to include some form of phase in for the Phase 1 standards to allow this previously unregulated industry to gain some familiarity with the compliance provisions and to allow for a more flexible compliance schedule. We are therefore including a two year phase in for the Phase 1 standards where 50 percent of a manufacturer’s total production must meet the Phase 1 standards in the 2006 model year and 100 percent of a manufacturer’s production must meet the Phase 1 standards in the 2007 model year. This phase in, in addition to the early credits program discussed in the section on averaging, banking and trading, should give manufacturers the flexibility they need to comply with the Phase 1 standards in an orderly manner.

3. PM Standards

What We Proposed:

We did not propose any PM standards for snowmobiles.

What Commenters Said:

Environmental Defense commented that we failed to establish separate PM standards for snowmobiles based on the rationale that reductions in HC will simultaneously reduce PM, but that we provided no evidence to support the claim that simultaneous reductions of PM would provide the greatest degree of emissions reductions achievable.

Our Response:

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

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

[rr]Memo to Docket, Mike Samulski, "Hydrocarbon Measurements as an Indicator for Particulate Matter Emissions in Snowmobiles," September 6, 2002, Docket A-2000-01, Document IV-B-42.

[ss]Carroll, JN, JJ White, IA Khalek, NY Kado. Characterization of Snowmobile Particulate Emissions. Society of Automotive Engineers Technical Paper Series. Particle Size Distribution in the Exhaust of Diesel and Gasoline. SP-1552, 2000-01-2003. June 19-22, 2000.

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

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

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

Finally, as noted in response V.B.1 above, standards regulating PM are not governed by section 213(a)(3), but by section 213(a)(4). Thus, our regulations for PM must be appropriate, but need not meet the specific requirements in section 213(a)(3). We do, however, believe the standards promulgated do require the greatest degree of emission reduction achievable in the time provided.

4. Test Procedures

What We Proposed:

We proposed test procedures for measuring snowmobile and snowmobile engine emissions. These test procedures are the same as those used for testing spark-ignition engines in part 1065. We proposed that emissions should be measured using a 5-mode steady-state snowmobile duty cycle with intake air between -15˚ and -5˚ C (5˚ to 23˚ F) and at ambient temperatures between -15˚ and +30˚ C (5˚ and 86˚ F). HC, CO, NOx, and CO_2 emissions should be measured using the dilute sampling process in part 1065. We also requested comment on the appropriate engine inlet air temperature during snowmobile engine emission testing, as the work done to develop the snowmobile duty cycle specified +10˚ to +20˚ C.

What Commenters Said:

Environmental Defense believes that EPA should adopt test protocols for snowmobiles that account for the colder ambient temperatures typical of snowmobile operation, not those of marine engines, in order to be an effective testing procedure. It believes that under the proposed testing procedure, engines would be tested with carburetor jetting and under conditions that are not normal for snowmobile use. It feels that information has not been provided substantiating how the testing procedure is representative of the amount of emissions that would be released from a snowmobile under actual operating conditions and therefore recommend that, in addition to the inlet air temperature, the test cell ambient temperature should be -15˚ and -5˚ C (5˚ to 23˚ F) as well.

ISMA supports the cold air testing method that was suggested in principle, and believes that it could eliminate incentives for manufacturers that attempt to establish artificially lean jetting parameters (with cold testing, this could subject the engine to the risk of catastrophic failure). However, they believe that we have proposed a potentially significant test method change relatively late in the process. ISMA stated that there is currently no reliable data to predict the potential effect of this change, and that it is critical that the effect of temperature on measured emissions be understood before the rule is finalized.

ISMA commented that it is essential to allow manufacturers to use raw gas sampling, rather than dilute sampling, to measure snowmobile emissions. ISMA pointed out that raw gas sampling was the method used to develop the emissions baseline for snowmobiles and it is the only method the snowmobile manufacturers are prepared to use. Further, ISMA pointed out that dilute sampling requires much more expensive equipment that is currently not used by the industry.

OTC urged that we should re-evaluate the test cycles used for snowmobile emissions testing to ensure that an appropriate transient test cycle is developed.

Our Response:

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

We agree with ISMA that raw sampling should be an option for snowmobile emissions testing. Much, but not all of the data used to develop the snowmobile emissions baseline was measured using raw sampling, and this method is consistent with the testing protocols for personal watercraft engines. Thus, we will allow manufacturers to use raw sampling provided that they can demonstrate equivalence with dilute sampling procedures.

The snowmobile duty cycle was developed by instrumenting several snowmobiles and operating them in the field in a variety of typical riding styles, including aggressive (trail), moderate (trail), double (trail with operator and one passenger), freestyle (off-trail), and lake driving. A statistical analysis of the collected data produced the five mode steady-state test cycle is shown in Table V-1. This duty cycle is the one that was used to generate the baseline emissions levels for snowmobiles, and we believe it is the most appropriate for demonstrating compliance with the snowmobile emission standards at this time. While we agree that snowmobile operation tends to be transient in nature, the development of a transient test cycle for snowmobiles was beyond the scope of our efforts in time for this final rule. We will reconsider the issue of the test cycle, and determine whether a transient cycle is appropriate in the context of any snowmobile emissions standards we might consider beyond the Phase 2 standards in the future.

Table V-1
Snowmobile Engine Test Cycle

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

C. ATVs

1. Standards

What We Proposed:

EPA proposed performance-based standards for ATVs in two phases. The proposed Phase 1 standards, for model year 2006, with full implementation by 2007, are 2.0 g/km for HC+NOx and 25 g/km for CO. It is expected that manufacturers would meet these standards through the use of 4-stroke engines. EPA also proposed alternate engine-based standards for Phase 1 wherein manufacturers may certify ATVs using the utility engine cycle (SAE J1088) and standards listed in Table VI.C-1 of the proposed rule. California allows this option in their program. The standards are as follows:

engines less than 225 cc- 12.0 g/hp-hr HC+NOx and 300 g/hp-hr CO
engines greater than 225 cc- 10.0 g/hp-hr HC+NOx and 300 g/hp-hr CO.

The proposed Phase 2 standards, for model year 2009 with full implementation by 2010, are 1.0 g/km HC+NOx and 25 g/km CO. At the time of the proposal, EPA expected that the 1.0 g/km standard for HC+NOx could be met through four-stroke engines with secondary air injection, and catalyst on some models. Comments were also requested on the level of the CO standard and whether or not it should be made more stringent for Phase 2 from the proposed 25 g/km level. A two-year phase-in period was proposed for both Phases of standards, with 50 percent of the models complying in the first year (2006 for Phase 1 and 2009 for Phase 2) and full compliance the following year.

We proposed to allow ATVs under 70 cc to be certified to the Phase 1, Class 1 Small SI standards contained in 40 CFR Part 90.

A. Separate 2-stroke and 4-stroke Standards

What Commenters Said:

We received comments from several groups and numerous private citizens supporting standards based on the use of 4-stroke technology. Bluewater Network comments that EPA has no other lawful choice but to set 4-stroke equivalent standards. NTWC and SRFN commented that EPA has a fundamental legal duty to set standards that reflect emission reductions achievable by the cleanest 4-stroke. Adirondack Mountain Club and Kettle Range Conservation Group supported the phase-out of 2-stroke engines due to their very high emission rates.

MIC commented that they accept reasonable regulations and member companies are preparing to meet the proposed Phase 1 standards which will require the phase out of 2-stroke engines.

We also received comments from vehicle dealers and many users that EPA should establish separate 2-stroke and 4-stroke standards. The commenters are concerned that the phase-out of the 2-stroke will result in a lack of product being available to the consumer. Consumers were concerned that EPA was banning 2-stroke engines. Some commenters (CMDA, Mach 1 Motorsports) referred to the situation in California at the beginning of their program in 1997, when no certified products were available.

AMA commented that without an additional standard we would force consumers to accept what they view as an inferior product. AMA recommends that EPA set a challenging yet realistic standard for two-stroke motorcycles and ATVs. AMA also commented that EPA should only set performance-based standards and should not require certain technologies to be used. Individual riders also provided comment that EPA should not ban 2-strokes.

Our Response:

We are required by CAA section 213 to establish the greatest degree of emissions reduction achievable through the application of technology that we believe will be available within the period of time provided to the manufacturers. EPA must give appropriate consideration to lead-time, cost, noise, energy, and safety factors. In establishing performance-based standards, we considered the current use of 4-stroke engines in the various segments of the ATV market. We estimate that 4-stroke engines are used in about 80 percent of ATVs sold and are used in all segments of the market including sport and youth models. Clearly, 4-stroke engines are available and we and manufacturers believe they can be used in all models by 2006. Manufacturers have several 4-stroke ATV models, sport and utility, that are currently certified to California standards. This will allow manufacturers to focus on reducing emissions from remaining uncertified models. We based our standards on emissions levels that can be achieved through the use of 4-stroke engine technology. Given the widespread use of 4-strokes currently in all subgroups of the ATV market and manufacturers plans to switch over to 4-strokes in time for 2006, and given manufacturer reluctance to lose the entire U.S. market for any product, we do not expect a lack of acceptable product due to the emissions standards.

It is important to note that we do not mandate the use of any specific technology. We concur with AMA in its support of performance-based standards. If a manufacturer can produce a clean 2-stroke ATV through the use of advanced technology such as catalysts and/or direct injection fuel systems, such an ATV can be brought to market. Unlike for off-highway motorcycles, EPA did not receive comments from any manufacturer currently working on such technology for ATVs. This is likely due to the dominance of the 4-stroke engine in this market. It is not clear if clean 2-stroke technology is viable for the ATV market. It would not have been appropriate under the Act for us to speculate in the absence of comments from manufacturers that a manufacturer might someday want to develop such technology for ATVs, and then set a less stringent standard based on a guess of what such an ATV might be able to achieve from an emissions perspective. The final standards are also based on averaging which allows manufacturers to sell products that have emissions levels above the standards as long as those emissions are off-set by sales of machines with emissions below the standards. This provision provides manufacturers with flexibility to potentially bring a larger range of technologies to the market.

b. Lead Time

What We Proposed:

For Phase 1, EPA proposed standards that would have a phase-in of 50 percent implementation for model year 2006 and full implementation by 2007. Likewise, for Phase

2 standards, the 50 percent phase-in would begin in model year 2009 with full compliance in 2010.

What Commenters Said:

Polaris considers phase-in to be a crucial aspect of the proposed regulations and believes that compliance would not be possible without it. They state that the phase-in of the standards for ATVs in model years 2006 and 2007 is necessary for them to re-engineer the ATV engine line.

The Kettle Range Conservation Group recommended that 2-stroke engines be phased out immediately. Another commenter believes that the standards violated the CAA requirements by providing too much lead-time. The commenter believes that because the EPA proposed standards are essentially the same as the current California standards, manufacturers should be required to meet them before 2006. The commenter recommends that the standards become effective in the year following the finalization of the rule.

One commenter claims that manufacturers would not need any lead-time to meet standards if they used the Orbital Engine Corporation direct injection system on their 2-stroke engines to meet standards.

Our Response:

The need for lead-time must be balanced with the stringency of the standards and we must give adequate lead-time to manufacturers to meet new standards. As the standards are finalized for model year 2006, manufacturers will have three model years lead-time to respond. Manufacturers with 2-stroke product offering, such as Polaris, must respond relatively quickly to the new requirements. We believe if we were to shorten the lead-time, we could potentially seriously disrupt the ability of companies with significant 2-stroke offerings to meet the standards. In addition, ATVs are previously unregulated by EPA and we must provide lead-time for manufacturers to prepare to meet program requirements. Most manufacturers have multiple engine families that will need to be certified. Requiring immediate compliance would not be feasible. We believe that the time-frame for the implementation of the program is appropriate given these factors.

While California does have emissions standards, they also permit noncomplying models to be sold and used in certain areas of the state during certain times of the year. Several noncomplying models are sold in California. Manufacturers need lead-time to reduce emissions from those noncomplying models and to certify their entire product line to EPA standards. Without adequate lead-time, manufacturers may not be able to sell a significant portion of their product line. We believe the lead-time we are providing is appropriate for the level of effort manufacturers will be undertaking to comply with standards.

Direct injection systems, including the Orbital system, may be one technology path that could be used to lower emissions from 2-stroke engines. We do not have emissions data on any ATVs equipped with the technology and have not received any comments that manufacturers are planning to use the system on ATVs in lieu of 4-stroke engines. While it is possible that the system could be developed for ATV applications, we disagree that the application of this technology could be done without lead-time. The technology would have to be applied, optimized, and thoroughly tested before manufacturers could be expected to use the technology. It would also not be reasonable to expect manufacturers to be able to apply the technology to all models and engines at once. While the technology may hold promise as a way to meet emissions requirements, we do not believe its use could be the basis to reduce the lead-time being provided to manufacturers.

c. Phase 1 Standards

What Commenters Said:

EPA received comments from CMDA and users that EPA overestimated emissions inventories and did not consider emissions in urban versus rural setting and that these factors lead EPA to propose standards that were unreasonable. The CMDA believes that the EPA estimates of usage will not survive scientific or legal challenges if this issue is not revisited. They believe that if the emissions inventory is accurately estimated, a more reasonable standard can be proposed. BRC also believes that EPA proposed unreasonable standards and commented that the rule failed to recognize the fact that a majority of off-highway motorcycle and ATV use does not occur in urban areas, cities, or nonattainment areas.

Our Response:

As discussed in Section II.B, we received comments from several parties on our emissions inventory modeling, and significant new data on ATV usage. In response, we have reduced our estimate of the annual usage rates for ATVs (see Section II.B. for our response on emissions modeling). We disagree with the commenters, however, that the emissions modeling lead us to propose unreasonable standards or has an impact in the level of stringency of the standard. If we find under CAA section 213 that a nonroad category causes or contributes to nonroad air pollution, we are required to establish standards that achieve the greatest degree of emission reduction achievable. Though we have changed our emissions modeling, we have not changed our finding that this nonroad category causes or contributes to nonroad air pollution (see Section II.C.). Neither of the commenters provided any evidence for a claim that ATVs do not contribute to ozone or CO contributions in nonattainment areas. In addition, even after making changes to the modeling and other numbers in response to comments, the cost and cost-effectiveness numbers for our final ATV standards are well within the cost-effectiveness levels for comparable regulations. Therefore, the requirements of the CAA regarding the stringency of the standards have not changed and the reduction in the emissions inventory does not affect the level of the standards being finalized.

What Commenters Said:

MECA commented that EPA should set more stringent standards for Phase 1 than were proposed. MECA believes that ATV engines are similar to automotive engines of the early 1980's and that Phase 1 standards should be set equivalent to the 1983 LDV standards of less than 1.0 g/km HC+NOx and around 7 g/km CO. MECA believes these levels can be achieved through the use of closed loop three-way catalyst systems and improved fuel delivery systems. Alternatively, MECA suggests pulling ahead EPA's proposed HC+NOx Phase 2 standards to 2006 with a more stringent CO standard. MECA cited the successful application of catalysts on small 2-stroke engines used in highway scooters in other countries and on small handheld utility applications in support of their feasibility for ATVs. MECA's comments were supported by NRDC, Environmental Defense et al.. The Adirondack Mountain Club also supported standards based on the use of catalysts. Many individuals also submitted comments in support of the use of catalysts.

Our Response:

We proposed a Phase 2 standard based on the anticipated use of catalyst technology but not a Phase 1 standard. We did not believe that manufacturers would be able to employ advanced 4-stroke technology in the 2006 time frame in addition to phasing out their 2-stroke models (see response to item b., above). With only three model years to respond to the requirements, we did not believe manufacturers would have enough time to meet a more stringent standard than that proposed. We have modified our view somewhat and are finalizing a more stringent Phase 1 standard (see the following section). However, the standards we are finalizing are not as stringent as those recommended by MECA. We do not have data to support finalizing standards as stringent as those recommended by MECA. MECA's approach of comparing ATVs with early 1980's automobiles does not account for the very different engine and vehicle designs and usage. It also does not account for the differences in the industries or the fact that ATVs are being regulated for the first time. Perhaps most importantly, we do not believe the results of our testing program with catalysts supports establishing standards as stringent as those recommended by MECA at this time. This discussed further in item (d..) of this section.

MECA's comments discuss the success Asian and European manufacturers have had placing catalysts on motorcycles. Most of this work has focused on reducing emissions from 50 cc 2-stroke on-highway scooters. MECA also refers to emissions control from 2-stroke Small SI handheld engines used in chainsaws and other equipment. These engines are quite different than the 4-stroke engines used in ATVs both in the way they operate and in the engine size. Also, the usage pattens of the vehicles are quite different. In addition, the test cycles and emissions control program requirements are different from those contemplated for ATVs in the rulemaking. For these reasons, we do not believe that the emissions control experience cited by MECA is directly applicable to ATVs. It is difficult to glean data or information from that submitted by MECA that would inform our decision on what emissions levels are achievable for ATVs through the use of catalyst technology.

What Commenters Said:

CARB raised concerns about the level of the Phase 1 HC+NOx standard that EPA proposed because it was significantly higher than the HC-only standard of 1.2 g/km contained in their program. CARB notes that several 4-stroke models are certified in California by a comfortable margin. CARB recommended that EPA cap HC emissions at 1.2 g/km so that HC emissions control is not lost between the two programs. This would harmonize the programs, which may also increase the number of compliant models available in California.

Environmental Defense et al. and Southern Rockies Forest Network (SRFN) commented that EPA proposed standards significantly less stringent than those in place in California and urge EPA to adopt consistent standards for Phase 1. They do not believe that the proposed standards will result in the greatest reductions achievable or are consistent with CAA requirements.

Bluewater Network also commented that EPA should harmonize with California and noted that a single standard would be less burdensome for industry. They commented that in order to comply with the CAA, EPA must at a minimum harmonize with California.

MIC commented that they supported reasonable regulations and were preparing to meet the Phase 1 standards which would effectively require the phase out of 2-stroke ATVs. MIC also commented that the CO standard was unnecessary and should be dropped because it would interfere with manufacturers' ability to bring compliant 4-stroke ATVs to market.

ATV Magazine commented that EPA should reconsider its proposed 25 g/km CO standard and finalize a less stringent standard. The commenter is concerned that if we set the standard too low, we will inhibit performance and hurt the sport ATV market. They are concerned that the addition of emissions controls will cause performance to be capped and lead to a stagnant market. ATV Magazine suggested another way to deal with the sport issue would be to finalize a competition exemption for ATVs similar to that of motorcycles. ATV Magazine points to Cannondale models as examples of competition ATVs and also states that four-stroke technology does not meet the needs of the racing community.

OTC believes that engine manufacturers could meet the proposed standards without catalysts and they support the two-phase approach proposed for ATVs. However, they believe that EPA could modify the standards to require engine optimization, yielding additional emissions reductions that are technically and economically feasible.

Our Response:

We concur with comments supporting the harmonization with California standards for Phase 1 for HC. Several models are certified to the California standards for J-1088 which manufacturers recommended to California as having equivalent stringency to their FTP-based standards. We are finalizing the option to certify ATVs to the J-1088 standards through model year 2008, which provides additional lead-time to manufacturers. Our testing of ATVs also suggests that the standard is feasible for ATVs provided the appropriate lead time. We believe this combination of standards is feasible in the lead-time provided, as discussed in Chapter 4 of the RSD. We have increased the numeric limit of the standard from the California level of 1.2 g/km to 1.5 g/km to account for NOx. For HC, we believe the two standards are equivalent based on testing we performed that shows NOx is about 0.3 g/km on average. The standard we finalized is an based on averaging which will allow manufacturers flexibility to deal with variations in NOx emissions. We believe it is important to finalize more stringent Phase 1 standards than proposed not only because they are consistent with CAA section 213 requirements, but also because we are not finalizing Phase 2 standards, as discussed below. Setting a long-term standard that was less stringent than the California's existing standard would not be consistent with the Act and would undermine the emissions control programs in California and nationwide.

Manufacturers commented that we should drop the standard, which they believe will undermine their ability to bring acceptable performance oriented 4-stroke products to market. Manufacturers have noted that some 4-stroke products have not been certified in California due to CO concerns. Commenters also raised questions regarding whether ATVs contribute to CO nonattainment. We do not believe it is appropriate to drop the CO standard for reasons discussed in Section II.C.

We proposed a CO standard higher than that of California (25 g/km compared to 15 g/km) in response to manufacturer concerns. Due to continued concerns regarding feasibility and the trade-off between controlling NOx and CO at the same time, we have raised the CO standard to 35 g/km in the Final Rule. Manufacturers are especially concerned about CO for ATVs on the FTP test cycle and the ability of 4-stroke engines to meet stringent standards for both pollutants at the same time. One of the primary strategies for controlling CO for 4-stroke engines is to lean-out the air fuel mixture. This tends to increase NOx emissions and this trade-off between the two pollutants can inhibit the ability of manufacturers to produce 4-stroke products of acceptable performance.

We concur with ATV Magazine's concerns about the proposed CO standard and are finalizing a higher CO standard as discussed above. We do not believe that broadening the exemption for competition ATVs would be a good approach to address feasibility concerns as they pertain to sport ATVs. With the somewhat higher CO standard, we expect feasibility concerns to be diminished and for high performance machines to continue to be available. Comments on the competition exemption are addressed in section V.A.7. We note, however, that the Cannondale models referred to as examples of models used for competition are equipped with 4-stroke engines. Other sport models are also currently equipped with 4-stroke engines and we would expect them to remain available in the future.

We received comment that the CO standard proposed was not stringent enough and that EPA should harmonize with California for CO as well as HC. California did not provide adverse comments on our proposal for CO. Although there are ATVs certified to California standards, they have generally been certified using the J-1088 option, which does not provide an indication of what emissions levels can be achieved on the FTP. We have harmonized CO standards for the ATV engine-based J-1088 test, but this option is only available in the EPA program through 2008. Manufacturers have not provided test data for ATVs on the FTP. Our test data indicates CO levels on the FTP are much higher than the 15 g/km level contained in the California program. For the FTP, we are not finalizing a more stringent CO standard at this time due to concerns that such a standard would interfere with the use of 4-stroke engines across the spectrum of ATV applications in the 2006 time frame. The use of 4-stroke engines instead of 2-stroke engines provides tremendous reductions in HC (90%+) but the CO emissions from the two types of engines are comparable in ATV applications. A lower CO standard could drive technology beyond that of the HC standard, including the use of catalysts. As discussed below, we are not prepared to establish standards based on the use of catalysts (see Chapter 4 of the RSD) and do not believe it would be appropriate to set a CO standard that would require catalyst technology at this time.

What Commenters Said:

MIC commented that EPA should allow ATVs up to 99 cc to be certified to the Small SI standards rather than 70 cc. MIC notes that EPA's Phase 2 standards for Small SI are higher for small displacement engines below 99cc and MIC believes the same issues regarding stringency exist for ATVs. The Phase 2 HC+NOx standards for Small SI engines are 40 g/kW-hr HC+NOx for engines between 66 cc and 99 cc and 50 g/kW-hr for engines less than 66 cc. The CO standard is 610 g/kW-hr.

Our Response:

Although there is very limited emission data for small ATVs with engine displacements less than 99 cc, we agree with MIC that the distinction between a 70 cc engine and a 99 cc engine is very small and it makes sense to allow ATVs with engines up to 99 cc be allowed to certify to the FTP-based 1.5 g/km HC+NOx and 35 g/km CO standards or to meet engine-based standards. All of the ATVs with engines below 100 cc are youth models which are speed governed for safety and the FTP vehicle test may present technical problems for testing these governed vehicles. Also, we recognize that the vast majority of engine families, including 4-stroke engines, below 100 cc are not certified to the California standards, which is an indication to us that the standards proposed may not be feasible for most engines in this size range given the lead time provided. However, manufacturers did not provide supporting data and we do not have data to confirm that the level recommended by the manufacturers would result in an appropriate level of control. The Phase 2 standards for Small SI engines are much less stringent than those we proposed and there is no data supporting the appropriateness of those standards for ATVs. This is of particular concern with an averaging program where credits can be used to certify products well above the standards.

We examined the 2002 model year certification data for non-handheld Small SI engines certified to the Phase 2 Class I-A and I-B engine standards (engines below 100 cc). We found that the five engine families certified to these standards had average emissions for HC+NOx of about 25 g/kW-hr. All of these engine families had CO emissions below 500 g/kW-hr (the highest CO level is 480 g/kW-hr) and well below the 610 g/kW-hr level recommended by manufacturers. We believe these levels are more representative of the levels that can be achieved with the lead time provided through the use of 4-stroke engines than the standards recommended by the manufacturers. Therefore, we are finalizing a 25.0 g/kW-hr HC+NOx standard and a 500 g/kW-hr CO standard for ATVs with engine displacements of 99 cc or less. These standards will be optional to the FTP-based standards and, unlike the J-1088 standards option for larger displacement engines, the option will not expire. We are retaining averaging for the HC+NOx standard but do not believe averaging would be appropriate for the CO standard. This is consistent with the approach outlined above for J-1088 standards for engines above 100 cc.

d. Phase 2 Standards

What Commenters Said:

MIC commented that EPA should drop the Phase 2 standard due to extraordinarily high cost per ton values that would result if EPA properly adjusted its ATV usage rates and cost estimates. MIC also commented that the likelihood of tampering must be considered by EPA when establishing catalyst-based standards. In prior communications, MIC supported harmonization with California's HC standards for Phase 2.[tt] At that time, MIC stated that going beyond the California requirements would create significant additional costs in exchange for relatively small reductions in emissions.

EPA received several comments supporting standards based on the use of catalysts on ATVs. Several commenters noted general support for the Phase 2 standards. (OTC, Environmental Defense et al, Bluewater Network). New Hampshire supports the two-phased approach proposed for ATVs. It is their understanding from the NPRM that manufacturers could meet the 2009 standard without the use of catalysts. New Hampshire commented that EPA should further study the expectations of applying three-way catalyst technologies to ATVs and base the 2009 standards on this analysis.

Earth Justice believes that the proposed standards for ATVs are unlawful because EPA fails to require the greatest degree of reduction through the application of available technology such as catalytic converters and electronic fuel injection. They believe that the setting of standards that are allegedly based on the application of secondary air injection do not meet the requirements of the CAA. Standards must require the application of all, not some, of the technology that will be available.

Our Response:

We based our proposal for Phase 2 standards on the use of catalysts on at least some ATV models. Since the proposal, we have conducted testing using the kinds of emission control strategies envisioned for Phase 2, including catalyst technology. As discussed in Section 4 of the RSD, the test results do not fully support the Phase 2 standards and we are not prepared to finalize them. Further testing is needed to establish what level of control is feasible beyond the level finalized in the Final Rule. We do not believe that the data collected thus far is sufficient to support the proposed Phase 2 standards. However, it is consistent with and supportive of the standard of 1.5 g/km we are finalizing.

[tt] Letter from Pamela Amette, Motorcycle Industry Council, to Linc Wehrly, EPA, August 6, 2001. Docket A-2000-01.

As discussed in Sections II.B. and II.E., we have considered comments on ATV usage rates and costs. We will continue to consider these issues in the future as we further investigate additional emissions control for ATVs. However, our decision not to finalize the Phase 2 standards is based primarily on the issues of feasibility discussed above.

We received comments that since we said in the proposal that catalysts, secondary air, and electronic fuel injection were "available" for ATVs to reduce emissions, we must establish standards requiring 100 percent use of these technologies. Although we indicated that manufacturers could potentially use these technologies, they have not been brought to market in a meaningful way that would establish the feasibility or emissions control potential for ATVs. It is not enough to suggest that the technologies could be used. We also must understand their feasibility and the emissions control potential to appropriately establish lead-time and the level of the standards. We do not believe that sufficient data is currently available to make these determinations. Manufacturers have not used fuel injection or catalysts in meeting the California requirements.

In order to establish standards based on the use of these technologies, sufficient test data must be available. We conducted a test program on catalysts and secondary air systems but were unable to apply fuel injection technology due to the complexity of the systems and the time and resources available. We applied several production highway motorcycle three-way catalysts that are currently used on 900 cc engines to a large 500 cc utility ATV. Even with catalysts of considerable size and loading, we were unable to generate emission levels below our proposed standard of 1.0 g/km HC+NOx. In fact, the levels for HC+NOx were 1.3 to 1.4 g/km, well above the 1.0 g/km standard. Due to time constraints, we did not have an opportunity to evaluate larger catalysts or optimize the fuel system for use with our test catalysts. We also did not have the time our resources to apply electronic fuel injection to any of our test ATVs. While electronic fuel injection should allow for improved fuel atomization and more precise timing of injecting the fuel into the combustion chamber, we have no data as to whether electronic fuel injection alone would reduce emissions to levels that meet our standards. Electronic fuel injection has been most beneficial in applications where a catalyst is used, since a three-way catalyst works most effectively at an air and fuel mixture at or near stoichiometry, where electronic fuel injection helps maintain precise fuel control. Our limited test program yielded data supportive of the standards we are establishing but additional testing and data is needed to establish the feasibility of further reductions. We were able to successfully apply secondary air to two ATV models but our catalyst work was not conclusive. In the process of evaluating the potential for further reductions, we would again need to also consider the costs of those controls. We plan to continue our evaluation of the applicability of emissions control technologies for ATVs. It should be noted that the HC standards established by the rule will result in long-term total HC reductions from ATVs on the order of 90% and incremental reductions available from 4-stroke ATVs would be small in comparison.

2. Test Procedures

What We Proposed:

EPA proposed that the current highway motorcycle test cycle, the Federal Test Procedure (FTP), be used for ATV emissions measurement. Further, we proposed that ATVs use the same class designations as highway motorcycles, so that engines with a displacement at or below 169 cc would be considered Class I vehicles and tested on a less severe cycle, and those above 169 cc would be tested over the FTP cycle for Class II and III motorcycles. Acknowledging that use of a chassis dynamometer could be costly for some manufacturers, EPA has proposed, for model years 2006 through 2008 only, that manufacturers have the option of using the J1088 cycle for certification. After 2008, manufacturers would be expected to use the FTP cycle.

What Commenters Said:

MIC believes that EPA should use care to select driving cycles and test procedures that accurately reflect in-use operation by an ordinary driver. MIC had concerns with use of the LA4 driving cycle, which estimates that the average operating speed of an ATV is 20 mph, and the fact that MIC member companies have stated that most ATV models cannot meet the 57 mph (and the 36 mph maximum, for smaller displacement models) top speed in the cycle. MIC believes that where substantial evidence exists to show that the driving cycle required by regulation is not representative of real-world conditions, EPA has failed to demonstrate a reasonable connection between the facts on record and the decision, and risks remand upon judicial review. MIC further states that the FTP may be less representative than J-1088. MIC recommends that both test procedures remain available until a new ATV specific test procedure is developed.

Polaris believes that EPA should permit the continued use of engine dynamometer-based emission testing for ATVs and other recreational and utility vehicles. They believe that chassis dynamometer testing is costly and wasteful, as it will require the construction of a new facility for testing and it is not necessary for adequately characterizing or controlling emissions from these engines. Also, they state that the FTP is based on highway automobile driving patterns, which bear no relation to ATV operational conditions which typically average 6 to 7 miles per hour, and some do not exceed 30 miles per hour. Polaris does not manufacture its own engines and chassis testing will not be possible at the engine manufacturing site. They state that this testing will preclude rapid detection of problems and result in slower remedial actions if problems occur and that a properly correlated engine-based test is just as accurate in determining engine emissions performance. MIC and Polaris both recommend that the current SAE J1088 test be used until such a test can be developed.

CARB supports that phase-out of the J1088 option for ATVs in favor of the Class I FTP test procedure.

Our Response:

When crafting our proposal we looked at the California program. California's primary program is based on the FTP and California allows the option to certify using J-1088. We have serious concerns with allowing the long-term use of the J-1088 test cycle because it is a steady-state cycle that tests engines at a single engine speed. ATVs may never be operated in this manner. ATVs have a variable throttle and their operation is highly transient. When we established our Small SI engine program and decided to exempt recreational engines, one of the reasons was that the test cycle was not representative of how the engine were operated. For ATVs this is certainly the case. Of the two test cycles, we believe the FTP is clearly more representative because it is a transient test that exercised the vehicle over a wide range of operation. It is also chassis-based which is a step closer to real world operation because the vehicle is tested rather than just the engine. We continue to believe that the FTP is an acceptable test cycle for ATVs. Because it is transient-based, it will ensure robust emissions controls more-so than the J1088 cycle. California shares our concerns and supports the phase-out of the J1088 option.

We concur with manufacturer concerns that the 57 mph top speed of the Class III cycle may be too extreme for ATVs. The data we have indicates average speed in the 10 mph range with top speeds that are sometimes below 57 mph. In response, we have modified the rule to allow the use of the Class I cycle for all ATVs, which has a top speed of 36 mph. The top speed of this cycle is well within reach of the capabilities of most if not all ATVs. With this adjustment, the speeds of the test cycle will not be out of line with how ATVs can be driven. If the speeds of the test cycle are somewhat higher than those of typical ATV operation, the test cycle might be a more of a worst case cycle but this is not necessarily inappropriate or out of line with the goal of controlling emissions. We are also finalizing provisions that will allow the smallest ATVs, those with engines under 99 cc, to be tested with the J-1088 test cycle. Through this allowance, we avoid any issues regarding the ability of these small vehicles to be tested on the FTP.

In the proposal, we recognized the need of manufacturers to install chassis dynamometers and the lead-time needs associated with FTP testing in two ways. First, we proposed to allow the use of J-1088 testing on a temporary basis in order for manufacturers to switch over to FTP testing. This would allow them to carry-over their J-1088 based certification data from California and allow them time to smoothly transition to the FTP requirements. Second, we signaled a willingness to work with industry on a new test cycle specific to ATVs with the goal of having the cycle in place in time for manufacturers to avoid FTP testing. We are finalizing the temporary use of the J-1088 cycle and are continuing to work with manufacturers on a new test cycle. We have entered into discussions with manufacturers and the State of California regarding the development of the new cycle. If we are successful, manufacturers will be able to avoid altogether FTP testing their ATVs. We do not believe that it would be appropriate to allow the J-1088 permanently in the absence of a new test cycle due to the issues we have with the cycle, described above. The additional lead-time for eventual FTP testing was proposed and is included in the Final Rule being finalized so that manufacturers can prepare for such testing.

3. ATV Definition/Utility Engines

What We Proposed:

In the proposed rulemaking, we defined ATVs as a nonroad vehicle with three of more wheels and a seat, designed for operation over rough terrain and intended primarily for transportation. This includes both land-based and amphibious vehicles. We requested comment on whether or not our definition would pull in any vehicles currently equipped with engines certified to the Small SI program standards and if this would be appropriate.

What Commenters Said:

OPEI commented that EPA's proposed definition may be broad enough to be construed to apply to low-speed utility vehicles (LUVs). LUVs are currently equipped with engines certified to Small SI emission standards. OPEI commented that they do not believe it is appropriate to define utility vehicles as ATVs or require LUVs to essentially be recertified to meet ATV standards. OPEI commented that CARB already carefully considered these vehicles and chose to define ATVs in a way that left LUVs in the small engines program. OPEI provided examples of how LUVs and ATVs differ significantly in design and usage. LUVs and designed for work tasks and are vehicle speed governed, limiting speeds to less than 25 mph. OPEI also notes that the engines are of a different design than ATV engines and the engines are also used in other utility applications such as generators and lawn mowers. Further, they state, the vehicle manufacturing community has always drawn a distinction between these vehicles, as they have separate industry design and performance standards. ATVs, by ANSI/SVIA standards, have straddle-type seats, handlebar steering, four suspended wheels, handlebar-mounted controls, a flagpole mount, a VIN number, and be intended for use by a single operator. In contrast, an LUV has bench or bucket seats, an automotive-type steering wheel, four to six wheels with no suspension requirement, automotive-style controls, no flagpole mount or VIN number requirement, and its intended use is to transport material loads or people.

OPEI is concerned because the engines are most often manufactured by a different company than the vehicle and believes that some companies may have to leave the market if they are required to certify the vehicle. OPEI is also concerned that the ATV test procedure and cycle would not be appropriate for LUVs. Because of the governed speeds, the vehicles would not be able to be run over the FTP test cycle. They request that EPA modify the ATV definition to exclude LUVs and that the preamble to the final rule explicitly recognize the regulatory distinction between LUVs and ATVs. OPEI also requests that EPA adopt the CARB regulatory definition of an ATV for purposes of harmonization.

Briggs & Stratton submitted comments supporting the OPEI comments opposing the inclusion of utility-type vehicles under the ATV portion of the proposed regulations. They believe that 40 CFR Part 90 or the LSI portion of these proposed regulations more appropriately covers these applications. Briggs & Stratton suggests that EPA modify the definition of ATVs to clearly indicate that utility vehicles are to be regulated under an appropriate engine standard, and not the ATV standard.

Kawasaki also submitted separate comments supporting OPEI concerning the definition of ATV Kawasaki is concerned that the proposed ATV definition is overly broad and could inappropriately be read to encompass utility-type vehicles (such as the Kawasaki Mule) whose engines are currently- and properly, as Kawasaki states- regulated under the Small SI engine rule. They believe that the proposed rule should be revised and clarified accordingly to ensure that these vehicles with small lawn and garden type engines are not removed from the scope of the small SI engine rule and inappropriately placed in the recreational vehicle rule. Kawasaki supports the comments provided by OPEI and agrees with their recommendation that the definition of ATVs be revised to match that of the CARB definition (13 CCR Section 2411(a)(1)), to ensure that utility vehicles with speeds below 25 mph are not included in this rule. They state (from OPEI comments) that these utility vehicles have design and usage features that are different from common ATVs, including speeds above 25 mph and are typically used for recreational purposes. They are defined by CARB as “relatively small vehicles with a single operator, a straddle seat, and handlebar steering”. Utility-type vehicles, states Kawasaki, have maximum speeds of 25 mph or less, a bench seat for multiple riders, a steering wheel, a hauling bed, and are typically used for lawn and garden applications.

Polaris believes that the definition of ATVs needs to be clarified so that vehicles are appropriately regulated under either the ATV emission standards, the large SI engine standards, or the small SI engine standards. This clarification should specify all distinguishing attributes required for a vehicle to be considered an ATV. They state that the Polaris Ranger utilize engines subject to the proposed ATV standards, but are not manufactured, marketed, or used solely for recreational purposes. They believe that distinctions can be made between these vehicles based on the engine size, vehicle features, number of seats, method of throttle activation, and the use of steering wheels or handlebars. Polaris recommends that 40 CFR Part § 1051.801 read, “a nonroad vehicle with three or more wheels and a straddle seat, designed for operation over rough terrain and intended primarily for transportation. This includes both land-based and amphibious vehicles.” To ensure that this issue is properly resolved, they suggest discussions between EPA and affected stakeholders.

Toro seeks confirmation that its nonroad work utility vehicles, the Workman and Twister, are not being classified as ATVs and would not be subject to the standards proposed for land-based recreational vehicles. Toro requests clarification that these engines will remain subject to the emissions standards applicable to non-handheld spark ignition engines. Toro provides descriptions of the vehicles and their use. Both vehicles are work vehicles with governed speeds of less than 25 mph. Toro is concerned that the statement “...designed for operation over rough terrain and intended primarily for transportation,” could result in these vehicles being considered ATVs. Though neither of these is intended for regular operation over rough terrain, these vehicles are equipped to do so and may see occasional use on rough terrain. Further, Toro maintains that these vehicles do not fit EPA’s definition of recreational, nor do their engines fit the existing definition of a recreational vehicle engine.

Koyker Manufacturing commented that they are a small manufacturer of two models of LUVs which are governed to speeds of less than 25 mph. The models are currently equipped with engines certified to the Small SI program. They do not believe that requiring them to certify their vehicles to the ATV standards would improve emissions. They commented that changing would result in a testing burden they could not absorb like a large manufacturer. Koyker requested that LUVs be allowed to continue to use engines certified to small SI and large SI engine standards.

Tecumseh believes that the application of the highway motorcycle transient test cycle is not appropriate for small off-road engines that are equipped with speed control governors. They believe that the use of a highway test cycle for nonroad applications that typically cannot achieve the speed or acceleration required for the requested test profile is not appropriate and should be deleted from the proposed rule for these engines.

OPEI submitted supplemental comments following a meeting with EPA staff on April 30, 2002. OPEI recommended that the definition of ATV be changed to say that it does not include utility vehicles and that EPA should define utility vehicles as “nonroad vehicles generally intended for work tasks because they have a rear payload capacity exceeding 350 lbs. and a seating configuration for an operator and a passenger". OPEI also commented that some utility vehicles use non small spark-ignited (SSI) engines which enable them to exceed speeds of 25 mph but that they are fundamentally designed for work and should not be defined as ATVs. The distinction in the definition is important because ATVs and utility vehicles are manufactured to their own safety standards. However, OPEI commented that those utility vehicles powered by non SSI engines should be subject to the ATV engine emissions standards.

Our Response:

According to comments, utility vehicles differ from ATVs in several ways. An ATV is operated and ridden very similar to a motorcycle, with the rider straddling the seat and using handlebars to steer the vehicle. The throttle and brakes are located on the handle bars, similar to a motorcycle and snowmobile. Utility vehicles look and operate very similarly to golf carts. The operator sits on a bench seat with a back support that holds two or more passengers. Rather than handlebars, utility vehicles use a steering wheel and have throttle and brake pedals on the floor, similar to an automobile. Utility vehicles also typically have a cargo box or bed (similar to that found on a pick-up truck) used for hauling cargo.

Also according to comments, the engines used in such vehicles are generally below 25 hp and are typically used in other lawn and garden or utility applications such as generators or lawn tractors. The engines differ significantly from those used in recreational products which are designed for higher RPM operation with an emphasis on higher performance. OPEI also provided comment on a newer type of utility vehicle, which uses a more powerful (over 19kW) ATV-based engine and is capable of speeds of up to 40 mph. OPEI recommends that these vehicles equipped with more powerful engines, and similar future vehicles, be required to meet ATV standards.

In response to manufacturers' concerns, the Final Rule allows low-speed utility vehicles (LUVs) to remain in the Small SI program. We are requiring only those utility vehicles capable of speeds in excess of 25 mph to be certified under the ATV program. This is consistent with the comments submitted by manufacturers. We are finalizing the approach because we agree with many of the points raised by OPEI. The engines used in low-speed utility vehicles are more similar in design and use to utility engines than ATVs. The engines used to power these vehicles are often used in other utility applications, such as lawn and garden tractors and generators and are typically produced by companies that specialize in utility and lawn equipment rather than powersport vehicles. These products are already certified to the Small SI standards. In addition, these low-speed vehicles would not be able to be tested on the FTP, which includes vehicle speeds of up to 36 mph, without some modification to the test cycle.

We are taking a slightly different approach than that recommended by OPEI of requiring all utility vehicles powered by non-SSI engines to be certified to ATV standards. We are using speed rather than engine size as the distinguishing feature because there may be LUVs in the future powered by non-SSI engines. It would be appropriate for all LUVs to be subject to the same emissions standards since the products compete directly with one another. Based on comments submitted by manufacturers, the 25 mph cut-point is already used by industry to distinguish between products and therefore we believe an appropriate cut-point to use in the regulations. Also, we believe that vehicles capable of speeds over 25 mph will experience usage that is more similar to ATVs and there will be fewer issues with applying the ATV test requirements to these vehicles. We are also providing the option to manufacturers to certify LUVs to the ATV standards in case manufacturers choose to use ATV engines in LUVs in the future and opt to have a common certification for the products.

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

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

Given the utility nature of the low-speed vehicles, we believe that at least for now, it is appropriate to continue to certify them to 40 CFR part 90 standards. For vehicles capable of higher speeds (e.g., greater than 25 mph) the engine designs and vehicle in-use operation are currently, and are likely in the future to be similar to ATVs. The test procedures and standards for ATVs will better fit these high speed vehicles than those in the Small SI program.

OPEI opposes classifying such vehicles as ATVs and recommends utility vehicles be defined as their own category. For regulatory purposes, we are defining an off-highway utility vehicle as a nonroad vehicle that has four or more wheels, seating for two or more persons, is designed for operation over rough terrain, and has either a rear payload capacity of 350 pounds or more or total seating for six or more passengers. This is functionally the same as the definition recommended by OPEI. However, we are applying the ATV regulations to those utility vehicles capable of speeds above 25 mph the same as ATVs.

D. Off-highway Motorcycles

1. Standards

What We Proposed:

EPA proposed 2006 off-highway motorcycle standards of 2.0 g/km for HC+NOx emissions and 25.0 g/km for CO. These standards will have the same two-year phase-in period similar to the ATV standards. EPA believes that these standards will largely be met through the use of four-stroke technology.

a. Separate Standards for 2 and 4-stroke Engines

What We Proposed:

EPA did not propose separate standards for two- and four-stroke engines; however comments were requested on a recommended level for such a standard and the costs and emissions benefits associated with the standard.

What Commenters Said:

BRC believes that the overstatement of usage by EPA lead to EPA wrongly targeting the two-stroke for extinction from recreational trail use. Further, they believe that manufacturers and users should not be punished for selecting an engine design that serves a distinct part of the market. BRC suggests that EPA restudy the real world usage of these vehicles and adopt separate, but parallel, emission tracks for two and four-stroke engines.

The CMDA suggests that either two standards should be proposed- one for off-road vehicles with two-stroke engines and one for vehicles with four-stroke engines- or a single universal standard that allows manufacturers to design cleaner two-stroke engines and higher-performance four-stroke engines that may become acceptable alternatives to current two-stroke engines.

Mach 1 Motorsports suggests that two separate standards be established: a higher standard to provide incentive for OEMs to build cleaner 2-strokes, and a lower standard for more competitive 4-strokes.

Rev! believes strongly that the proposed rule could be improved by changing the proposed value of the HC+NOx standard. Rev! (in conjunction with Bombardier) is developing 'clean' two-stroke hardware that they predict, through computer simulation and testing, would meet a combined HC+NOx standard of 4.0 g/km, or would meet a total combined HC+NOx+CO of 25 g/km. (See enclosed graph of October 20, 2001 comments.) Rev! believes that a 4.0 g/km standard for HC+NOx (instead of 2.0 g/km) would allow customers the ability to purchase motorcycles with the preferred 2-stroke technology but only in 'clean' DI form. This relaxed limit will allow this technology the latitude to improve over time; the value is low enough that no carbureted two-strokes could be certified, and it is consistent with reducing four-stroke engine emissions as well.

Several users raised concerns about the demise of the two-stroke engine and urged EPA to develop separate standards for two- and four-stroke off-highway motorcycles. They also stated that they felt there were some safety issues with using four-stroke engines in off-highway motorcycles. They argued that off-highway motorcycles that use four-stroke engines are heavier and less maneuverable. In addition, one user commented that there are very few good performance-based four-stroke off-highway motorcycle models to choose from.

Our Response:

We are required by CAA section 213 to establish the greatest degree of emissions reduction achievable through the application of technology that we believe will be available within the period of time provided to the manufacturers. EPA must give appropriate consideration to lead-time, cost, noise, energy, and safety factors. In establishing performance-based standards, we considered the current use of 4-stroke engines in the various segments of the off-highway motorcycle market. We estimate that 4-stroke engines are used in about 33 percent of off-highway motorcycles sold and are used in all segments of the market including competition and youth models. For non-competition motorcycles, 4-stroke engines are used in almost 55 percent of off-highway motorcycles sold. Clearly, 4-stroke engines are available and we and manufacturers believe they can be used in all non-competition models by 2006. Therefore, we based our standards on emissions levels that could be achieved through the use of 4-stroke engine technology. Given the widespread use of 4-strokes currently in the off-highway motorcycle market and manufacturers plans to switch over to 4-strokes in time for 2006, we do not expect a lack of acceptable product due to the emissions standards.

It is important to note that we do not mandate the use of any specific technology. If a manufacturer can produce a clean 2-stroke off-highway motorcycle through the use of advanced technology such as direct fuel injection (DFI) systems, such an off-highway motorcycle can be brought to market. We received comments from Rev! motorcycles stating that they intend to build and sell high-performance off-highway motorcycles, including competition models, equipped with two-stroke engines using their unique direct fuel injection system. Although they felt their technology could not meet the 2.0 g/km HC+NOx standard, they stated that they felt they could meet a HC+NOx standard of 4.0 g/km. Rather than request separate standards for two- and four-stroke technologies, they encouraged us to raise our proposed standard from 2.0 g/km to 4.0 g/km. As stated above, Section 213 of the CAA does not allow us to promulgate less stringent standards if we know that more stringent standards are feasible and four-stroke engine technology is clearly feasible. However, we decided that it made sense to adopt an optional set of standards for off-highway motorcycles that may allow the use of some two-stroke engines.

Several off-highway motorcycle users and their associations have told us that they have concerns about being able to legally resell their used competition off-highway motorcycles, since used competition machines are more often used for recreational purposes than competition purposes as the machines get older. Rev! stated that by building a competition off-highway motorcycle equipped with DFI two-stroke engine that was certified, it could eliminate the concern over reselling used competition machines into the secondary market, since the owner would be able to use the vehicle both for competition and recreation.

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

We believe that this approach is responsive to all of the above comments. It directly addresses the concerns of the manufacturer developing the new competition motorcycle and also helps address the concerns of users. The successful development and certification of clean competition models increases the choices for consumers in the marketplace. Offered the option of a certified high performance off-highway motorcycle that can be used both for competition and recreation, consumers may not feel the need to purchase exempt competition motorcycles. This option has the potential to significantly decrease the number of conventional 2-stroke competition machines sold under the competition exemption and is likely to decrease the potential for misuse of competition machines. Conventional competition 2-stroke motorcycles generate extremely high levels of HC emissions, as noted above. For every conventional 2-stroke competition machine replaced by a certified competition machine, HC emissions would be reduced by 90 percent, or more.

As for potential safety issues with four-stroke off-highway motorcycles, we do not agree with the commenters that the extra weight of the four-stroke engines poses any safety threat. While it is true that most four-stroke off-highway motorcycles are heavier than their two-stroke counterparts, there is no evidence which indicates that four-stroke off-highway motorcycles are any more dangerous than two-strokes. The comments provided are anecdotal and while we believe the commenters believe them to be true, they did not provide any data that supports their assumption. Manufacturers have been very successful at reducing the weight of four-stroke off-highway motorcycles over the last several years and we are confident that they will be able to produce four-stroke motorcycles that will be acceptable to their customers.

b. Lead Time

What We Proposed:
As previously stated, the 2006 standards for off-highway motorcycles will feature a two-year phase-in period in which 50 percent of the fleet will be expected to comply in 2006 and full compliance will be expected in 2007.

What Commenters Said:

No comments were received on lead time.

c. Level of Standards

What We Proposed:

We proposed standards for off-highway motorcycles of 2.0 g/km for HC+NOx and 25 g/km for CO. The standards are phased in at 50%/100% in model years 2006/2007.

What Commenters Said:

EPA received comments from CMDA and users that EPA overestimated emissions inventories and did not consider emissions in urban versus rural setting and that these factors lead EPA to propose standards that were unreasonable. The CMDA believes that the EPA estimates of usage will not survive scientific or legal challenges if this issue is not revisited. They believe that if the emissions inventory is accurately estimated, a more reasonable standard can be proposed. BRC also believes that EPA proposed unreasonable standards and commented that the rule failed to recognize the fact that a majority of off-highway motorcycle use does not occur in urban areas, cities, or nonattainment areas.

Our Response:

As discussed in Section II.B, we received comments from several parties on our emissions inventory modeling, and new data on off-highway motorcycle usage. In response, we have reduced our estimate of the annual usage rates for off-highway motorcycles (see Section II.B. for our response on emissions modeling). We disagree with the commenters, however, that the emissions modeling lead us to propose unreasonable standards or has an impact in the level of stringency of the standard. The commenters do not provide any evidence for a claim that off-highway motorcycles do not contribute to ozone or CO nonattainment areas. If we find under CAA section 213 that a nonroad category causes or contributes to nonroad air pollution, we are required to establish standards that achieve the greatest degree of emission reduction achievable. Though we have changed our emissions modeling, we have not changed our finding that this nonroad category causes or contributes to nonroad air pollution (see Section II.C.). In addition, even after making changes to the modeling and other numbers in response to comments, the cost and cost-effectiveness numbers for our final off-highway motorcycle standards are well within the cost-effectiveness levels for comparable regulations. Therefore, the requirements of the CAA regarding the stringency of the standards have not changed and the reduction in the emissions inventory does not affect the level of the standards being finalized.

What Commenters Said:

CARB has reservations about the proposed HC+NOx standard, they believe that EPA should incorporate the ARB HC standard (1.2 g/km) to serve as a cap for the HC component of the standard. ARB believes that this would harmonize the market and increase the number of compliant models for the California market.

Environmental Defense believes that the fact that the proposed standards that are less stringent than those of California is an example of how EPA has not achieved its clear legal duty and urges EPA to adopt emission standards that are consistent with California. They believe that the rationale provided for this is unsubstantiated and recommend that EPA adopt Tier 1 emission standards for off-highway motorcycles consistent with those of California.

Our Response:

California has an HC-only standard of 1.2 g/km for their off-highway motorcycle program. Our standard is a HC+NOx standard of 2.0 g/km. We believe it is prudent to set a HC+NOx standard in lieu of a HC-only standard since the main emission control strategy is expected to be the use of four-stroke engines in lieu of two-stroke engines. Two-stroke engines emit extremely low levels of NOx. Four-stroke engines, on the other hand, have higher NOx emission levels, in the range of 0.3 g/km on average. This is part of the reason why we proposed a somewhat higher numeric standard compared to California.

The California standards, which were adopted in 1994, were stringent enough that manufacturers were unable to certify several models of off-highway motorcycles, including some models with four-stroke engine technology. This was due to the fact that there was insufficient four-stroke engine designs available to replace existing two-stroke engines at the time and those four-stroke engines that did exist ran poorly because the air and fuel mixture had to be enleaned (excess air) to meet the stringent HC and CO standards. The result was a substantial shortage of products for dealers to sell in California. The shortage led California to change their program to allow manufacturers to sell non-compliant off-highway motorcycles in many circumstances.[uu] As a result, approximately a third of the off-highway motorcycles sold in California are compliant with the standards. The uncertified models being sold in California include both 2-stroke and 4-stroke machines.

[uu] See Docket A-2000-01. Public Hearing to Consider Amendments to the California Regulations for New 1997 and Later Off-highway recreational Vehicles and Engines. II-D-08.

We received comments from CMDA and off-highway motorcycle users concerned that a similar shortage could arise nationwide if EPA adopted the California standards. We proposed standards that were somewhat less stringent than that of California, based on our test data from high performance four-stroke machines. We are finalizing this approach to ensure adequate product can be made available in the 2006 time-frame. Although the approach we are finalizing contains somewhat less stringent standards than the California program, we believe it will achieve reductions beyond that of the California program because more products will be certified (even when the competition exemption is taken into account). The vast majority of the HC reductions achieved by the program come from shifting away from conventional 2-stroke engines which have HC emissions levels in the range of 35 g/km. The 2.0 g/km standard represents about a 95% reduction in emissions for these vehicles.

The concerns raised by CMDA and some off-highway motorcycle users over the potential that a shortage in certified off-highway motorcycles could arise nationwide if EPA adopted the California standards should be nonexistent since we are not adopting the California standards and we have attempted to incorporate concerns over product performance in setting our standards. In addition, there will have been almost ten years passed between 1997, when the California regulations went into effect and 2006 when our standards take affect. During that time, manufacturer will have had ample time to improve off-highway motorcycle designs and provide their customers with an adequate supply of certified well performing four-stroke machines. Since our standards are federal standards applying to the whole country, rather than just the state of California, manufacturers will have added incentive to provide a wide variety of available products so that there overall sales don't decline substantially. Already the non-competition off-highway motorcycle market is dominated by four-stroke motorcycles that would be capable of meeting our standards with little change to the motorcycle.

We believe that if we were to set a cap for HC emissions of 1.2 g/km, per the California standard, it would have the same effect as setting a more stringent standard, resulting in the same concerns discussed above. We are also concerned that a HC cap of 1.2 g/km could encourage off-highway motorcycle users to purchase non-certified competition machines in lieu of certified products. This is because most high-performance motorcycles tend to operate with a slightly rich air and fuel mixture for added performance and engine durability. In order to meet a 1.2 g/km cap, they would have to reduce the amount of fuel in the air and fuel mixture, potentially affecting performance. Our emissions test data on four-stroke off-highway motorcycles indicate that 1.2 g/km could not be met without some modification to the air and fuel mixture[vv].

[vv] The average HC emission level of the four off-highway four-stroke motorcycles we tested was 1.25 g/km. The Husaberg FE501 had an average HC level of 1.3 g/km, while the

What Commenters Said:

MECA believes that the decision to not propose catalyst-based standards for off-highway motorcycles misses an opportunity to achieve significant and cost effective emission reductions from these vehicles. They believe that the success of applying catalyst technology to highway motorcycle two and four-stroke engines makes a case for establishing more stringent standards for off-highway motorcycles. MECA is concerned that an analysis of catalyst technology application to off-highway motorcycle engines was not included in the proposal. MECA states that actual commercial experience with two and four-stroke two-wheeled vehicles has demonstrated that all industry concerns with the application of catalysts can be easily addressed. MECA believes that packaging of catalysts is an engineering challenge, but argues that it can be done- catalyst technology has been successfully designed, packaged, and equipped on over 15 million motorcycles worldwide. They also state that catalysts have also been applied to 500,000 two-stroke and 400,000 four-stroke lawn and garden engines that presented the same challenges due to space constraints. To address the issue of space limitations in highway motorcycles and mopeds, many techniques have been employed, none of which add significant volume or complexity to the vehicle. These include placing the catalyst in the muffler system, mounting the catalyst close to the manifold, and using catalyst coated plates and tubes.

MECA recommends that the Phase 1 and Phase 2 standards for off-highway motorcycles be based on the final European 2003 and 2006 standards, respectively.

Earth Justice believes that EPA has not set standards that reflect the greatest degree of reduction through the use of currently available technologies such as three-way catalytic converters, electronic fuel and secondary air injection. They also believe that the statements that electronic fuel injection could have adverse cost and performance impacts, secondary air injection could have performance impacts, and that catalytic converters could have safety concerns are not justified. Further, Earth Justice does not see any reason that the safety concern with catalytic converters cannot be addressed through the use of heat shields.

New Hampshire supports EPA's efforts to regulate emissions from off-highway motorcycles, including two-stroke competition and four-stroke recreational machines.

NESCAUM agrees that 4-stroke systems and improved fuel management systems can help off-highway motorcycles meet the proposed standards. They also believe that

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Yamaha WR250F had an average HC level of almost 1.5 g/km. Chapter 4 of the Regulatory Support Document provides more detail of our testing of four-stroke off-highway motorcycles.

catalysts can be used on 2 and 4-stroke engines to further, and cost effectively, reduce emissions.

Rev! states that regulating HC while neglecting NOx and/or CO would discourage the development of clean burning two-stroke technologies which have the potential to produce uncatalyzed emissions that are lower than those from uncatalyzed four-stroke engines. Rev! is in favor of a combined regulation that would limit the sum of CO, HC, and NOx.

STAPPA and ALAPCO recommend that the control of off-highway motorcycles also be based on the application of catalyst technology. They believe that this will achieve significant further emissions reductions safely, durably, and cost effectively.

Our Response:

We believe that at this time, standards based on clean four-stroke technology are the most stringent technologically feasible in the 2006 time frame. With only three model years to respond to the requirements, we do not believe manufacturers would have enough time to meet a more stringent standard than that proposed. The standards we are finalizing are not as stringent as those recommended by MECA. We do not have data to support finalizing standards as stringent as those recommended by MECA.

MECA's comments discuss the success Asian and European manufacturers have had placing catalysts on highway motorcycles. Most of this work has focused on reducing emissions from 50 cc 2-stroke on-highway scooters. The use of catalytic converters poses concerns over packaging, durability and safety. Off-highway motorcycles are very light and narrow. These attributes are necessary for operating through tight forest trails and other harsh conditions. This leaves little room for packaging a catalyst so that it won't be damaged from engine vibration, shock resulting from jumps and hopping logs, and falling over and hitting objects, such as trees and rocks. Earth Justice argues that heat shields could be applied to prevent riders from being burnt from the hot catalyst. However, due to the abuse off-highway motorcycles can receive from operating in harsh conditions, it is possible for heat shields to be destroyed.

MECA also refers to emissions control from 2-stroke Small SI handheld engines used in chainsaws and other equipment. These engines are quite different than the 4-stroke engines used in off-highway motorcycles both in the way they operate and in the engine size. Also, the usage pattens of the vehicles are quite different. In addition, the test cycles and emissions control program requirements are different from those contemplated for off-highway motorcycles in the rulemaking. For these reasons, we do not believe that the emissions control experience cited by MECA is directly applicable to off-highway motorcycles. It is difficult to glean data or information from that submitted by MECA that would inform our decision on what emissions levels are achievable for off-highway motorcycles through the use of catalyst technology

Earth Justice also stated that technologies such as secondary air injection and electronic fuel injection are available for off-highway motorcycles. As discussed above, the operating conditions for off-highway motorcycles can be excessive. Excessive engine vibration, shock to the vehicle resulting from aggressive operation such as performing jumps and hopping logs, falling over and hitting objects, and forging small rivers or operation in swamps or bogs where the motorcycle can enter high levels of water, all make the use of relatively fragile technologies such as secondary air injection and electronic fuel injection questionable. Electronic fuel injection systems use small on-board computers to control the injection system and any other necessary electronic sensors and actuators, all of which are needed for these systems to function. All of these added electronic devices would have to be protected from the elements. Most off-highway motorcycles have very minimalist designs that do not provide an abundance of locations to locate sensors, actuators, and computers such that they would be protected from the harsh environment they would operate in. These technologies have existed in highway motorcycles for some time, but they do not operate in nearly as harsh conditions and there is no data that we are aware of that indicates durability of these technologies in such operating conditions.

Finally, we do not agree with MECA's comment that we should adopt the final European 2003 and 2006 highway motorcycle standards. As discussed above, the technologies available for highway motorcycles do not necessarily transfer to off-highway motorcycles due their harsh operating environment. We believe the standards we are finalizing will require 4-stroke engines that are well calibrated for emissions control without sacrificing performance to the point that the product is not acceptable to the consumer. For these reasons, and the lack of information establishing the feasibility and durability of secondary air injection and electronic fuel injection, we believe the standards we are establishing for off-highway motorcycles are appropriate at this time.

II Test Procedures

What We Proposed:

EPA proposed that, for measuring emissions of off-highway motorcycles, the current highway motorcycle test cycle, the Federal Test Procedure (FTP), should be used. EPA also proposed that the same class/cycle distinction that is used for highway motorcycles be used for off-highway motorcycles, vehicles with an engine displacement at or less than 169 cc would be tested as Class I and those vehicles with an engine displacement above 169 cc would be tested over the Class II and III FTP cycle.

What Commenters Said:

MIC suggested that we allow off-highway motorcycles with engine displacements below 279 cc be allowed to use the Class I cycle, which has lower maximum speeds and acceleration rates than the Class II and Class III cycle. They felt this was appropriate due to the lower operating speeds for these smaller motorcycles.

Our Response:

In our emission test program we tested numerous off-highway motorcycles with engine displacements below 279 cc without any problems. All of the motorcycles were capable of following the driving trace without any difficulties and their emission results did not appear to be higher than then the larger displacement motorcycles tested. One of the most common engine displacement categories for off-highway motorcycles is the 250 cc category. The majority of 250 cc off-highway motorcycles have very high power-to-weight ratios which allow these machines to accelerate quickly and reach top speeds well in excess of the 57 mph top speed found on the Class II and Class III FTP cycle. Therefore, we do not see any reason to expand the use of the Class I highway motorcycle FTP test cycle to include off-highway motorcycles with engine displacements between 170 cc and 279 cc. We are already allowing off-highway motorcycles at or below 169 cc to use the Class I test cycle.

E. Other Vehicles

What We Proposed:

For recreational vehicles that are not defined as snowmobiles, ATVs, or off-highway motorcycles, EPA proposed to apply the standards otherwise applicable to nonroad SI engines.

What Commenters Said:

Tanaka concurs with the approach outlined in the NPRM for handling other recreational vehicles including small scooters. They believe that small gas powered scooters should be included in the Small SI regulations (as described in the NPRM), as these engines are the same/similar to lawn and garden engines. They believe that the requirements of these engines should be the same as those of hand-held utility engines since hand-held engine manufacturers will be suppliers of these engines and this will synergize their efforts of certifying engines that may be common to both power equipment and small personal transportation vehicles (e.g. scooters).

Honda is unable to find consistent logic in the proposed rule for when a small nonroad engine would be covered by 40 CFR Part 90 or by the recreational regulation in Part 1051. Some small nonroad vehicles would be allowed to certify to Part 90 VI.A.1.d. (Other recreational vehicles). There is a contrary determination requiring certification to Part 1051 for small nonroad Class 1 and 2 engines used in utility vehicles and children's snowmobiles. This is based on broad definition of ATVs and the lack of exclusion in 1051.615 (snowmobiles). Honda further adds that while the products may be difficult to categorize, the engines follow fairly well defined design and performance. If an engine is being used within the speed and load parameters of its emission certification, it should not matter what product it is powering as engines characteristics are well defined by the class of certification. Honda believes that it is a more workable solution to use the engine and their relatively few manufacturers as the basis for the rulemaking, as it will be virtually impossible to require that manufacturers understand what category the many unique small engine powered products belong in, request consideration from the Agency, or certify their engine to a second standard. Honda suggests that EPA develop a narrow definition of recreational ATV to distinguish the motorcycle-derived engines used in these vehicles from the class 2 (garden tractor) engines that are used in utility ATVs.

Tecumseh raises concerns over the fact that the proposed rule changes the SORE definition of recreational vehicle engines from those with a rated speed in excess of 5000 rpm and not equipped with a speed control governor to any engine used in finished goods that are viewed as recreational vehicles. They state that this, and the definition of ATVs in the proposal, either incorrectly classify or do not clearly define several finished goods, including fun carts and chore carts. Tecumseh states that an equipment manufacturer could run the risk of purchasing a SORE certified engine and place it in a product that is later deemed to be a recreational vehicle, which would require re-certification of the piece of equipment. Further, they fear that the manufacturer could be required to make changes in the engine's emission control system to allow the certification process to be completed. Tecumseh believes that EPA should refrain from changes to the existing SORE regulation's definition of a recreational vehicle engine.

Our Response:

We concur with comments that it is appropriate for engines used in recreational applications that are not snowmobiles, off-highway motorcycles, and ATVs to remain in the Small SI program (or Large SI program, if appropriate). Vehicles such as stand-on scooters, golf carts, go-carts, and other motorized recreational products are most often equipped with engines certified to the Small SI standards. We believe it is appropriate to continue to allow manufacturers of these products to continue to use Small SI certified engines. Comments regarding utility vehicles have been addressed in detail in section III.C.3., above. We have examined the comments and have established definitions for the three vehicle types (snowmobiles, off-highway motorcycles, and ATVs) that will capture the appropriate vehicles. The variety of other products that can be produced for recreation using Small SI engines is very broad and it would not be practical or necessary to establish different programs for each type of vehicle at this time. Snowmobiles, off-highway motorcycles, and ATVs have been separated because they use different types of engines than those used in Small SI applications, and the vehicle types represent large markets which could be considered for separate standards in this Rule. In the future, we may need to consider other types of recreational products for unique regulations.

There are limited circumstances where we are allowing Small SI certified engines to be used in these vehicle categories without recertification. For small entities, we provide the option to use engines certified to the Small SI standards for five model years. This will allow small manufacturers more flexibility to meet requirements and transition into the program.

We believe that the above provisions will address the vast majority of situations that are of concern for the commenters regarding the application of Small SI engines. We are not taking the approach recommended by Honda for snowmobiles, off-highway motorcycles, and ATVs. Honda's recommended approach would allow manufacturers of these vehicles to circumvent the standards contained in this Final Rule by using engines certified to the Small SI program. If we allowed this option in general for all snowmobiles, ATVs, off-highway motorcycles we would provide an avenue for manufacturers to avoid the recreational vehicle program. When the Small SI standards were originally adopted, recreational vehicles were excluded because the standards and test procedures were not believed to be appropriate. We continue to believe that this is the case, and we do not believe it would be appropriate to now offer the Small SI option to manufacturers. We believe that all snowmobiles, ATVs and Off-highway motorcycles must be held to their respective emissions control requirements in order to maintain a level playing field in the market and maintain the integrity of the program.

Summary and Analysis of Comments: Recreational Vehicle Permeation

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VI. Permeation from Recreational Vehicles

A. Permeation Standards

1. Level and Form of the Standards

What We Proposed:

We requested comment on setting permeation emission standards for fuel tanks and hoses on recreational vehicles including snowmobiles, all-terrain vehicles (ATVs) (including off-road work and specialty utility vehicles which are otherwise classified as ATVs), and off-highway motorcycles (OHMCs). For fuel tanks, we discussed in detail potential standards requiring a 95 percent reduction in permeation emissions. These reductions imply a tank permeability standards of 0.04 grams per gallon per day at 30°C or about 0.4 to 0.5 grams per square meter per day. We also requested comment on the form of this standard. For hoses, we considered a permeation standard of 5 grams per square meter per day at 23°C. This constitutes a 99 percent reduction in permeation when compared to the SAE R7 hose specification of 550 grams per square meter per day. We only focused on permeation emissions rather than broad evaporative emission standards for land-based recreational vehicles because the fuel tanks are generally small, resulting in diurnal and refueling emissions that we expect to be low. The use rates (hours of operation) of recreational vehicles are likewise low compared to other sources, and we expect that hot soak emissions will be low as well.

What Commenters Said:

MIC commented that, although vendors claim 95 percent reductions are feasible, they have not had time to test barrier treated tanks. MIC states that we should set a standard of 3.0 g/m^2/day for fuel tanks, which is consistent with the requirements that apply to portable fuel containers in California, would allow a greater margin of safety, and may allow use of non-barrier strategies. They commented that this would represent a 75 percent reduction in permeation from an average baseline of 12 g/m^2/day. MIC stated that a 3.0 g/m^2/day standard would allow them to use less effective alternative tank materials in lieu of barrier treatment. Polaris commented that we should consider a design standard for a 55 to 60 percent reduction so that injection molded nylon could be used to reduce permeation, which Polaris claims would have significantly decreased costs. Briggs & Stratton commented that a permeation requirement of 0.04 g/gal/day is not supported by the test data in the record. They claimed that the CARB data only show a 92 percent reduction and no field data was collected. Honda commented that they could achieve a 2/3 reduction in permeation using Selar® and recommended a standard of 10 g/m^2/day at a higher test temperature of 40°C.

MIC commented that a $g/m^2/day$ basis is the appropriate way to express the standard because this would allow all fuel tanks to use the same permeation treatment without regard to variations in fuel tank geometry. They stated that this would prevent small, complex-shaped fuel tanks from being unfairly penalized due to higher surface to volume ratios. Briggs & Stratton commented that the standards should not be specified as g/gal/day because permeation is a function of surface area, not volume. Polaris also commented that the standard should be based on $g/m^2/day$. Bluewater commented that the standards should be in g/gal/day because this would agree with how other states such as California set their standards.

MIC and Polaris commented that fuel hose standards based on automotive fuel lines such as specified in SAE J2260 as Category 1 would be inappropriate for recreational vehicles. They recommended setting a standard of 15 $g/m^2/day$ which can be met by hose specified in SAE J30 as R9 hose and would achieve more than a 95 percent reduction in hose permeation. Honda commented that a fuel hose standard of 5 $g/m^2/day$ is not practically feasible and that hose permeation is very low compared to fuel tank permeation. Honda recommended that no fuel hose standard be implemented, but if a standard is desired quickly, it should be on the order of 200-300 $g/m^2/day$ at a higher test temperature of 40°C. (Honda subsequently recommended 100 $g/m^2/day$ in materials provided to EPA on August 8, 2002).

Bluewater Network commented that a 95 percent reduction in permeation from recreational vehicles is easily attainable and could be achieved using non-permeable hoses and non-corrosive metal fuel tanks. Environmental Defense commented that 95 percent reductions in fuel tank permeation and 99 percent reductions in hose permeation could be achieved cost-effectively, and safely.

Our Response:

We have identified several strategies for reducing permeation emissions from fuel tanks and hoses. A specific example of technology that could be used to meet the fuel tank permeations would be surface barrier treatments such as sulfonation or fluorination (other examples are discussed in Chapter 4 of the RSD). With these surface treatments, more than a 95 percent reduction in permeation emissions from new fuel tanks is feasible. As discussed in Chapter 4 of the RSD, the baseline emissions from HDPE fuel tanks is about 0.85 g/gal/day over the CARB test cycle[ww] while the three fluorinated fuel tanks treated at

[ww] "Test Method 513; Determination of Permeation Rate for Spill-Proof Systems," California Environmental Protection Agency, Air Resources Board, originally proposed August 6, 1999, (Docket A-

the highest level averaged 0.04 g/gal/day. Some sulfonated fuel tanks included in the CARB test program also achieved this level.[xx]

However, variation in material tolerances and in-use deterioration can reduce this effectiveness. We believe that, given the lead time for the standards, manufacturers will be able to provide fuel tanks with consistent material quality, and we believe that the surface treatment processes can be optimized for a wide range of material qualities and additives such as pigments, plasticizers, and ultra-violet (UV) light inhibitors. We do not expect a large deterioration in use. Chapter 4 of the RSD presents data on a sulfonated automotive fuel tank tested before and after 5 years of service that shows no measurable decline in permeation resistance. The RSD also provides data on slosh testing on fluorinated and sulfonated fuel tanks (which may be harsher than typical recreational vehicle conditions) which suggests that some deterioration may occur. To accommodate variability and deterioration, we are finalizing a standard of 1.5 $g/m^2/day$ which represents about an 85 percent reduction in permeation emissions from plastic fuel tanks. It is our expectation that manufacturers will aim for a surface treatment effectiveness rate as near to 100 percent a practical for new tanks. Therefore, even with variability and deterioration in use, control rates are likely to exceed 85 percent.

We recognize that some of these technologies may be more desirable than others for some manufacturers, and we recognize that different strategies for equal emission reductions may be better for different applications. However, we do not believe that it is appropriate to relax the standards so that less effective technology can be used such as injected molded nylon or non-optimized barrier platelets because there are very cost-effective alternatives that can meet our final standard.

We agree with commenters that the fuel tank permeation standards should be expressed in a g/gallon/day or a $g/m^2/day$ form. Although volume is generally used to characterize fuel tank emission rates, we base the standard on inside surface area because permeation is a function of surface area. In addition, the surface to volume ratio of a fuel tank changes with capacity and geometry of the tank. Two similar shaped tanks of different volumes or two different shaped tanks of the same volume could have different g/gal/day permeation rates even if they were made of the same material and used the same emission control technology. Therefore, we believe that using a $g/m^2/day$ form of the standard minimizes complexity.

2000-01, document IV-A-08).

[xx] www.arb.ca.gov/msprog/spillcon/reg.htm, Updated March 26, 2001, Copy of linked data reports available in Docket A-2000-01, Document IV-A-09.

We are finalizing a standard of 15 g/m^2/day for fuel hoses. This is consistent with the SAE J30 R9 hose specification except that we will require this level to be met with a 10 percent blend of ethanol in gasoline while R9 hose is based on Fuel C which is a gasoline blend without alcohol. Several materials are available today that could be used as a low permeation barrier in rubber hoses that are resistant to permeation on alcohol fuel blends. In fact, SAE J30 specifies R11 and R12 hose which are low permeability hoses tested on 15 percent methanol blend. Manufacturers using R11 or R12 hose may certify by design.

2. Implementation Dates

What We Proposed:

In our discussion of potential permeation standards for recreational vehicles, we discussed phasing-in the requirements for all three types of recreational vehicles at 50 percent of new sales in 2006 and 100 percent of new sales in 2007 and later. This is the same phase-in schedule as we proposed for exhaust emission control from these vehicles.

What Commenters Said:

MIC commented that the fuel tank and hose permeation standards should be delayed until 2009. They stated that they could not simply treat existing fuel tanks but would also need to make design changes and perform durability testing. MIC stated that if stiff low-permeation lines, such as SAE 2260 Category 1, were used, then the stress at the fittings would be increased and they would have to be more firmly supported. In addition, the fittings would have to be redesigned to be compatible with the new hose. Also, durability testing would be required. MIC commented that major design changes would not be required with the more flexible SAE J30 R9 fuel hose.

ISMA commented that their typical validation period for new designs is two years, so the permeation standard should not go into place until 2008. They also raised the concern that time would be needed to evaluate the impact of using low permeation technology on their products. Polaris commented that they would need an additional two years beyond 2006 to meet the fuel tank requirements. They stated that if they were able to use SAE R9 hose to meet the standard that they would be meet the requirement in the time-frame discussed in the proposal, but they would need an additional two years if rigid tubing were required to meet the hose permeation standard. Briggs & Stratton commented that the implementation dates should be delayed because the May 1, 2002 notice did not give them enough time to evaluate the potential impacts of permeation standards on their industry.

Bluewater Network commented that we should set standards that achieve the maximum emissions reductions at the earliest date possible. The commented that the technology is available today and that the emissions reductions are necessary as soon as possible. Environmental Defense commented that the permeation requirements should be implemented by 2004. They commented that California already requires the use of fluorinated or sulfonated gas cans and that the cost of low permeation fuel tanks and hoses is minimal.

Our Response:

We are implementing the permeation emission standards for fuel tanks beginning with the 2008 model year. Several technologies are available that could be used to meet this standard. Surface treatments to reduce tank permeation are widely used today in other container applications, and the technology and production facilities needed to conduct this process exist. Selar® is used by at least one portable fuel tank manufacturer and has also been used in automotive applications. Plastic tanks with coextruded barriers have been used in automotive applications for years. Alternative, low permeation materials, for molding fuel tanks are available today. However, fuel tanks used in recreational vehicles are primarily (if not exclusively) high-density polyethylene tanks with no permeation control. We believe it is appropriate to give manufacturers until the 2008 model year for the fuel tank permeation standards. Manufacturers will need lead time to allow for durability testing and other development work associated with applying this technology to recreational vehicles. This is especially true for manufacturers who choose to set up their own sulfonation or fluorination facilities in-house.

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

3. Technical Feasibility

What We Proposed:

We stated that we believe there are available technologies that can reduce permeation emissions to near-zero levels. The application of these technologies to land-based recreational vehicles appears to be relatively straightforward, with little cost and no adverse performance or aesthetic impacts. In addition, the control technology would generally pay for itself over time by conserving fuel that would otherwise evaporate.

For fuel tanks, we discussed two types of barrier processes, fluorination and sulfonation, that can be employed to reduce or eliminate permeation in HDPE plastic tanks. The fluorination process causes a chemical reaction where exposed hydrogen atoms are replaced by larger fluorine atoms which form a barrier on the surface of the fuel tank. In a similar barrier strategy, called sulfonation, sulfur trioxide is used to create the barrier by reacting with the exposed polyethylene to form sulfonic acid groups on the surface. Either of these processes can be used to reduce gasoline permeation by more than 95 percent.

For fuel hoses, we discussed low permeation hoses that are available that could be used in recreational vehicle applications. Typical constructions for these hoses are to use thermoelastomers or thermoplastics to create a low permeability barrier in the hose. In automotive applications, very-low permeation fluoroplastic fuel lines are generally used rather than hose. By replacing mono-layer rubber fuel hoses with low permeability barrier fuel hoses, permeation emissions through the fuel hoses can be reduced by more than 95 percent.

What Commenters Said:

MIC commented that although we have collected data showing a greater than 95 percent reduction in permeation from fuel tanks using barrier treatments, they have not had the opportunity to run durability tests on this technology. They expressed this concern because recreational vehicles are exposed to severe service conditions. ISMA specifically commented that they do not have sufficient information on long term exposure to alcohol, cold temperatures, shock loading, flexing of tank, ultra-violet (UV) light exposure, abrasion of outer surface of tank, exposure to cleaners. They also commented that they did not know what the effects of pigmentation and polyethylene formulation on the barrier treatments. ISMA and Polaris made the claim that a fluorinated tank would only have a 30 percent reduction in emissions if tested on a 10 percent ethanol fuel, but provided no data. Polaris commented that a 55-60 percent reduction could be achieved using injected molded nylon which has a decreased cost, more freedom in manufacturing, lighter weight, and better aesthetics than barrier treated HDPE. Briggs & Stratton commented that the ARB data only shows a 92 percent reduction in permeation and that it is based only on laboratory testing. They commented that the long-term exposure to sun, vibration, and dirt need to be demonstrated. Also they claimed that the ability of the barrier treatment to be implemented on a production level needs to be demonstrated. Honda commented that they could achieve a 67 percent reduction in fuel tank permeation using Selar® laminar barriers molded into their fuel tanks. They stated that the durability and practicality of fluorination has not been demonstrated on recreational vehicles. Fast Inc commented that the chemicals used in fluorination and sulfonation are hazardous.

MIC commented that they cannot use rigid fuel lines such as Category 1 fuel tubing specified in SAE J2260. They stated that the standards must allow for flexible fuel hose such as R9 specified in SAE J30. MIC commented that R9 hose would achieve a 97 percent reduction in permeation emissions from a baseline R7 hose which has a permeation level of 550 $g/m^2/day$. They explained that rigid fuel lines do not provide the flexibility needed to accommodate the relatively high level of engine movement due to vibration and shock and would require a redesign of numerous subsystems to incorporate special connectors, reenforce stress areas, and to solve routing problems. ISMA stated that they do not know if their fuel system will work with a low permeability hose. Polaris commented that SAE J2260 fuel lines and SAE J1527 marine hose are not appropriate for recreational vehicle applications. They also stated that they don't make their own fuel lines so they wish to use an existing hose that meets an SAE standard. Therefore, they recommended that SAE J30 R9 hose be required under the new permeation standard. Honda commented that the use of SAE J30 R9 hose would require the use of a clamp to hold it in place due to vibration where the hose they use today does not. In subsequent material provided to EPA on August 8, 2002 Honda clarified that the current fuel line does use a clamp and that this requirement would require a more robust clamp.

Bluewater Network commented that greater than 95 percent reductions in permeation are easily attainable and could be achieved using non-permeable hoses and non-corrosive metal fuel tanks. Bluewater supports a fuel tank standard requiring a 95 percent reduction because it approaches the reductions from metal tanks but still give industry flexibility in its manufacturing processes. They commented that plastic fuel tank permeation can be reduced using fluorination, sulfonation, coextruded barrier layers such as ethylene vinyl alcohol, or by increasing wall thickness and decreasing surface area. Environmental Defense commented that the technology to reduce permeation emissions from fuel tanks and hoses has been available for years. They stated that California already requires the use of fluorinated or sulfonated portable gas cans.

Our Response:

We have identified five technologies that could be used to meet the fuel tank permeation standard. These technologies are sulfonation, fluorination, coextrusion with a barrier layer, non-continuous barrier platelets (i.e. Selar®), and alternative materials.

These technologies are discussed in detail in Chapter 4 of the Final Regulatory Support Document. This discussion includes test data on more than 150 fuel tanks. This data includes slosh testing on three sulfonated and three fluorinated fuel tanks that shows no significant deterioration after 1.2 million cycles as well as in-use data on a sulfonated automotive fuel tank showing no deterioration. We believe that these conditions are at least as severe as would be seen on recreational vehicles. We believe that, given the lead time for the standards, manufacturers will be able to provide fuel tanks with consistent material quality, and we believe that the surface treatment processes can be optimized for a wide range of material qualities and additives such as pigments, plasticizers, and UV inhibitors. Barrier treatment vendors are already working with fuel tank manufacturers to identify appropriate material specifications. As discussed above in Section VI.A.1, we believe that by relaxing the standard to 1.5 $g/m^2/day$, we are allowing for variability and deterioration, and we do not believe that it is appropriate to relax the standard further to accommodate less effective technology.

Manufacturers expressed concern about the effectiveness of surface treatments with the materials they use in their plastic fuel tanks. However, we believe that the fuel tank manufacturers and surface treatment specialists will be able to work together to identify materials an processes that can be used to meet the standards. For instance, the UV inhibitor known as HALS can reduce the effectiveness of the sulfonation process. Two other UV inhibitors, known as carbon black and adsorber UV, are also used in similar fuel tank applications. These UV inhibitors cost about the same as HALS, but have the benefit of not interfering with the sulfonation process. A list of resins and additives that are compatible with the sulfonation process is included in the docket.[yy]

Manufacturers commented that emission control technology such as fluorination is substantially less effective with 10 percent ethanol fuel. However, as discussed in Chapter 4 of the Final Regulatory Support Document, data shows that there is no significant increase in permeation from sulfonated or fluorinated fuel tanks when alcohol blended fuel is used. This is not true for technologies relying on the barrier properties of nylon such as injection molded nylon tanks or nylon-based Selar®, which are two technologies recommended by commenters. In fact, the permeation rate of 10 percent ethanol fuel through nylon is more than ten times higher than the permeation rate of gasoline. Ethylene vinyl alcohol-based Selar® has much better permeation resistance to alcohol fuel blends.

One commenter stated that the chemicals used in fluorination and sulfonation are hazardous and another commented that these processes have not been demonstrated on a production line. A manufacturer concerned about their ability to safely conduct these

[yy] "Resin and Additives - SO3 Compatible," Email from Tom Schmoyer, Sulfo Technologies to Mike Samulski and Glenn Passavant, U.S. EPA, June 19, 2002,(Docket A-2000-01, document IV-A-40).

processes would have the option of sending their fuel tanks out to be treated by a vendor. Fluorination has been widely used for years to treat chemical storage and other bottles. At least one sulfonator is working with a process in which the sulfur trioxide is made just before injecting into the fuel tanks so that this material does not need to be stored in large quantities; in addition, the sulfur trioxide is neutralized after processing. In addition, the fuel tank material can be recycled because the barrier is only up to 20 microns thick and it prevents saturation of the plastic with fuel.

Thermoplastic fuel lines for automotive applications are generally built to SAE J2260 specifications. Category 1 fuel lines under this specification have permeation rates of less than 25 g/m^2/day at 60°C on CM15 fuel. However, manufacturers have commented that this fuel line would not be flexible enough to use in recreational vehicle applications which require flexible rubber hose to fit tight radiuses and to resist vibration. In addition, using plastic fuel line rather than rubber hose would require the additional cost of changing hose fittings on the vehicles.

Manufacturers recommended using SAE J30 R9 fuel hose as a low permeation requirement which has a maximum permeation rate of 15 g/m^2/day on ASTM Fuel C. On a fuel containing an alcohol blend, permeation would likely be much higher from these fuel hoses. SAE J30 specifically notes that "exposure of this hose to gasoline or diesel fuel which contain high levels, greater than 5% by volume, of oxygenates, i.e., ethanol, methanol, or MTBE, may result in significantly higher permeation rates than realized with ASTM Fuel C." SAE J30 also designates R11 and R12 hose which are intended for use as low permeation fuel feed and return hose. R11 has thee designations known as A, B, and C. Of these, R11-A has the lowest permeation specification which is a maximum of 25 g/m^2/day at 40°C on CM15 fuel. Because permeation rates are generally higher on CM15 than CE10 and because they are 2-4 times higher at 40°C than at 23°C, hose designed for this specification would likely meet our permeation requirement. R12 hose has a permeation requirement of 100 g/m^2/day at 60°C on CM15 fuel. This is roughly equivalent in stringency as the R11-A permeation requirement. These hose specifications can be met without a significant change in the flexibility of the hose compared to R9 or even R7 fuel hose.

There are lower permeation fuel hoses available today that are manufactured for automotive applications. These hoses are generally used either as vapor hoses or as short sections of fuel line to provide flexibility and absorb vibration. Chapter 4 of the Final Regulatory Support Document presents data on several low permeation hose constructions that could be used to meet the recreational vehicle permeation standards. In look and flexibility, these hoses are not significantly different than the SAE J30 R7 hose generally used in recreational vehicle applications today. Low permeation hose, using THV [zz] as a barrier, is produced in mass quantities today for automotive applications and is readily available for use in recreational vehicles.

4. Legal Authority

What We Proposed:

As discussed in the NPRM, we made an affirmative determination on June 17, 1994 that nonroad emissions are significant contributors to ozone or CO in more than one nonattainment area and that these engines make a significant contribution to PM and smoke emissions that may reasonably be anticipated to endanger public health or welfare. Under section 213 of the 1990 Clean Air Act Amendments, we are required to set standards that require the greatest degree of emission reduction achievable using technology giving appropriate consideration to cost, lead time, noise, energy, and safety factors.

What Commenters Said:

MIC commented that permeation emissions are expected to primarily occur in urban areas and they therefore may contribute to violations of the National Ambient Air Quality Standard for ozone. Bluewater Network commented that recreational vehicle permeation, including snowmobiles, is a significant source of emissions and that reductions would have a beneficial impact on air quality, visibility, and public health. Environmental Defense also commented that permeation from tanks and hoses is a significant part of the total emissions from recreational vehicles. They commented that hydrocarbons are linked to respiratory health problems including lung cancer, are precursors to ozone formation, and include toxic air contaminants.

Our Response:

We agree that permeation emissions from recreational vehicles contribute to air pollution from nonroad vehicles. Permeation emissions from recreational vehicles, including snowmobiles, result in the release of hydrocarbons that contribute to ozone concentrations in non-attainment areas and are properly regulated under section 213 of the Clean Air Act.

B. Certification and Compliance Issues

1. Certification Responsibility

[zz] tetra-fluoro-ethylene, hexa-fluoro-propylene, and vinyledene fluoride (THV)

What We Proposed:

In our description of the regulatory concept, we stated that certification with the permeation requirements would need to be based on test data. We outlined a concept in which vehicle manufacturers or fuel tank manufacturers could certify and either could contract with a party providing barrier treatment or another source to do the required testing for the fuel tank permeation standards. Fuel hoses could be certified as being manufactured in compliance with certain SAE specifications. We took comment on allowing manufacturers to certify to permeation standards by submitting a statement that the fuel tanks and hoses used on their products meet standards, specified materials, or construction requirements based on testing results. For fuel tanks which could have several designs in one emissions family, certification would be based on the worst case fuel tank in the emission family.

What Commenters Said:

MIC commented that fuel tank manufacturers have the option of certifying to the permeation standards and that a company that applies a barrier treatment to a fuel tank have the option of being considered the manufacturer of the fuel tank. They also commented that they support the concept of allowing a recreational vehicle manufacturer to certify by submitting a statement that it has used tanks of a specific construction, material, or treatment process that has been demonstrated to EPA's satisfaction to meet the performance requirements. ISMA commented that the tank manufacturer should be responsible for "tank shortcomings" rather than the vehicle manufacturer. ISMA also requested clarification on the definition of an emissions family. Polaris commented that the recreational vehicle manufacturer should only need to specify a permeation limit and test standard to a vendor and retain the specifications on record. Polaris stated that the standards should be based on these design specifications rather than requiring vehicle manufacturers to perform certification and testing and to assume liability.

Our Response:

We are finalizing a certification process similar to our existing program for other mobile sources. Manufacturers test representative prototype designs and submit the emission data along with other information to EPA in an application for a Certificate of Conformity. As discussed in Section VI.B.2, we are allowing manufacturers to certify based on either design (for which there is data) or emissions testing. If we approve the application, then the manufacturer's Certificate of Conformity allows the manufacturer to produce and sell the vehicles described in the application.

The recreational vehicle manufacturer is responsible for certification to the permeation requirements. We could not give the option of fuel tank manufacturers, barrier treatment vendors, or hose manufactures to certify. However, recreational vehicle manufacturers would be able to use data generated by their suppliers. They would either submit this data in the record or show that the fuel tank or hose qualify for design-based certification. In practice, this should not result in an additional burden on recreational vehicle manufacturers who we would expect to require their vendors to meet specific requirements in building and selling their products and/or services. Vehicle manufacturers may also contractually obligate their vendors to be responsible for any liability resulting from a violation of these regulations caused by the vendor.

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

2. Design-Based Certification

What We Proposed:

As discussed above in Section VI.B.1, we described a concept where once a technology was demonstrated by testing, no further testing would be required in future certification applications for tanks and hoses using that technology. For instance, fuel hoses could be certified based on certain accepted SAE specifications. We also gave specific examples of technology that we believe would meet a the standards discussed in this notice; metal fuel tanks and SAE J2260 Category 1 fuel tubing would be able to certify by design.

What Commenters Said:

MIC commented that manufacturers should be able to certify plastic fuel tanks by design provided that they use emission control technology that has been demonstrated to EPA's satisfaction to meet the permeation standards. For instance, a fuel tank using a barrier treatment or alternative fuel tank material that meets parameters already shown to meet the permeation standard could be certified without further testing. Polaris commented that a hose should be able to certify by design if the hose has been tested and marked by the fuel hose manufacturer to meet SAE J30 R9 specifications. Briggs & Stratton expressed support of a design standard along with a procedure to certify any non-standard design. They commented that using hose meeting SAE specifications is a good approach for a design-based standard.

Our Response:

In general, test data would be required to certify fuel tanks and hoses to the permeation standards. Test data could be carried over from year to year for a given emission control design. For instance, if a certain level of sulfonation (i.e. measured SO_3 concentration on final product) is shown to meet the fuel standard for a fuel tank of a given material composition and wall thickness, this data could be used to certify similar fuel tank designs. There are some specific cases where we would allow certification based on design. These special cases are discussed below.

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

Fuel hoses can be certified by design as being manufactured in compliance with certain accepted SAE specifications. Specifically, a fuel hose meeting the SAE J30 R11-A or R12 requirements could be design-certified to the standard. In addition, fuel line meeting the SAE J2260[bbb] Category 1 requirements could be design-certified to the standard. Although these fuel hoses and fuel line specifications are based on 15 percent methanol fuel and higher temperatures, we believe that fuel hoses and lines meeting these requirements would also meet our hose permeation standards based on the material property data presented in Chapter 4 of the RSD. In the future, if new SAE specifications are developed which are consistent with our hose permeation standards, we would consider

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

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

including hoses meeting the new SAE requirements as being able to certify by design. We would not consider hoses meeting SAE J30 R9 as meeting the standard by design because hoses meeting this standard is tested on a ASTM Fuel C which does not contain alcohol. On the 10 percent ethanol fuel specified in our permeation test procedures, R9 hose could exceed the standard.

3. Averaging, Banking, and Trading

What We Proposed:

We requested comment on whether an emission credit averaging, banking, and trading (ABT) scheme would be helpful and necessary for the fuel tank permeation requirements. We stated that if we were to adopt ABT provisions, we would envision an ABT program similar to that used for heavy-duty engines.

What Commenters Said:

Bluewater Network commented that they do not support ABT because these programs do not generally reduce overall emissions. They commented that although manufacturers may produce vehicles that have less pollution on average, this does not mean that the less polluting machines are purchased and used by consumers.

Our Response:

Bluewater commented that ABT could allow higher polluting vehicles to be purchased and used by consumers. However, the ABT program is based on actual vehicle sales and not on projected production. A benefit of a corporate average approach is that it provides an incentive for developing new technology that can be used to achieve even larger emission reductions or perhaps to achieve the same reduction at lower costs.

Although we did not receive comments supporting this approach we are finalizing it as a voluntary provision for fuel tanks in order to encourage the use and of testing of permeation resistant technologies. To meet the standard on average, manufacturers would be able to divide their fuel tanks into different emission families and certify each of their emission families to a different Family Emissions Level (FEL). The emission families would include fuel tanks with similar characteristics, including wall thickness, material used (including additives such as pigments, plasticizers, and UV inhibitors), and the emission control strategy applied. The FELs would then be weighted by sales volume and fuel tank inside surface area to determine the average level across a manufacturer's total production.

4. Emission Labels

What We Proposed:

We proposed that recreational vehicle engines have a permanent label that includes the emission levels that the vehicle is certified to meet. We also proposed the use of hang tags for recreational vehicles at the point-of-sale for consumer benefit and education. For the evaporative emission discussion in the notice of reopening for comments, we did not discuss this issue further.

What Commenters Said:

Bluewater Network commented that we should require a permanent label on each fuel system component so that vehicle manufacturers will know that the products they use will meet the permeation standards. They also commented that vehicles should have permanent labels on the vehicles showing the permeation emissions from the certification to provide consumers with this information.

Our Response:

We are requiring that the vehicle label include the permeation emission levels to which the vehicles are certified. However, we do not believe that the fuel tank and hose manufacturers need to label their products for the vehicle manufacturers' education. The vehicle manufacturers will need to specify the permeation technology used in their application certification and can be expected to coordinate with their vendors.

5. Special Compliance Provisions for Small Manufacturers

What We Proposed:

We proposed several flexibility options for small manufacturers to help them comply with the exhaust emission standards. These flexibility options included a 2 year delay of the standards, design-based certification, broader engine families, waiving production line testing, use of assigned deterioration factors, carryover of certification data, ABT, and hardship provisions. For the evaporative emission discussion in the notice of reopening for comments, we did not discuss this issue further, though the sample regulatory provisions accompanying the notice indicated that it was our intent that these provisions carry over to evaporative controls as well.

What Commenters Said:

Fast Inc. commented that, as a small business of snowmobiles, they would have additional hardship due to this rule because they do not have the volume to install the barrier treatment in-house for fuel tanks. They also commented that shipping and processing of fuel tanks could tie up funds for 3-4 months and that it would be unworkable to tie up funds this long because they are a small business.

Our Response:

We believe that the permeation control requirements should be relatively easy for small businesses to meet, given the relatively low cost of the requirements and the availability of materials and treatment support by outside vendors. Low permeation fuel hoses are available from vendors today, and we would expect that surface treatment would be applied through an outside company. We believe that the treatment processes are well established and would be completed well under 3 months even including shipping time. However, to make sure that these requirements do not adversely affect small manufacturers, we are implementing, where they are applicable to permeation, the same flexibility options we proposed for the exhaust emission standards.

6. General Compliance Provisions

What We Proposed:

In the NPRM, we proposed a detailed set of general compliance provisions for recreational vehicles. In the May 1, 2002 notice that focused on permeation emissions we did not expand on the general provisions; however, we provided a set of possible regulations for meeting permeation requirements.

What Commenters Said:

ISMA commented that compliance requirements that would go with a permeation standard have not been addressed. They requested clarification on if production line testing, selective enforcement auditing, or administrator testing would be included in the requirements. They also asked what the provisions for selling replacement fuel tanks would be.

Our Response:

In general, our compliance program for the permeation standards is similar to that for the exhaust emission standards. Our sample regulations would have applied the same compliance requirements for both sets of standards. One exception in our final regulations is that production line testing is not required for the fuel hose and tank permeation standards. However, we reserve our right to perform selective enforcement auditing or EPA in-use permeation testing of fuel tanks and hoses. Uncertified replacement tanks would be allowed for uncertified recreational vehicles, but certified recreational vehicles would need certified fuel tanks.

C. Test Procedures

1. Test Fuel

What We Proposed:

Because permeation rates may be different for different test fuels, we requested comment on what test fuel would be the most appropriate for permeation testing. In the notice, we considered four possible test fuels: (1) Neat gasoline such as current EPA certification fuel, (2) certification quality gasoline with a 10 percent ethanol blend as is prescribed for the Tier 2 automotive evaporative emission standards, (3) ASTM D471 test fuel C (50% iso-octane, 50% toluene), and (4) ASTM D471 test fuel I (test fuel C with 15 percent methanol). We stated that Tier 2 type test fuel was of special interest because permeation is greater with alcohol-blend fuels and because there is a significant amount of ethanol and other alcohols used in gasohol and other summer and winter gasolines.

What Commenters Said:

Polaris commented that EPA should specify ASTM Fuel C for the fuel tank and hose permeation testing. They stated that fuel tank permeation would be much higher on a 10 percent ethanol blend for fluorinated tanks and that using Fuel C would be consistent with the specifications for SAE J30 R9 hose. MIC commented that testing on methanol-gasoline blends would have higher permeation rates than testing on ethanol-gasoline blends or gasoline. Bluewater Network commented that we should use the most permeable fuel blend on the market and specifically point to alcohol blended fuels, such as ethanol, being used today.

Our Response:

We are requiring that the fuel used for permeation testing be a blend of 90 percent gasoline and ten percent ethanol (E10). This fuel is consistent with the test fuel used for on-highway evaporative emission testing. We believe that it is appropriate to base the standards on this fuel because higher permeation is seen on alcohol blends, ethanol is commonly blended into fuels in-use, and alcohol fuels may be used more in the future in an effort to use alternative energy sources. For fuel tank permeation testing, the permeation weight loss test may be performed using gasoline; however, all of the durability testing and preconditioning must be performed using E10 fuel.

2. Fuel Tank Test Procedures

What We Proposed:

We presented sample regulatory text that included test procedures for measuring permeation emissions from recreational vehicle fuel tanks. These test procedures described testing for permeation at constant temperature 28 ± 2°C with the tank filled and sealed over a period of 10 to 30 days. The permeation loss would be measured by subtracting the weight of the sealed fuel tank after the test from the pre-test weight. Prior to testing, the fuel tank would need to be soaked at 30 ± 10°C for 60 days to ensure that the permeation rate has stabilized.

These test procedures also outlined four durability tests that would be required to ensure that the permeation emissions measured would be representative of in-use operation. These durability steps were based on a draft SAE procedure[ccc]. The durability tests included a slosh test, pressure cycling, temperature cycling, and a UV light exposure test.

What Commenters Said:

MIC commented that the soak period for the preconditioning step should be the same as the test temperature of 28 ± 2°C. They also commented that the testing should be able to be performed in a temperature controlled room or enclosure rather than just in an evaporative emission SHED. Honda commented that the testing should be performed at 40°C and that the soak period should be 6 weeks at 40°C. They commented that the alternative UV test procedures should be allowed and that fuel tanks not exposed to sunlight in-use (covered by outer panels) should be exempt from the UV testing. Honda also requested separation of the compliance demonstrations for the four durability items (slosh, pressure, temperature, and UV) so that the testing can be performed on a shorter time line.

We also received detailed comments from a permeation expert that was involved in the development of the draft SAE J1769 test procedures. He commented that the soak period should be at 40 ± 2°C for 10 weeks and that automotive testing is usually done at this temperature for 20 weeks. He commented that as barrier treatment improves, more time is necessary. He also commented that the references to a "SHED" should be changed

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

to “chamber” because a SHED includes evaporative emission measurement equipment and other characteristics that are expensive and unnecessary for this testing. He commented that it may not be possible to weigh fuel tanks greater than 20 gallons on explosion proof scales using current technology. For the permeation test, he commented that the testing should take place at 40°C for 14 to 28 days with weight measurements every 7 days to make sure that the permeation rate has stabilized. On the durability testing, he expressed support of the slosh testing, commented that the pressure testing should be from 0.5 to 2.0 psi, and that the temperature testing, as written appeared to call for very fast temperature cycling that may not be possible.

Our Response:

We are incorporating several of the above comments into the fuel tank permeation test procedures. We are modifying the soak period to be 20 weeks at a temperature of 28°C ± 5°C. Manufacturers will be able to petition for a lower soak period if they test at a higher temperature if they can demonstrate that the permeation rate will be stabilized. The permeation rate from fuel tanks is measured at a temperature of 28°C ± 2°C over a period of at least 2 weeks. A longer period would be required if necessary for an accurate measurement for fuel tanks with low permeation rates. As an option, permeation may be measured using alternative methods that will provide equivalent or better accuracy. Such methods include SHED testing as described in 40 CFR part 86.

The durability testing would be used to determine a deterioration rate to be applied to certification tests on new fuel tanks (the fuel soak would still be required). This durability testing would include slosh testing, pressure-vacuum cycling, and UV exposure. The purpose of these deterioration tests is to help ensure that the technology is durable and the measured emissions are representative of in-use permeation rates. For slosh testing, the fuel tank is filled to 40 percent capacity and rocked for 1 million cycles. The pressure-vacuum testing contains 1000 cycles from -0.5 to 2.0 psi. The slosh and pressure-vacuum durability tests are consistent with the comments and the draft recommended SAE practice. We have modified the UV exposure requirement to more specifically state the level of UV on the test tank (0.40 mW-hr/m^2 /min on the tank surface for 15 hours per day for 30 days). However, we will also accept the option of exposing the fuel tank to direct natural sunlight for an equivalent period of time. Upon manufacturer request, we will consider waiving UV testing for fuel tanks that are not exposed to direct sunlight on a case-by-case basis.

The draft recommended SAE practice also included temperature testing which includes two hot temperature ranges (460 cycles from 18 to 41°C and 100 cycles from 38 to 66°C) and two cold temperature ranges (50 cycles from -7 to -29°C and 20 cycles from -7 to -40°C). However, we are not including this temperature cycling in our final test procedures for two reasons. First, discussions with industry experts show that this testing is more intended for materials testing rather than permeation barrier testing. The pressure-vacuum testing is more appropriate for permeation barrier testing and is sufficient for our purposes. Second, the temperature cycling as proposed is time consuming and would require expensive test equipment to perform.

3. Hose Test Procedures

What We Proposed:

We presented sample regulatory text that included test procedures for measuring permeation emissions from recreational vehicle fuel hoses. We referenced the permeation test procedures in SAE J1527 and stated that the test procedures used in SAE J1737 could be used provided that the testing was performed at a temperature of 23 ± 2°C.

What Commenters Said:

MIC commented that the test procedures specified in SAE J30 should also be allowed. Polaris commented that neither the test procedures in SAE J2260 or SAE J1527 apply to recreational vehicle hose. They stated that SAE J2260 is intended for high pressure applications and has requirements not necessary for recreational fuel hoses. They also stated that SAE J1527 is intended for marine hoses and includes abrasion resistance requirements that are not necessary for recreational vehicle fuel hoses. They commented that the SAE J30 test procedures used for R7 and R9 hose should be used.

Our Response:

The permeation rate from fuel hoses will be measured at a temperature of 23 ± 2°C over a period of at least 2 weeks. A longer period may be necessary for an accurate measurement for hoses with low permeation rates. We reference the test methods specified in SAE method J 30[ddd] for measuring permeation. We will only reference the measurement procedures and would not require the hose to meet all of the requirements of these SAE practices. In addition the test temperature and fuel would be that specified above. The hose must be preconditioned with a fuel soak to ensure that the permeation rate has stabilized. Alternatively, for purposes of submission of data at certification, permeation could be measured using alternative equipment and procedures that provide equivalent results. To use these alternative methods, manufacturers would have to apply to us and demonstrate equivalence. Examples of alternative approaches that we anticipate

[ddd] SAE Recommended Practice J30, "Test Procedure to Determine the Hydrocarbon Losses from Fuel Tubes, Hoses, Fittings, and Fuel Line Assemblies by Recirculation,"1997, (Docket A-2000-01, document IV-A-92).

manufacturers may use are the recirculation technique described in SAE J1737,[eee] SHED type testing such as in 40 CFR Part 86, or weight loss testing such as described in SAE J1527.[fff]

D. Regulatory Impacts

1. Economic Impacts

What We Proposed:

In the May 1, 2002 notice, we presented our estimates costs and fuel savings associated with the potential fuel tank and hose permeation standards presented in that notice. For fuel tanks, the economic impact analysis included the cost of fluorination and shipping and handling costs to the fluorination facility. For hoses, we estimated an increase of $1.00 per foot. We also included certification and compliance costs. In this analysis, the discounted fuel savings were shown to be larger than the cost of the technology.

What Commenters Said:

MIC commented that the cost of the permeation control is significantly higher than EPA estimated, especially for fuel lines. ISMA commented that the EPA analysis did not include engineering, testing, and administrative costs, and the costs of packing and unpacking fuel tanks for shipping. Polaris commented that EPA underestimated the cost of barrier technologies and that the use of rigid fuel lines would require changes to fittings on the vehicles. Briggs & Stratton commented that the cost of fluorination can be twice as high as the $0.50 estimated by EPA. They also commented that the cost of hose to meet the standard would be $1.50 per foot rather than the $1.00 per foot estimated by EPA, and they commented that additional costs would need to be added for fuel line connections and additional assembly time. Honda commented that the use of low permeation hose would result in the addition of clamps or special connectors which would require a revision in the assembly process. Fast Inc. commented that prices for fluorination were in the area discussed by EPA, but without shipping and handling costs. They said that they are a small business that would not be able to set up an in-house processing facility.

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

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

Bluewater Network commented that the technologies for reducing permeation from recreational vehicles are available today and are cost-effective. They cite ARB data showing that it will cost about $2 for every pound of smog forming compounds reduced which is very cost-effective compared to other ARB programs which are typically $5 per pound. Environmental Defense commented that millions of gallons of gasoline are wasted every year due to evaporative emissions and that permeation emissions can be significantly reduced with highly cost-effective pollutant abatement measures.

Our Response:

In Chapter 5 of the Final Regulatory Support Document we present costs for meeting the fuel tank permeation standards using three approaches: barrier platelets, sulfonation, and fluorination. We use the sulfonation costs for our final analysis and we add in shipping and handling costs for sending the fuel tanks to an outside vendor. For hoses, we base the cost on known costs for low permeation hose.[ggg,hhh] We mark up these variable costs using a rate of 29 percent to account for the vehicle manufacturers' overhead and profit. Finally, engineering, testing, and administrative costs associated with certification and compliance are included.

Manufacturers have commented that they have been quoted higher costs for fluorination than we have seen. However, our fluorination costs in the May 1, 2002 notice were taken from price sheet provided by a fluorination vendor.[iii] Costs would be higher if a manufacturer chose to treat an entire vehicle sub-assembly which included the tank rather than just the plastic tank. In any case, we are basing our final fuel tank costs on prices quoted for sulfonation.[jjj] Because our cost estimates include shipping and handling, they would be lower for a recreational vehicle manufacturer that set up an in-house treatment facility. While sulfonation costs are lower, they are not significantly less on a cents/gallon basis than fluorination.

[ggg] Trident Marine Hose, "Retail Price List 2001," Docket A-2000-01, Document No. IV-A-15.

[hhh] Denbow, R., Browning, L., Coleman, D., "Report Submitted for WA 2-9, Evaluation of the Costs and Capabilities of Vehicle Evaporative Emission Control Technologies," ICF, ARCADIS Geraghty & Miller, March 22, 1999, Docket A-2000-01, Document No. IV-B-05.

[iii] "Information on Costs and Effectiveness of Fluorination Received from Fluoroseal," Memorandum from Mike Samulski to Docket A-2000-1, March 27, 2002, Docket A-2000-01, Document IV-B-03.

[jjj] "Visit to Sulfo Technologies LLC on April 18, 2002," Memorandum from Mike Samulski, U.S. EPA to Docket A-2000-01, April 22, 2002, Document IV-B-07.

Manufacturers also commented that fuel line costs would be higher than projected by EPA and that costs for new fuel line connections and additional assembly time would need to be included. However, it appears that these costs are based on using plastic automotive fuel tubing. We believe that our hose permeation standard can be met using rubber hose with a barrier layer. This hose in not significantly less flexible than non-barrier hose used on recreational vehicles today. It is in fact common practice to use clamps on fuel lines so there would be no incremental cost unless the clamps were upgraded.

2. Emissions Impacts

What We Proposed:

We believe that permeation emissions from recreational vehicles are significant contributors to air pollution. In the May 1, 2002 notice, we present our analysis of the estimated emission reductions possible from regulating permeation from fuel tanks and hoses. For fuel tanks, we looked at a 95 percent reduction from a baseline of about 0.85 g/gal/day (about 10 g/m^2/day) at 30°C. For fuel hoses, we looked at reducing permeation from a baseline of 550 g/m^2/day to 5 g/m^2/day at 23°C. Because the rate of permeation is a function of temperature, we modeled the emissions inventory using a distribution of temperature, throughout the year, for six different regions of the nation.

What Commenters Said:

MIC commented that they believe that combined fuel tank and hose permeation emissions are only on the order of 2 pounds per vehicle per year which is about 70 percent less than EPA estimates. MIC estimates that the baseline fuel tank permeation rate is 12 g/m^2/day and that a 3.0 g/m^2/day standard would achieve a 75 percent reduction in permeation. MIC commented that EPA's estimate of fuel tank permeation is very close to their independent analysis. However, they commented that their estimate of hose permeation is about 90 percent less than EPA's estimate. In calculating the percent reduction possible for using R9 fuel hose which has a permeation rate of 15 g/m^2/day, MIC stated that the baseline hose emissions are 550 g/m^2/day. MIC pointed out an error in the May 1, 2002 notice in which the EPA stated that the hose permeation rate would be about 5 g/m^2/day per foot of fuel hose. They detail a calculation of a 1/4 inch I.D. hose at 550 g/m^2/day and show a rate of 3.4 g/m^2/day per foot of fuel hose. MIC also commented that fuel hose would not permeate all of the time because if the user closes the petcock between the fuel tank and fuel hose, then the hose would only permeate until it was empty of fuel, which they estimated would be 35 days per year.

Polaris commented that it would take extensive engineering, tooling, and cost to apply rigid automotive fuel tubing to their recreational vehicles. Briggs & Stratton commented that their hose only permeates at 380 $g/m^2/day$ which suggests that EPA overestimates hose permeation reductions. Honda commented that the hose they use today is less than 20 percent of EPA's estimate of baseline hose permeation.

Bluewater Network cites ARB analysis which states that the 9.8 million untreated portable fuel containers (gas tanks with a nominal fuel capacity of 10 gallons or less) is 87 tons per day which is the equivalent to the tailpipe emissions from about 1 million cars. They commented that reductions in permeation emissions can have a beneficial impact on air quality, visibility, and public health.

Our Response:

Commenters generally seemed to agree with our estimates of the baseline permeation rates for fuel tanks in $g/m^2/day$. Based on further data collected (presented in Chapter 4 of the Final RSD), we have increased our estimate of the baseline emission rate in g/gal/day from 0.85 to 1.12; however, this does not affect our estimate of the baseline in terms of $g/m^2/day$. One commenter used the same baseline hose permeation rate in their analysis as we did; however, two commenters stated that their measured hose permeation rates are lower than the rate we used in our calculations. In Chapter 6 of the Final Regulatory Support Document, we describe our final emission inventory analysis. In this analysis we continue to use the baseline hose permeation rate of 550 $g/m^2/day$. This is the maximum permeation rate specified by SAE J30 for R7 hose which is typical of hose used on recreational vehicles. Although some commenters claim that their hose has a lower permeation rate than this, hose could be used that is as high as 550 $g/m^2/day$ and still meet industry standards. In addition, these hose permeation rates do not consider the blending of alcohol into in-use fuels. Data in Chapter 4 of the Final Regulatory Support Document shows that, even for baseline hose constructions, permeation rates can be twice as high when tested on a 10 percent ethanol blend than on gasoline without any alcohol in it. One commenter stated that the annual hose permeation is lower because users close the petcock between the fuel tank and hose when the vehicle is not in use. However, this analysis is based on the assumption that petcocks are always closed when the vehicles are not in use which is a function of user behavior. Manufacturers have not provided evidence that this is the case and considering it in the analysis is problematic.

We did find a mathematical error in our calculation of the total inside hose surface area for recreational vehicles used for the May 1, 2002 notice. This error has been corrected, and this correction results in significantly lower estimates of permeation from hoses. However, the new calculations still show that the hose permeation standards are cost-effective and that the fuel savings outweigh the cost. Even if we were to assume, for the sake of a sensitivity analysis, that the reductions in hose permeation were 90 percent lower than we estimate, as suggested by MIC, the permeation standards would still be cost-effective (100-400 $/ton with discounted fuel savings).

E. Other Comments

1. Rulemaking Process

What We Proposed:

The NPRM for this rule proposed only exhaust emission controls for recreational vehicles. However, several commenters raised the issue of control of evaporative emissions related to permeation from fuel tanks and fuel hoses and indicated that our obligations under section 213 of the Clean Air Act included control of permeation emissions. The commenters stated that work done by the California Air Resources Board (ARB) on permeation emissions from plastic fuel tanks and rubber fuel line hoses for various types of nonroad equipment as well as portable plastic fuel containers raised a new emissions concern. Our own investigation into the hydrocarbon emissions related to permeation of fuel tanks and fuel hoses from recreational land-based and marine applications supports the concerns raised by the commenters. Therefore, on May 1, 2002, we published a notice in the Federal Register reopening the comment period and requesting comment on possible approaches to regulating permeation emissions from recreational vehicles. The notice provided a detailed analysis of possible approaches to regulating permeation emissions and the expected costs and emission reductions from these approaches. The notice also cited sample regulation language that could be used if we decided to finalize such requirements. Commenters had thirty days from May 1, 2002 to provide comments on the notice.

What Commenters Said:

MIC commented that, although the May 1, 2002 notice was published as an extension of comment period for the October 5, 2001 NPRM, that it is actually a new regulatory program. They do not believe that the process used in this instance complies with the rulemaking requirements of the Clean Air Act and specifically CAA section 307(d) and 42 USC 7607(d). They commented that, because permeation is an entirely new issue, we must issue an entirely new NPRM. Also, they commented that they did not have the opportunity to make an oral presentation of their data, views, or arguments as provided under CAA section 307(d)(5)(ii). Finally, the stated that they reserve the right to challenge the permeation standard based on the problems with the process.

Several manufacturers commented that the time frame allowed for the preparation of comments was very limited. They commented that they did not have enough time to fully evaluate or submit full explanation of the issues raised by the May 1, 2002 notice. Polaris also stated that the May 1, 2002 notice is informal and best fits the criteria of an ANPRM.

Our Response:

As a result of our investigations and the comments received, we have determined that it is appropriate to promulgate standards regulating permeation emissions from these vehicles.

Regarding the comments from MIC, EPA believes that it was appropriate to publish the May 1, 2002 as a reopening of the comment period. EPA was advancing a suggestion advocated by commenters as a result of the initial proposal, not setting up a new rulemaking. The issue of whether to promulgate permeation standards for recreational vehicles under section 213, while not addressed in the proposal, was directly related to and arose as a result of the issues raised in the proposal. In particular, many commenters questioned whether our proposed regulations met our burden under section 213 to promulgate standards regulating ozone-causing emissions from recreational vehicles if they did not include regulation of emissions caused by permeation.

Rather than an "all new regulatory program," these standards represent a minor extension of the program already proposed. The regulated parties and most the elements for regulatory program had already been proposed in the context of the exhaust emission standards. The increased costs and emission reductions that would result from any permeation regulations were discussed in the notice, and additional regulatory language that would apply was also cited.

We do not believe that every time EPA believes that it should request comment on an idea suggested by commenters that it must undergo the entire set of regulatory requirements under section 307(d) for rulemaking proposals. Certainly no case law is presented by MIC that would require such a result. Much of the case law in this area suggests that EPA may finalize an approach that was not in an initial proposal so long as it has provided adequate notice following proposal. The May 1, 2002 notice certainly provides adequate notice that we were examining the possibility of promulgating standards regulating permeation. In fact, the notice contains a fairly detailed description of the possible approaches we might take if we decided to take final action on the suggestion to add standards regulating permeation emissions.

Moreover, though MIC notes that we did not have a public hearing on this notice, MIC does not suggest how its interests were at all harmed by this. A public hearing could have been held prior to thirty days after publication (fifteen days following publication in the Federal Register is presumptive adequate notice under the Federal Register Act, and shorter periods could, arguably, also be adequate). Yet MIC had thirty days to present their comments in writing to the Agency. In addition, we met with MIC two weeks after the comment period closed. MIC does not state how they were at all prejudiced by their inability to make these comments in a public hearing.

Moreover, MIC notes the larger amount of time provided for comment on the initial proposal. Yet that proposal, unlike the notice, proposed an entire new regulatory program for several different types of engines, including regulation of several different types of pollution from several different types of engines. The notice was by comparison much more limited in scope and effect. Though EPA regrets not being able to provide more time for public comment on the notice, and EPA recognizes the comments of others that the time provided was limited, EPA was constrained by the court-ordered deadline to sign a final rule by September 13, 2002 and EPA believes that the thirty days provided gave commenters enough time to provide well reasoned comments that have, in fact, led to changes in our final rule from what was suggested in the May 1 notice. Moreover, EPA has met with many of the commenters since May 31 where any new comments on this issue could have been raised, and commenters could also have requested to provide comments out of time if there were issues that they were unable to raise within the time frame provided.

Regarding the comments that the May 1 notice was less formal than a NPRM, EPA believes that the notice and accompanying documents provided substantial information upon which to comment and gave a clear indication of the structure and costs of potential permeation standards.

2. Regulatory Flexibility Analysis

What We Proposed:

The NPRM for this rule discussed several flexibility options for small businesses manufacturing recreational vehicles. When we reopened the comment period on May 1, 2002 to request comment on possible approaches to regulating permeation emissions from recreational vehicles, we did not specifically discuss small business issues.

What Commenters Said:

We received written comment from the Small Business Administration (SBA) stating that, in the May 1, 2002, notice, we failed to include an initial regulatory flexibility analysis (RFA). They commented that we were required by the Administrative Procedure Act (5 U.S.C. § 553) to provide either an initial RFA or a certification of "no significant economic impact on a substantial number of small entities" with supporting information (5 U.S.C. §§ 603, 605). They stated that the IRFA for the NPRM addresses exhaust emissions while the May 1,2002 notice focuses on permeation emissions and argue that small entities have been denied the right to comment on the new requirements. SBA recommends that we should take additional steps prior to publishing a final rule that will give small entities opportunity for notice and comment. At a minimum, the commented that we should prepare a final RFA that estimates the combined effects of exhaust and permeation requirements on small businesses and considers less-burdensome alternatives and publish this final RFA with the final rule for public comment.

Our Response:

EPA disagrees with SBA's contention that EPA may have failed to comply with the RFA. First, as SBA notes, the requirement to provide an IRFA applies only when the agency is required (in this case, under the Clean Air Act, not the APA) "to publish a general notice of proposed rulemaking." The notice did not propose any standards, but merely asked for comments on the suggestions of the commenters. EPA was not required to publish such a general notice of proposed rulemaking in order to receive comment on the suggestion by commenters to promulgate permeation standards. As noted in the response above, no notice of proposed rulemaking, much less a "general notice if proposed rulemaking," as opposed to supplemental notice, was required in this situation. SBA cites no law supporting its contention.

Even if EPA had proposed the standards, they represented a minor extension of the previous proposal and would fit into the preexisting proposed regulations governing recreational vehicles. This is made clear by the fact that the sample regulations referenced in the notice (and in fact the final regulations for permeation) add only a few new regulatory sections to the preexisting proposed regulations, and that the costs discussed in the notice were very small compared to the cost of the proposed program. Far from being a "general notice of proposed rulemaking," it would have been a minor supplemental proposal. As noted in the previous response, the Clean Air Act does not require EPA to engage in the entire set of regulatory requirements every time it requests comment on suggested revisions to its proposal. Thus, section 603(a) of the RFA was not implicated by the notice.

SBA's suggestion that an IRFA or certification of "no significant economic impact on a substantial number of small entities" ("no SISNOSE") be done separately for permeation standards would have made little sense in this context (even if EPA had proposed them), because EPA was not proposing to promulgate these regulations separately from the preexisting proposal, but instead was requesting comment regarding whether to promulgate the standards at the same time it promulgated the rest of the rule. Thus, a certification of "no SISNOSE" makes no sense unless the certification could be made for the entire regulation.

Regarding whether EPA described the impact on, and flexibility for, small entities in the notice, EPA did not note the affect of the possible regulations on small entities specifically, but EPA did provide a detailed analysis of the possible costs of such regulations on all regulated entities, of which small entities are a part. Moreover, EPA's sample regulations, when read together with the previously proposed regulations, clearly would have extended the same general flexibilities for small entities to permeation requirements as were proposed for exhaust requirements. Thus, in effect EPA incorporated the work of the SBREFA panel into its sample scheme for regulating permeation emissions from recreational vehicles and the rule we are promulgating reflects the same flexibilities for exhaust and permeation requirements.

Regarding the claim that affected entities, were "arguably denied the right to comment under the APA," the purpose of the May 1 notice was in fact to solicit comment on this issue and to present a detailed framework upon which the comments could be based. EPA in fact received comments from several affected entities, including at least one small entity, and the comments have been addressed in the final document, including several changes made at the behest of the commenters.

Finally, EPA agrees that the final analysis of regulatory impact on small entities must look at the cumulative effect of the rule (including permeation requirements) on small entities. EPA has done this in our final small business analysis and in our certification that the rule had "no significant economic impact on a substantial number of small entities."

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

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

3. 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. See also the air quality update, 1998-2000 Ozone and 1999-2000 Carbon Monoxide, available at www.epa.gov/oar/aqtrnd00. A copy of this document is also available at Docket A-2000-01, Document No. IV-A-141.

4. Alaska Air Quality Program. Environmental Services Division. Anchorage CO Emissions Inventory and Year 2000 Attainment Projections. Draft report. May 2001. Docket Number A-2000-01, Document II-A-40.

5. Written comments from J.S. Grumet, Executive Director, Northeast States for Coordinated Use Management (NESCAUM), Docket A-2000-01, Document IV-D-196.

6. Doss, Howard. Snowmobile Safety. Michigan Agricultural Safety Health Center. A copy of this document can be found in Docket A-2000-01, Document IV-A-148 (an attachment).

7.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.

8.Julia Rege, Environmental Scientist, EPA. Memorandum to Docket A-2000-0. Predicted visibility effects from snowmobile exhaust (particulate matter) on or near snowmobile trails in Yellowstone National Park. July, 12, 2002. Docket A-2000-01, Document IV-A-147.