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

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1. Health, Welfare and Air Quality

Summary of the Issue

The emission standards being promulgated in the final rule are intended to be a major step in reducing the human health and environmental impacts of ground-level ozone and particulate matter (PM). In the Notice of Proposed Rulemaking (NPRM), the Environmental Protection Agency (EPA) described the need for reductions in emissions of PM and ozone-forming pollutants, and also discussed the contribution of nonroad engines to these emissions.

Comments

State organizations agreed with EPA's assessment of air quality and emission inventory trends and the need for oxides of nitrogen (NOx) and PM reductions. The State and Territorial Air Pollution Program Administrators / Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) described EPA's strategy as "appropriate" and the Ozone Transport Commission stated that the proposal would be a significant step toward meeting air quality goals in the Ozone Transport Region. STAPPA/ALAPCO commented that diesel particles are classified by EPA as a probable human carcinogen and smoke is a source of nuisance complaints.

Environmental organizations stated that EPA should be going further in its attempts to regulate nonroad diesels. They stated that, in the United States, nonroad diesel engines contribute at least 13 percent of all NOx emissions and 20 percent of all PM emissions, and that in the Northeast, nonroad sources will exceed 72 percent of total annual NOx and 60 percent of total annual PM by 2010. They also stated that the new National Ambient Air Quality Standards (NAAQS) for ozone and PM highlight the need for continued reductions from major sources including nonroad diesels, and that diesel exhaust is also a significant source of airborne toxic emissions, noting that EPA has proposed to identify diesel exhaust as a "probable human carcinogen".

Engine manufacturers expressed their belief that EPA's emissions estimates were too high due to overly optimistic sales growth estimates in the farming and construction industries. They also stated that, to the extent that EPA's assumptions are found in the future to be unsupported by the relevant data, the Agency must consider the impact of those results on the stringency of the final standards. Finally, they expressed the view that links between expected human exposures to diesel exhaust and cancer are not conclusive.

Analysis

The NOx and PM emission estimates presented by the environmental organizations, like the estimates presented by EPA in the NPRM, show a very large contribution by nonroad diesel engines to total emissions. The emissions modeling community has been able to continually improve the state-of-the-art for modeling of emissions of NOx and PM. The estimates presented

in the NPRM as well as the improved estimates presented in this final rule strongly support the importance of achieving large emission reductions from nonroad diesel engines. Even if EPA were underestimating the emission contribution of these engines, EPA still believes its proposed program is consistent with the mandate of the Clean Air Act section 213(a)(3) which requires EPA to establish emission standards to achieve the "greatest degree of emission reduction achievable" given the criteria set forth in the Act. While further emission reductions may be necessary to attain NAAQS in certain areas, EPA does not believe that further reductions from nonroad compression-ignition (CI) engines, beyond those being promulgated in the final rule for these classes of engines and equipment, are currently feasible.

Finally, regarding the questions of diesel exhaust and cancer, EPA is aware of and is, in fact, playing a leadership role in advancing the understanding of this health concern. However, EPA is not relying on potential cancer-reduction benefits to justify this rule. A fuller discussion of the health and environmental effects of ozone, PM, and smoke are discussed in Chapter 5 of the Final Regulatory Impact Analysis (RIA).

2. Standards

a. Form and Level of the Emission Standards

Summary of the Issue

The Agency proposed emission standards that it believed to be consistent with the Clean Air Act requirement that such standards represent the "greatest degree of emission reduction achievable" given the criteria specified in section 213(a)(3) of the Act. This section discusses comments regarding the stringency and form of the proposed emissions standards. EPA's discussion of comments on the technological feasibility of the proposed standards (Section 6) is also relevant to this discussion. Comments on the level of the smoke standards are discussed in Section 8.d.

Comments

Most commenters supported the proposed standards levels. State and local governments generally supported EPA's efforts to adopt new stringent standards. Engine manufacturers expressed support provided that other provisions, outlined in their detailed written comments, are adopted as well. Environmental groups expressed the view that the proposed standards are not stringent enough to meet EPA's new NAAQS, and argued that lower standards are necessary, technologically viable, and cost-effective, although without providing any supporting rationale. The Manufacturers of Emission Controls Association (MECA) stated that additional emission reductions are possible through the use of oxidation catalysts, particulate filters and selective catalytic reduction.

Commenters for the most part supported EPA's efforts to harmonize its emissions standards with those in Europe and California. Industry commenters stressed the importance of adopting harmonized standards. The European Commission requested that Tier 2 standards for three of the power bands be further harmonized by combining them into one band, with one set of limit values and one implementation year.

Several groups commented on EPA's deferral of Tier 3 standards for engines less than 37 kW or over 560 kW, as well as EPA's deferral of Tier 3 PM standards for engines between 37 and 560 kW. In general, industry commenters agreed that these Tier 3 standards could not be promulgated at this time due to the uncertainty regarding the feasibility of more stringent standards and limitations in current testing methods for PM. Several of these commenters, however, urged EPA not to adopt more stringent Tier 3 PM standards in the future. On the other hand, government and environmental groups called for EPA to express its commitment in the Final Rule to establishing stringent Tier 3 PM and (for engines under 37 kW) NOx standards.

One commenter expressed support for the combined NOx and nonmethane hydrocarbon

(NMHC) standard as providing helpful flexibility for the manufacturers, a point also made by other manufacturers in development of the Supplemental Advance Notice of Proposed Rulemaking (ANPRM).

One commenter pointed out that the power category descriptions are slightly askew from current regulations which establish the largest power category as "greater than 560 kW" rather than the proposed "greater than or equal to 560 kW".

Finally, emission control manufacturers and state and local governments commented that EPA should set standards for in-use nonroad diesel fuels by extending the highway low-sulfur diesel fuel requirements to nonroad applications.

Analysis

Based on a review of the comments received, EPA believes that the proposed standards levels represent the greatest degree of emission reduction achievable considering feasibility, cost, safety, noise and energy factors. Although no convincing evidence was provided that standards levels below those proposed would better fulfill the requirements of the Act, the Agency does agree that continued progress in the development of diesel emission control technology may justify the adjustment of the Tier 3 (Tier 2 for engines under 37 kW) standards levels in the 2001 feasibility review rulemaking. EPA acknowledges those concerns raised by industry regarding the feasibility of more stringent future controls. Before adopting any new, more stringent emission standards, EPA will review feasibility, cost and the other criteria prescribed in Clean Air Act section 213(a)(3) to determine the greatest degree of emissions reductions achievable.

The minor differences between the levels of the standards being promulgated in this final rule and those being pursued in Europe do not compromise essential harmonization. These differences are too small to cause manufacturers to build multiple versions of engine and machine models sold to multiple markets.

The proposal's slight change in power category definitions around 560 kW was inadvertent. The final regulations define the affected categories as "greater than or equal to 130 kW but less than or equal to 560 kW" and "greater than 560 kW", to preserve consistency with current EPA regulations and with the European program.

Although the Agency discussed the future possibility of regulating nonroad diesel fuel in the Supplemental ANPRM, it did not propose any such regulations, and does not consider such regulations necessary at this time to make the proposed emission standards feasible. EPA may, of course, consider regulating nonroad diesel fuel in future actions.

b. Leadtime

Summary of the Issue

The proposed emission standards would be phased in according to a schedule beginning in 1999. Special flexibility provisions were proposed to allow equipment manufacturers additional time to incorporate new engine designs into their machines. Comments related to these flexibility provisions and the leadtime issues for equipment manufacturers are discussed in Section 4.

Comments

Most commenters raised no objections to the proposed leadtimes for achieving emissions reductions. Two commenters concerned with harmonization between the proposed standards and standards being considered in Europe suggested leadtime changes. To facilitate harmonization of standards and reduce trade barriers, Euromot and the European Commission (EC) requested that EPA change the Tier 1 implementation date for 19 to 37 kW engines from 1999 to 2001. The European Commission also urged EPA to combine the three power bands for 130 to 560 kW engines into a single power band with a Tier 2 implementation date of 2002.

Analysis

EPA believes that the proposed implementation dates are appropriate under the Clean Air Act. Despite some differences between the deadlines for the standards being promulgated in this final rule and those being considered in Europe, these differences do not compromise essential harmonization. Special provisions being adopted in this rule's Averaging, Banking, and Trading program provide manufacturers with flexibility to produce engines for both markets during the transition years without undue duplication of design. Furthermore, the fact that the EC program is still in a proposal stage makes it unadvisable for EPA to tie its implementation plan too strongly to that being considered for Europe.

c. Feasibility Review

Summary of the Issue

In the NPRM, EPA proposed to conduct a special review, to be concluded by 2001, to reassess the appropriateness of the Tier 2 standards for engines rated under 37 kW and the Tier 3 standards for engines rated between 37 and 560 kW. This review and any resulting changes to the program would involve a public notice and comment opportunity. Any Tier 3 PM standards and changes to test procedures would also be proposed in this notice.

Comments

Environmental groups commented that EPA should state in the final rule that the new ozone and PM2.5 NAAQS will weigh heavily in the 2001 review. STAPPA/ALAPCO commented that EPA should commit in the final rule to have the 2001 review include promulgation of Tier 3 PM standards, a PM-controlling transient test, and a thorough assessment of aftertreatment

technologies. The California Air Resources Board (ARB) stressed the importance of developing a transient test cycle for the Tier 3 program. The National Association of Home Builders (NAHB) encouraged EPA to expand the scope of the feasibility review to include economic impacts on diesel engine dealers and consumers. Engine manufacturers stressed the critical importance of the review, including the assessment of costs, leadtimes, emissions inventories, health effects data, and equipment redesign impacts. They also commented that the Agency must clarify in the final rule that EPA is committed to Tier 2 standards that allow for the continued existence of direct injection technology in the under 37 kW market. Engine manufacturers also doubted that a transient test cycle would be needed for effective control of PM, and expressed concern that such a test may be infeasible for very large engines.

Analysis

The 2001 feasibility review will re-evaluate portions of this rulemaking, primarily to consider technology improvements and their impact on engines and equipment. Other factors relevant to making an informed decision on the appropriateness of Tier 3 standards (Tier 2 standards for engines rated under 37 kW), such as any new health effects and inventory data, economic considerations, and the Agency's approach to applying new NAAQS to emission control programs, must be considered as well. Furthermore, the Agency's intent to adopt appropriate Tier 3 PM standards and test procedures, will clearly affect the review of the other Tier 3 standards being promulgated in this final rule. The Agency believes that more information is needed before the form of, and even the justification for, a transient test cycle for Tier 3 PM control can be established, but is now working to gather this information.

The Agency reiterates its commitment in the Statement of Principles to have the feasibility review include an assessment of the progress in meeting Tier 2 standards for engines under 37 kW that use direct injection technology, and its expectation that final Tier 2 standards will allow for the continued existence of that technology.

3. Durability

a. Useful Life

Summary of the Issue

Regulatory useful life was proposed to be based on typical time to first rebuild. For engines at or above 37 kW, this was defined in the large CI Tier 1 rule as 8,000 hours or 10 years, whichever occurs first, with an in-use testing liability period of 6,000 hours/7 years. For smaller engines, EPA proposed the useful lives and recall testing periods shown in Table 1. EPA also requested comment on the appropriateness of basing the useful life on the typical time until first rebuild.

Table 1: Proposed Useful Life and Recall Testing Periods

Power Rating	Rated Engine Speed	Useful Life		Recall Testing Period	
		hours	years	hours	years
< 19 kW	All	3000	5	2250	4
19-37 kW	Constant speed @≥3000 rpm	3000	5	2250	4
	All others	5000	7	3750	5

Comments

A number of commenters suggested that the proposed useful lives are too short. STAPPA/ALAPCO recommended a useful life of 14,000 hours, but did not provide data to support this. The California ARB recommended that useful lives be based on engine retirement, and suggested that this would typically be 14,000 hours for engines greater than 75 kW. Although supportive of the proposed useful life periods for engines below 19 kW, the ARB commented that all engines from 19 to 37 kW should have useful lives of 5,000 hours. American Augers commented that a useful life of 8,000 hours or 6 years, whichever occurs first, is appropriate for 37 kW engines. No commenters suggested raising the useful life of engines below 19 kW. Cummins and the Engine Manufacturers Association (EMA) supported the useful life requirement for engines at or above 37 kW. EMA argued that basing useful life on a period longer than the time to first rebuild would be inappropriate, because the point of rebuild is substantially determined by the technical capability of the engine to operate reliably. To make engine manufacturers liable for performance after that point makes them liable for the work of people over whom they have limited or no control.

Analysis

EPA is retaining the 8,000 hour useful life for engines above 37 kW. The report done by ICF for EPA shows this to be the average time to rebuild for these engines. Although aware of a general trend toward longer-lived diesel engines, EPA cannot at this time justify an increase in the useful life for these engines without data which demonstrates a time to first rebuild longer than 8,000 hours. The commenters who favored longer useful lives did not provide any additional data which supported their position.

Similarly, for engines between 19 and 37 kW, commenters did not provide information which supports raising the useful lives above those proposed. EPA's report demonstrates an average time to rebuild for these engines to be 5,000 hours for variable speed engines. Information provided by a manufacturer indicates a 3,000 hour useful life for constant speed engines in the 19 to 37 kW power range. Therefore, EPA is adopting the proposed useful lives.

EPA is aware that the structure of the industry, with the widespread practice of independent rebuilding, makes it very difficult to adopt an enforceable program that carries manufacturers' liability beyond the time to first rebuild. It is therefore not changing the basis for determining useful life at this time.

b. Warranty Period

Summary of the Issue

The existing minimum warranty period for emission related parts on nonroad diesel engines rated at or above 37 kW is 3,000 hours or 5 years of use, whichever occurs first. EPA proposed to apply this warranty period to engines ranging from 19 to 37 kW as well. For engines less than 19 kW, EPA proposed a warranty period of 1,500 hours/3 years.

Comments

Cummins and American Augers supported the warranty requirements for engines at or above 37 kW. EMA supported the proposed periods because they are consistent with current practice, but also stated that warranty periods should be shorter than useful lives. Euromot considered the proposed warranty period to be onerous and recommended a period of 1,500 hours/2 years for all engines less than or equal to 37 kW. Euromot commented that the warranty period for constant speed engines rated from 19 to 37 kW should be less than the full useful life of the engines. Euromot also commented that engine manufacturers should not be responsible for warranting engines that are not properly used or maintained, and suggested that the warranty only apply to exhaust emission related components. ARB and STAPPA/ALAPCO commented that the warranty period should be 80 percent of the useful life, consistent with the approach taken for on-road vehicles.

Analysis

EPA agrees with Euromot's comment concerning the warranty period for under 19 kW engines and for 19 to 37 kW constant speed engines rated at 3,000 rpm and above. Since these engine categories have the same useful lives, they should have the same warranties. The warranty period for these engines will be 2 years or 1,500 hours, whichever occurs first. EPA is not changing the warranty period for other categories, consistent with their useful lives. EPA does not agree with increasing the warranty periods to 80 percent of useful life. Only critical emission related components are covered in the on-road programs referred to by commenters. The nonroad diesel engine warranty periods, although shorter, covers all emission control components for longer periods than the equivalent warranty for other types of regulated engines. The warranty requirements for engines rated under 37 kW are listed in Table 2.

Table 2: Warranty Periods for Engines Under 37 kW.

Power Rating	Rated Engine Speed	Warranty Period	
		hours	years
< 19 kW	All	1500	2
19-37 kW	Constant speed, ≥ 3000 rpm	1500	2
	All others	3000	5

EPA's recognition of owner responsibilities for proper maintenance of emission controls is already reflected in the regulations and therefore manufacturer concerns about being held responsible for warranting engines that are not properly used or maintained are already addressed. Consistent with the goal of the emissions control program, EPA's warranty provisions require manufacturers to warranty those parts for which failure can cause the engine to be in noncompliance with the emissions standards. Limiting these provisions to a subset of these components would not serve the goal of the program.

c. Deterioration Factors

Summary of the Issue

EPA proposed to require deterioration factors (DFs) for regulated emissions for all engines covered by this rule. Similar to the program for on-highway engines, EPA did not propose a specific procedure but rather that manufacturers develop the DFs in accordance with good engineering practices. The DFs were proposed to be subject to EPA approval. As an added flexibility for nonroad engine manufacturers, EPA proposed that, where applicable, data from certified highway engines could be used to develop DFs for similar nonroad engines. EPA also proposed that, for engines using established technology, good engineering judgement could be used in lieu of testing to develop DFs. Under the terms of the proposal, EGR and aftertreatment would not be considered to be established technology. The proposal would also allow

manufacturers to petition the EPA to classify engines meeting the Tier 3 NMHC+NOx standard as using established technology.

Comments

Cummins and EMA commented that deterioration factors (DFs) should not be subject to EPA approval. Caterpillar expressed concern that because the DFs are subject to EPA approval, manufacturers could be in the position where they cannot develop approved DFs in time to certify, because of overly long reviews by compliance officers. Euromot stated that the establishment of DFs would be difficult in the time proposed, especially for engines below 37 kW. Euromot recommended the use of EPA-assigned DFs. The California ARB and STAPPA/ALAPCO supported the proposed DF requirements.

Caterpillar, Cummins and EMA commented that engineering analysis and carryover (model year-to-model year) or carry across (engine family-to-engine family) data be the primary methods for determining DFs. They also commented that exhaust gas recirculation (EGR) and aftertreatment should eventually be considered established technologies. Cummins and EMA commented that separate NOx, carbon monoxide (CO), NMHC, and NMHC + NOx DFs should not be required, and requested a straightforward, combined NMHC + NOx DF.

Analysis

EPA believes that the DF requirements proposed in the NPRM are an essential part of the emission control program, and are needed to ensure that engines meet the emission standards over their useful life. Although the manufacturers are in the best position for assessing their engine's deterioration to prove compliance with the standards or with the family emission limits (FELs) chosen in the averaging, banking, and trading (ABT) program, the Agency clearly has a role as well in reviewing the manufacturer's submittal for adequate substantiation of the DFs. Even a small DF can have a significant impact on the amount of credits generated or used under the ABT program. Given the importance of DFs, EPA is retaining the manufacturer-determined DF provision and the Agency's opportunity to disapprove any inadequately substantiated DFs.

Although retaining a requirement to provide DFs, EPA believes that it has provided a great deal of flexibility to allow manufacturers to avoid unnecessary testing. EPA expects that carryover or carry across data will be the primary method for determining DFs. EPA retains the opportunity to disapprove the use of the carryover or carry across if significant differences exist between the engine on which the data were generated and the engine to which the data are applied.

EPA agrees that there may be insufficient time for manufacturers of engines below 37 kW to verify DFs before the Tier 1 compliance dates. Service accumulation testing can be a time-consuming and complicated process, especially for manufacturers who have no prior experience with EPA programs because they only manufacture engines rated under 37 kW, which were not

previously regulated. Alternative means of determining DFs may not be useful because these smaller engines are currently not regulated by EPA, and so there may be little test data from which to establish DFs. Therefore EPA believes that the development of accurate DFs using these methods would not be possible in all cases for certification of engines in very limited time available before the 1999 model year, and that the time between the anticipated effective date of this rule and the compliance dates for the 2000 model year may also be too short to support DF development using these methods. As a result, the Agency is allowing manufacturers to determine DFs for these engines in model years 1999 and 2000 based on good engineering judgement and reasonably available information. All information used for this purpose would need to be made available to EPA, if requested. Any requests for carryover of these models into the 2001 model year would need to include the more thorough justification of DFs under the new requirements.

EPA agrees with Cummins and EMA that only one DF is needed for the NMHC + NOx standard, and is adopting a combined DF for NMHC + NOx. However, consistent with the approach taken in other EPA programs, notably the recently finalized program for heavy-duty highway diesel engines (October 21, 1997 62 FR 54695), decreasing emissions of one pollutant over time will not be allowed to offset increasing emissions of the other pollutant in this combined DF. In effect, if one of the pollutants measured in determining this combined DF exhibits a decrease in emissions over time, the DF must be adjusted to reflect an assumption of no change in the emissions of this pollutant. A combined NMHC + NOx DF is not appropriate for engines using aftertreatment devices, for which a multiplicative DF is required, because this would inappropriately skew the DF toward one pollutant unless weighting factors were applied. Therefore, for these engines, separate NOx and NMHC DFs will be required. Regarding the possibility that EGR and aftertreatment could eventually be considered established technology, EPA believes that its 2001 feasibility review will provide a better opportunity to assess this potential and update the regulations if appropriate.

d. Allowable Maintenance Intervals

Summary of the Issue

For the engines covered by the new standards, EPA proposed limits on the frequency of maintenance that can be required of the engine owners for emission-related items. These limits were also proposed to apply to maintenance performed by the engine manufacturer during engine certification and durability testing. The proposed allowable maintenance intervals are consistent with requirements for on-highway engines.

Comments

Case, Euromot, and Cummins commented that the manufacturers are responsible for meeting their customers needs and that EPA should leave establishment of maintenance intervals to the discretion of manufacturers. Cummins commented that if EPA set limits, they should be

only about 42% of the proposed limits. Cummins stated that the proposed intervals are based on on-highway intervals which are inappropriate for nonroad engine which operate under more severe conditions. EMA comments were similar to Cummins. However, EMA suggested that EPA should lower the maintenance intervals by a third for engines over 37 kW and by two thirds for engines less than 37 kW. Case commented that the proposed fuel injector maintenance interval is difficult to meet. Case stated that injector cleaning may be needed at 1,000 hours, with maintenance at 2,000 hours. Cummins stated that the proposed intervals are exceeded by current engines but that new technologies may require more frequent maintenance. Euromot commented that minimum maintenance of fuel injectors for engines less than 130 kW is unreasonable especially for high speed engines. American Augers, ARB, and the Ozone Transport Commission supported the proposed maintenance intervals.

Analysis

Of the components for which EPA proposed maintenance intervals, fuel injectors and turbochargers are the only ones commonly used on current engines regulated under the Tier 1 program. A review of owners' manuals from seven engine manufacturers for engines at or above 37 kW was performed to determine current maintenance practices for these components. Three of the seven manufacturers specify a maintenance frequency for fuel injectors. The other four manufacturers do not require injector maintenance. The minimum maintenance interval for injector cleaning is 2,400 hours. Two of seven manufacturers specify maintenance intervals for turbochargers. The shortest interval is 4,800 hours. Based on this review, EPA believes that proposed intervals would impose no undue burden for these engines.

However, the Agency is aware that engines not currently regulated and new engine designs to meet Tier 2 standards may have different needs. The Agency is particularly sensitive to manufacturers' concern for more frequent maintenance in severe operating environments. Because the Agency agrees that manufacturers have a business incentive to avoid specifying overly frequent maintenance in user manuals, EPA is finalizing the proposed maintenance interval requirements, but is applying them only to testing performed by manufacturers to demonstrate compliance, none of which is expected to occur in severe operating environments. Furthermore, the Agency agrees that some engines rated below 19 kW and some 19 to 37 kW constant speed engines rated at 3,000 rpm and above may not be able to meet the allowable maintenance interval requirements, and is therefore allowing shorter intervals to be used on a case-by-case basis, subject to EPA approval.

e. Critical Emission-Related Components

Summary of the Issue

EPA proposed a list of engine components that are considered critical emission-related components. For these critical emission-related components, EPA proposed that manufacturers must show that there is a reasonable likelihood that any scheduled maintenance on these

components will be performed in use. In the proposal, there are several options available to the manufacturer to satisfy EPA that in-use maintenance is likely. These proposed options included: 1) showing that performance would degrade without the maintenance; 2) providing survey data showing that the maintenance already occurs in use; 3) providing the engine with a visible signal system to alert the operator when maintenance is required; 4) collecting survey data to show that the visible signal system is not necessary; 5) providing maintenance free of charge; or 6) any other method approved by the Administrator.

Comments

Euromot expressed concerns with the proposed critical emission-related component maintenance requirements. First they stated that positive crankcase ventilation valves (PCVs) should not be considered critical since they have no effect on exhaust emissions and maintenance for these valves is not necessary during the useful lives of these engines. Second, Euromot commented that the options proposed to ensure that maintenance on critical emission-related components were not feasible for nonroad engine manufacturers because: 1) no formal record keeping on small engine maintenance exists for preparing a survey; 2) visible signal systems require electrical systems, which do not exist on some small construction engines; 3) the survey data option does not account for the great variety and low production of nonroad engines; and 4) it is not practical to offer free maintenance due to long travel distances from remote users to service centers.

Analysis

EPA does not believe that the proposed provisions are infeasible or overly burdensome. Components that do not require maintenance, as Euromot indicates to be the case for PCVs, are not affected by this provision. For other components, EPA believes that, although the full complement of options on the list may not be available for any particular engine family, there is substantial flexibility in the provision for manufacturers to meet it. For the options that involve survey data, EPA is aware that manufacturers can and do carry out surveys on their engines and a lack of a formal recordkeeping process should not be an impediment to this. Finally, it is unlikely that this requirement will affect the small engines of concern to Euromot because it is doubtful that the listed critical emission-related components, other than PCVs, will be needed on the small inexpensive engines, and PCVs are not likely to require maintenance according to Euromot. The requirement that manufacturers demonstrate a reasonable likelihood that scheduled maintenance of critical emission-related components will be performed does not apply if the manufacturer requires no maintenance for those components.

f. Rebuild Requirements

Summary of the Issue

EPA proposed to implement the same rebuilding requirements for nonroad diesel engines as

those that are now in place for 2004 and later model year heavy-duty highway engines. This proposal included requirements that the engine be rebuilt correctly to maintain equivalent emission levels as the certified configuration. In addition, EPA proposed modest record keeping requirements; EPA proposed that these records be held for 2 years but asked for comment on whether or not a longer time would be appropriate. EPA made no distinction in its rebuild requirements for marine engines.

Comments

The Automotive Engine Rebuilders Association (AERA) generally supported the proposed rebuild requirements stating that nonroad diesel engine rebuilding is sufficiently similar to on-highway diesel engine rebuilding. AERA stated that having the same requirements for on-highway and nonroad engines would avoid the uncertainty associated with having different sets of rules and would lessen the likelihood for unintentional noncompliance by rebuilders. However, AERA did express two concerns. First, they believe that the phase-in of the model years and engine designs that do not change across model years would make it difficult for rebuilders to identify which specifications apply to rebuilding the engine. AERA suggested that the engines subject to the new rule should be labeled or at least have an indicator included in the serial number. Second, AERA commented that the rebuilder does not necessarily know the hours of use on the engine at the time of rebuild and that the rebuilder should not be required to investigate this any further than asking the party providing them with the engine to tell them the hours of use for the purpose of the record keeping requirements. In addition, AERA commented that a 2-year retention of records is sufficient and is consistent with the on-highway provisions.

EMA commented that replacement engines should not have to be of the same or later model year, but consistent with the highway regulations, should only have to be replaced with an engine with equivalent or better emissions. They also commented that it would be unrealistic to require remanufacturers to build an engine to match the particular configuration of an engine that is brought in as a core. EMA stated that there would be no incentive to replace engines in equipment with previous emissions configurations; therefore, the proposed requirement that replacement engines must be of the same configuration as the original engine is not needed.

American Augers claimed that the proposed record keeping requirements for engine repairs would add unnecessary costs to small businesses without any real value. The California ARB commented that records should be kept for 5 years for engines at or above 37 kW and 3 years for all others. EMA supported the proposal not to require a particular format and the proposed 2-year retention of records. Case and Cummins commented that rebuild record keeping should not be done by engine manufacturers since rebuilds are generally beyond their control. Cummins and EMA stated that EPA should amend the proposal so that manufacturers would be allowed to build older model year engines for replacement in older equipment. STAPPA/ALAPCO supported the proposed rebuild requirements.

The International Association of Drilling Contractors (IADC) expressed several concerns

related to the application of the rebuild requirements to marine engines. First, they argued that the requirement that an engine be rebuilt to a configuration of the same or later model year as the original engine may not be realistic. They noted that if parts or components are produced specifically to allow new engines to meet the more stringent criteria, and these parts outwardly appear identical to parts from earlier engines and are interchangeable with those parts, then the parts will inevitably be interchanged. They added that when an old part is installed on a new engine, the anti-tampering provisions would be violated. They also expressed concern over whether or not the substitution of non-original equipment parts would be allowed to constitute "the same configuration."

Second, IADC argued that the requirement that a replacement engine be an engine of (or rebuilt to) a configuration of the same or later model year as the original engine would preclude the use of spare engines on a rotating basis between equipment. This was seen as unreasonable.

Third, IADC argued that the requirement that all emission-related components be checked and cleaned, repaired, or replaced where necessary, following manufacturer recommended practices, could be used by manufacturers to limit locations where repairs can be undertaken or preclude the use of parts other than "original equipment" replacement parts.

Finally, IADC pointed out that marine engines are not used solely in the United States, and it may be unduly burdensome (if not impossible due to custom requirements in some countries) to obtain replacement parts from the U.S. while a vessel is abroad.

Analysis

To address comments from AERA and EMA, EPA is changing the language originally proposed in 89.130(b) to be the same as for on-highway engines. The final language allows engines to be rebuilt to a certified configuration and requires that the model year(s) of the resulting engine configuration be identified. This allows for a rebuilder who is unable to identify the original certified configuration to rebuild the engine to any certified configuration. However, when an engine is being rebuilt and remains installed or is reinstalled in the same piece of equipment, there should be no uncertainty regarding the engine's configuration, and so it must be rebuilt to a configuration of the same or later model year as the original engine.

EPA also agrees with EMA that, when an engine is being replaced, the replacement engine must be an engine of (or rebuilt to) a certified configuration that is equivalent, from an emissions standpoint, to the engine being replaced. This allows for rebuilt engine configurations that, although of a different model year than the original engine, were designed for the same tier of emission standards. If the replacement engine is new, it must also meet the replacement engine requirements of 40 CFR §89.1003(b)(7).

EPA is retaining the record keeping requirements as proposed. These requirements are the same as the on-highway regulation. Only engine rebuilders need to keep rebuild records. When

purchasing a used engine, the buyer need not obtain the rebuild records. The purchaser of the used engine is responsible for buying a used engine which is documented by the rebuilder to be of the same, or later, model year as the engine it replaces. The number of engine hours recorded by the rebuilder should be based on the best available information, and so does not place an unreasonable demand on the rebuilder to determine this information when it is not readily available.

Regarding the concern that engine manufacturers could take advantage of EPA regulations to limit locations where repairs can be undertaken or preclude the use of parts other than "original equipment" replacement parts, EPA believes that there is sufficient clarity in the regulations to avoid this. The rebuilder of an engine is clearly responsible for ensuring the appropriate parts are used for the rebuild. The regulations allow for used or aftermarket parts. Parts installed, whether the parts are new, used, or rebuilt, are such that a person familiar with the design and function of diesel engines would reasonably believe that the parts perform the same function with respect to emission control as the original parts. Furthermore, EPA would not view any manufacturer recommended practices that specifically restrict the location of the work being performed as required practices under these provisions.

With regard to the effect of the replacement engine provisions limiting the ability of users to rotate engines among pieces of marine equipment, EPA believes that this concern is not so serious as to warrant dropping this requirement or adding special treatment for this equipment. First, as explained above, EPA has relaxed this provision to require only replacement with an engine that is equivalent, from an emissions standpoint, to the engine being replaced, rather than of the same or later model year. Second, EPA expects that the ability to rotate marine engines among vessels is generally limited by the design requirements of the marine vessels or associated equipment. These design requirements may make it impossible to rotate an older engine into a newer vessel because of installation and performance concerns. For example, engine mounting hardware or connections to the vessel's cooling system, or engine calibration and power characteristics, may limit the ability to put an uncontrolled replacement engine on a vessel designed to accommodate a Tier 1 or Tier 2 engine. Third, in those cases where such vessel/engine interfaces are not a problem, EPA believes it is not unreasonable to expect owners of fleets large enough to warrant the maintenance of a stock of spare engines to accommodate partial or full conversion of this stock to complying configurations. Finally, EPA believes that this requirement is important for preserving the emissions benefit of the program. Replacement of a complying engine with an engine that has inferior emissions performance will clearly result in higher in-use emissions, even if the complying engine may eventually be rotated back into service. Furthermore, the fleet owner has no obligation to rotate this engine back into service. A modified provision that requires this to occur would likely prove impractical.

Finally, EPA does not believe the rebuild provisions will be unduly burdensome for engines installed on U.S. vessels that operate internationally. The engines subject to this rule are small, and vessel owners often keep replacement parts on board for repairs. At worst, vessel operators may be required to make a temporary repair while abroad, and bring the engine back into compliance once appropriate parts can be obtained.

g. Marine Concerns - In-Use and Recall

Summary of the Issue

EPA made no distinction in its in-use and recall programs for marine engines. Marine engines would be subject to the same durability provisions as other nonroad engines.

Comments

One commenter expressed concern about imposing in-use and recall requirements on marine engines. This commenter noted that it is almost impossible to conduct a recall or in-use test on a marine engine. These engines are typically installed deep within a boat, eliminating the ability to remove the engine in one piece from the boat without first severely physically altering the boat. Also, it requires a considerable amount of money, time, and labor to remove an engine. According to this commenter, no owner would allow this to be done to his boat just to conduct an in-use emission test. Another commenter noted that many of the new marine engines subject to this rule will be subject to periodic survey under the standards adopted by the International Maritime Organization (IMO), therefore subjecting them to two in-use requirements. This commenter argued that this is another reason to distinguish marine engines in terms of whether they are installed on vessels operated domestically or internationally.

Analysis

EPA does not expect these requirements to be burdensome for the small, under 37 kW marine engines that are subject to this rule. Because of their size, they should be fairly easy to remove from a vessel for testing, if such a testing program becomes necessary. Also, owners of engines are not required to participate in any in-use program. With respect to the second comment, these engines are not subject to IMO inspections provisions, since the Annex VI NOx provisions cover only diesel marine engines above 130 kW. For both of these reasons, EPA believes that the recall and in-use provisions as proposed are appropriate for diesel marine engines less than 37 kW.

4. Equipment Manufacturer Flexibility Program

a. The Need For Flexibility

Summary of the Issue

In developing the proposal, EPA was made aware of difficulties in implementing the Tier 1 program experienced by equipment manufacturers (called original equipment manufacturers, or OEMs, in the proposal) whose products contain diesel engines. As a result, the Agency proposed several provisions to allow OEMs to install a limited number of noncomplying engines in their products during the first few years of the program.

Comments

OEMs provided more detailed information regarding the challenges they have faced when certified Tier 1 engine designs were made available to them with very little time left to perform the corresponding machine design and tooling changes. No commenters argued against providing some form of flexibility. One commenter felt that the Agency should adopt a program that reapplies the schedule of flexibility allowances with each new tier of standards.

Analysis

The information received from commenters reinforces the Agency's opinion that implementation flexibility for OEMs is needed. The program being finalized provides substantial flexibility for both the earlier and later tiers of standards, although it is acknowledged that an engine model that is substantially redesigned for Tier 2 and again for Tier 3 could strain an OEM's ability to cope with the changes. However, this possibility is a key concern of the 2001 feasibility review. Changes to flexibility provisions will be made as appropriate in light of the findings of that review.

b. Percent-of-Production Allowance Equity

Summary of the Issue

EPA proposed that a specified percentage of each OEM's U.S.-directed production volume be allowed to use noncomplying engines in the first several years after a Tier 2 standard is implemented in each power category at or above 37 kW. A somewhat more restrictive provision would apply for equipment using engines rated under 37 kW in the Tier 1 time frame, although an alternative proposal was made that this equipment receive the same flexibility allowances as equipment with larger engines.

Comments

Commenters supported the percent-of-production allowance concept but objected to the lesser allowance proposed for OEMs using engines under 37 kW. They expressed the view that the short implementation leadtimes for OEMs using these engines argued for flexibilities at least as great as those for OEMs using larger engines.

Analysis

The Agency agrees with the commenters' arguments that the flexibility provisions for OEMs using engines under 37 kW in their products should be broadened to match those provided to OEMs using larger engines. The standards for engines under 37 kW are not as stringent as those for larger engines, and therefore the impact of these standards on engine redesigns, and subsequently on equipment redesigns, are likely to be less severe for the smaller machines. However, the tight engine enclosures of many of these smaller machines will make whatever engine changes do occur more challenging. This, together with the short leadtime provided for any Tier 1 redesigns that might be needed, creates a need for flexibility that, in EPA's estimation, is roughly equivalent to the needs of manufacturers of larger machines.

c. One-Model Restriction for the Small Volume Allowance

Summary of the Issue

EPA proposed an allowance intended to help the many small OEMs who make a very small number of models. The proposal would allow OEMs to exempt up to 100 machines of any one model annually. EPA proposed, as an alternative, that the one-model restriction be dropped.

Comments

No commenters objected to this proposed provision for a small volume allowance. Several OEMs and engine manufacturers supported adoption of the allowance without a one-model restriction.

Analysis

EPA felt the small-volume allowance was necessary for small OEMs who, because of their limited product offering, gain little from exempting a set percentage of their production. Expansion of this provision to cover multiple models, however, would also benefit larger OEMs with more diverse product offerings, who, though fully able to use the percent-of-production allowance, would get more exemptions from the small volume allowance. EPA examined relevant sales data from the Power Systems Research (PSR) database and found that, if EPA were to both allow the aggregation of exemptions (discussed below) and drop the one-model restriction, almost all OEMs in each power category (85 to 98 percent) would be entitled to more exemptions from the small volume allowance than from the proposed percent-of-production

allowance.[1] These OEMs represent a substantial portion of the total sales (10 to 70 percent) in each power category. Many of them have a diverse product offering. The Agency believes that the net result of such greatly expanded flexibility defeats the purpose of the small volume exemption.

On the other hand, there appear to be many companies with very small annual sales volumes, often well under 100, for whom the one-model restriction would be problematic because their viability is enhanced by offering slightly different versions of a basic machine product, marketed as separate models. These OEMs are within the scope of EPA's target group for the small volume allowance. The Agency therefore is extending the allowance to cover any of an OEM's models in each power category using engines in a single engine family. Although there may be some small volume manufacturers with limited product offerings that do span multiple engine families, the Agency feels that there would be a much lower likelihood that more than one of these engine families would be beset with late delivery or redesign challenges. Furthermore, other provisions of this program are available to help such OEMs. This resolution also resolves the Agency's concern about how to define a "model" because the engine family designation is well-established and readily available from the engine supplier.

Because this program allows exempted equipment in the power categories below 37 kW to use uncertified engines (which do not have engine family designations), the small volume allowance for each of these power categories will be applied to any of an OEM's models using engines made by a single engine manufacturer.

d. Aggregating Exemptions Over Time

Summary of the Issue

The NPRM contained an alternative proposal which would enable OEMs to aggregate their annual percent-of-production allowances and use the aggregated exemptions in any year of the transition program. A similar proposed alternative would also enable aggregation of the small volume allowances.

Comments

OEMs strongly supported the concept of aggregation, stating that it would allow them to pursue implementation of the new standards in the most cost effective fashion. Deere further commented that time limits on the use of exemptions are unnecessary.

Analysis

[1]EPA Memorandum from Don Kopinski to Docket A-96-40, "Potential Use of Small Volume Allowance", August 7, 1998. EPA Docket A-96-40 item IV-B-01.

EPA agrees that allowing the aggregation of percent-of-production exemptions over time is appropriate. The reasons that a company may have for needing exemptions will vary from OEM to OEM. OEMs needing flexibility to accommodate late deliveries of complying engines may need to use their exemptions early in the transition process. Other OEMs with diverse product offerings and limited engineering resources may need to spread exemptions more evenly to allow themselves more time to roll out redesigned products. EPA sees the added flexibility of aggregation as a way to deal with this diversity without resorting to lowest common denominator solutions or to the granting of more hardship relief, with their potential for loss of environmental benefit.

Allowing the complete aggregation of exemptions for the small volume allowance, however, would create serious problems as discussed above in the summary and analysis of comments on the one-model restriction for the small volume allowance, and would essentially defeat the purpose of the small volume exemption. Therefore the Agency is finalizing the aggregation of these exemptions with a cap on the number of exemptions that can be used in any one year. The annual small volume exemptions may be aggregated, but no more than 200 exemptions may be used in any year in any power category under this allowance provision. This strengthens the small volume manufacturer flexibility without expanding the provision so greatly that larger manufacturers for which the allowance is not targeted may take advantage of it. This approach also deals with the concern EPA expressed in the NPRM regarding the undesirable curbing of sales by manufacturers whose production of exempted machine models goes marginally over 100 before they have redesigned these models to accommodate complying engines.

EPA based it's choice of a 200-machine single-year cap for this allowance on a review of data in the PSR database.[2] This data shows that, under the no-cap scenario, most of the power categories would have 20 percent or more of their total annual sales coming from manufacturers who would benefit more from the small volume allowance than from the percent-of-production allowance. In contrast, the 200-machine cap reduces these sales percentages to the 5 to 15 percent range in all but the 450-560 kW power band. This is a relatively less important power band with a small population and emissions impact compared to the other bands. The Agency views this possible maximum-use scenario for the small volume allowance to be acceptable, considering the likelihood that many manufacturers will not make full use of any of the flexibility allowances.

The Agency believes that it is essential to retain the time limits on the flexibility program to preserve its character as a transition program, and to avoid the need for interminable tracking and enforcement functions. No commenters provided evidence that longer durations are needed.

e. Expanded Allowances

[2] EPA Memorandum from Don Kopinski to Docket A-96-40, "Potential Use of Small Volume Allowance", August 7, 1998. EPA Docket A-96-40 item IV-B-01.

Summary of the Issue

In the proposal, EPA identified a number of factors that the Agency believed would make implementation of the new emissions standards more difficult for manufacturers of farm and logging equipment. As a result, the Agency proposed that OEMs who make farm and logging equipment receive expanded percent-of-production allowances for this equipment.

Comments

OEMs, including those with sizeable agricultural equipment markets, argued that the reasons given by EPA for granting extended exemptions for farm and logging equipment would apply to other applications as well, or, in some cases, are simply not valid. They supported combining the allowances for the farm/logging and general application categories into a single aggregated percent-of-production allowance, or adding a provision to allow exemption transfers between the two categories. Various suggestions were made regarding the appropriate level of the combined allowance. The Equipment Manufacturers Institute (EMI) recommended a combined aggregated allowance of 135 percent (the level proposed for farm and logging equipment). Deere and the Industrial Truck Association (ITA) recommended an averaged value of 90 percent. Caterpillar suggested factoring in the environmental impact of both categories. No commenters expressed support for limiting expanded allowances to farm and logging equipment manufacturers as proposed.

Analysis

EPA's rationale for limiting special treatment to only farm and logging equipment was effectively refuted by commenters, even those who were likely to benefit from the special treatment. OEMs identified a wide range of other applications and special situations that involve the same or comparable implementation challenges as those faced for farm and logging applications.

Instead of suggesting that the expanded allowance for farm and logging equipment should be dropped, these commenters argued that EPA should expand allowances for other categories. Examples cited include forklifts, skid steer loaders, drilling rigs, and low volume models of all applications. Although the comments on this topic were numerous, EPA does not view the public record established by them as providing a comprehensive listing of all applications and special situations that might need more flexibility. As might be expected, each commenter's particular business interests tended to be reflected in their comments. Nevertheless, EPA is convinced that some additional flexibility is warranted to meet the requirements of paragraph 213(a)(3) of the Clean Air Act calling for the "greatest degree of emission reduction achievable" given certain criteria, including "the cost of applying such technology within the time available to manufacturers". The Agency is also convinced by the comments and its own review of equipment redesign challenges that the need for this flexibility is widespread across the regulated power bands. For example, many smaller engines must fit into very compact equipment

packages for which cost considerations are paramount; farm equipment predominates in the medium-size power bands; and the largest engines are typically used in very low sales-volume equipment models, for which aggressive redesign schedules may be costly or impossible.

The Agency is therefore expanding the percent-of-production allowance for all equipment to a cumulative percentage of 80 percent in each power category, compared to the proposed separate allowances of 45 and 135 percent for the general and farm/logging categories, respectively. The proposed 7 year period for use of these exemptions will be retained. This approach is superior to attempting to identify all applications and situations deserving of special treatment and either assigning individual allowances to them or granting exemptions on a request basis, because it maintains the proposal's focus on giving OEMs long-range control over how they use their assigned pool of exemptions for their products affected by each new set of standards, rather than on dictating category-by-category or model-by-model allowances. It also serves the goal of avoiding unnecessary complexity by avoiding the need for numerous equipment category definitions and exemption "account" calculations, a goal that was supported by several commenters.

The choice of a cumulative allowance of 80 percent is based on the Agency's best estimate of the degree of flexibility needed to meet the requirements of the Clean Air Act. EPA chose this figure to provide a rough balance between the allowances proposed for manufacturers of agricultural equipment and manufacturers of non-agricultural equipment.[3] Commenters demonstrated that manufacturers of non-agricultural equipment needed additional allowances for several types of equipment facing implementation challenges. This final percent of production figure also reflects the feeling of manufacturers who produce both agricultural and non-agricultural equipment that the proposed farm and logging equipment allowances might be less necessary for some agricultural equipment than for some types of non-agricultural equipment. Finally, as discussed below, EPA believes this percent of production allowance, combined with the small volume allowance provision, adequately protects those manufacturers producing primarily agricultural equipment. EPA believes that this combination of circumstances is best addressed by taking the total number of allowances proposed for all manufacturers, and reallocating them in the form of a cumulative allowance of 80 percent, without substantially changing the total number of allowances provided for all manufacturers.

The same 80 percent allowance is being adopted in every power band because, based on the information available, the Agency has found the flexibility needed to meet the criteria of Clean Air Act section 213(a)(3) to be fairly uniform across the power bands, although for different reasons. Equipment using engines rated under 37 kW have early implementation dates, exist in a large number and variety of models, are typically more cost-sensitive than larger machines, and in many cases have very tight engine enclosures. These issues are balanced somewhat by the less

[3] EPA memorandum from Phil Carlson to Docket A-96-40, "Comparison of Emission Inventories Under Different Equipment Manufacturer Exemption Scenarios Analyzed for the Nonroad Diesel Engine FRM", August 1998.

stringent Tier 1 standards compared to the Tier 2 standards for larger engines, allowing some Tier 1 engines and the equipment that uses them to require little modification from existing designs. Engines between 37 and 75 kW also go into numerous models, many of which also have packaging constraints such as the need to design farm tractor hoods for crop row visibility. Compared to the smaller engines, they have more stringent standards that will likely cause larger redesign impacts, but this is balanced by the several additional years of leadtime before standards start. Packaging constraints are less severe in applications above 75 kW, although still common. However, except for the very largest engines (those above 560 kW) the standards for these engines are more stringent than those for smaller engines, and they have early implementation schedules, adding to the need for equipment redesign flexibility in the first few years of the program. Engines above 560 kW typically go into low-production equipment models. For this reason, these models are on very long normal redesign cycles and so the flexibility is needed in many cases more to avoid costly premature redesigns than to solve difficult packaging or performance problems.

EPA has examined the impact on environmental benefits of the combination of changes being finalized for this program, including this expanded allowance and the dropping of special treatment for agricultural equipment. Although the actual impact will depend on the degree to which the industry takes advantage of the flexibility provisions, the Agency has determined that the net effect will be roughly equivalent to the impact of the proposed program.[4]

Although, no commenters supported limiting the special treatment to farm and logging equipment, the Agency recognizes that some OEMs whose products are predominately focused in farm or logging applications may have less flexibility in the program being finalized than in the one proposed. The Agency has reviewed available sales data in the PSR database and has concluded that almost all of these companies that are potentially adversely affected by the final approach are very small and would therefore obtain more flexibility from the small volume allowance than from the percent-of-production allowance, regardless of the final form of the latter.

f. Transfer of Exemptions Across Power Categories

Summary of the Issue

Although it expressed concerns about competitive inequities and inappropriate expansion of the flexibility program, the Agency requested comment on whether to allow exemptions for one power category to be used in another, possibly with weighting to reflect the differing emissions impacts of larger and smaller machines.

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[4] EPA memorandum from Phil Carlson to Docket A-96-40, "Comparison of Emission Inventories Under Different Equipment Manufacturer Exemption Scenarios Analyzed for the Nonroad Diesel Engine FRM", August 1998.

Comments

OEMs expressed support for the allowance of such exemption transfers, arguing that it would maximize the usefulness of a company's full complement of exemptions envisioned in the proposal. They argued that, rather than potentially disadvantaging a manufacturer who produces equipment in only one power category by allowing a more diverse competitor to stack exemptions in that category, the lack of a transfer mechanism disadvantages the more diverse competitor, because it cannot use its exemptions on the highest-cost machines unless they are evenly divided among power categories.

Analysis

EPA disagrees with the view that a lack of transfer opportunity disadvantages the more diverse manufacturers. These manufacturers receive just as large a share of exemptions and are just as free to use their exemptions on higher cost machines in a power category as their less diverse competitors. The Agency proposed the OEM flexibility allowances based on the view that the introduction of new standards in each engine power category triggers the need for implementation flexibility for the makers of machines using those engines. Expanding the exemption allowance in any category by letting a manufacturer use exemptions it did not need in another category would run contrary to this approach, and could create competitive inequities.

g. Purchase of ABT Credits

Summary of the Issue

EPA proposed that OEMs be allowed to purchase ABT credits and turn them in to the Agency in exchange for additional equipment exemptions.

Comments

The California ARB objected to this proposal, stating that it defeats the purpose of the ABT program by creating a new source of revenue for engine manufacturers, rather than simply providing implementation flexibility. Engine manufacturers expressed support for the concept, stating that such a program increases the potential value and usefulness of credits and increases both engine and equipment manufacturer flexibility. Equipment manufacturers were less enthusiastic. Some equipment manufacturers commented that they expected opportunities for equipment manufacturers to purchase emission credits to be scarce, rendering this flexibility provision largely illusory. They suggested that EPA improve OEMs' access to credits by giving them the opportunity to purchase credits whenever they purchase an engine certified at a family emission level below the applicable standard, or by requiring vertically integrated engine manufacturers to make emission credits available for purchase by non-affiliated manufacturers to the same extent that they make them available to a corporate affiliate.

Analysis

EPA's past experience with ABT programs tends to confirm the expectation that ABT credits may not be very available to OEMs without some provision to require that engine manufacturers make them available. The Agency believes that such a requirement would be inappropriate, because it would take away from the voluntary nature of the ABT program. Credits could be generated voluntarily but could, in effect, be involuntarily taken away. Furthermore, the Agency believes that this program has the potential to be very complex, involving the need to convert grams-based ABT credits to number-of-machine-based exemptions without an environmental detriment, and the potential need to administer many more ABT accounts. Therefore, EPA is not finalizing this provision.

It should be noted that OEMs may still work to facilitate credit trades between engine manufacturers to achieve similar results. An OEM dependent on an engine manufacturer who cannot provide complying Tier 2 engines could arrange for this manufacturer to buy credits from another engine manufacturer. The credits could then be used to demonstrate compliance while the manufacturer continues to sell Tier 1 engines to the OEM. EPA recognizes that this may be of limited usefulness to OEMs, but believes that the proposed program, with no provision to force the sale of credits, has the same limitation.

h. Hardship Relief

Summary of the Issue

EPA proposed that a safety valve provision be adopted whereby small OEMs could apply for and receive up to one year of additional relief if they are unable to comply with the regulations due to engine supplier problems. They would need to provide evidence that the pending noncompliance was not their fault and that they face possible bankruptcy if forced to comply. Comment was requested on the advisability of requiring those who receive relief to recover some of the lost environmental benefit, such as by purchasing Blue Sky Series engines.

Comments

Equipment manufacturers supported the proposed provision but commented that the solvency criterion is impractical and should be replaced with a need to show a loss of sales or a significant adverse economic impact. The Outdoor Power Equipment Institute (OPEI) asked that similar relief be extended to engine manufacturers who cannot sell all of the engines they produce in anticipation of requests by OEMs for exempted engines. One equipment manufacturer objected to any inclusion of Blue Sky Series engine purchases as part of a relief agreement.

Ingersoll-Rand provided evidence from their Tier 1 experience that being a large OEM does not necessarily ensure the cooperation of engine suppliers in accommodating timely equipment

redesigns. They felt that the exemption provisions, though helpful, must be supplemented by an extension of the hardship relief provision to all non-vertically integrated OEMs, large and small, without a need to prove impending bankruptcy.

Analysis

The Agency has granted requests in the past for relief from regulations in cases involving unforseen special circumstances and the potential for major disruptions of business. By defining specific criteria for granting and restricting hardship relief, the proposed provision will help to ensure consistency and avoid abuse. The Agency agrees that the need to prove impending bankruptcy may be too restrictive and that a showing of serious economic hardship to the company is sufficient to discourage abuse of the provision. EPA is also convinced by experience in the Tier 1 program that there is a need for a safety valve provision of this type for larger non-vertically integrated OEMs as well as small ones, and is therefore extending this provision to them.

To avoid the creation of a self-fulfilling prophecy, by which the very existence of this provision prompts engine manufacturers to delay engine developments, the Agency wishes to make clear that it expects this provision to be rarely used. Each granting of relief would be treated as a separate agreement with no prior guarantee of success, and with the inclusion of measures, agreed to in writing by the OEM, for recovering the lost environmental benefit. Any engine manufacturers who do not make their best attempts at timely compliance, incorrectly believing that their OEM customers will receive routinely-granted, no-cost relief, will likely have very unhappy customers and a loss of future business instead. The Agency does not feel that specifying the details of the emissions benefit recovery provisions in the regulations, such as setting a quota of Blue Sky Series engine purchases, is possible or desirable at this time.

The requested granting of hardship relief to engine manufacturers to sell off unanticipated surpluses does not appear appropriate. The potential for abuse of a provision of this sort would be very large.

i. Design Freeze Concepts

Summary of the Issue

Some OEMs and Post-Manufacture Marinizers (PMMs) who do not make their own engines have argued in the past for a program in which OEMs and PMMs would have a year or two after engine manufacturers are required to finish their designs, in order to redesign their own products to accommodate the new engines. This would amount to a mandatory engine design freeze for a year or two before the engines would be required in the marketplace.

Comments

Some OEMs and one PMM continued to argue for some form of this arrangement. Engine manufacturers commented that it would be impractical and illegal to try to force an engine manufacturer to have later Tier production engines available a year or more before anybody is required to buy them. These commenters also explained that equipment manufacturers usually encourage their engine manufacturer to improve performance and reduce costs on an ongoing basis, rather than "freeze" on some less-than-optimal package.

Analysis

Although sympathetic to the concerns expressed by non-vertically integrated OEMs and PMMs, the Agency received no new information that would allow it to conclude that requiring a design freeze is practical. The likelihood of repeated delays in the program phase-in and extensive litigation appear high. Instead, the Agency has chosen to provide additional relief for these OEMs in other flexibility provisions, especially in expanding the hardship relief provision.

j. Early Compliance Credits

Summary of the Issue

Proposed flexibility provisions apply after a standard takes effect, with no credit provision for early compliance.

Comments

Ingersoll-Rand requested that EPA allow non-vertically integrated OEMs to gain additional exemptions for producing equipment that uses engines meeting emission standards sooner than required--essentially an exemption banking program. Each early compliance credit would be valid for the use of a noncomplying engine for 18 months after the certification date applicable to that engine. The credits could be used across product lines and power categories, with proper weighting factors for power differences.

Analysis

Although the Agency welcomes suggestions for environmentally-neutral flexibility programs, it expects that engine manufacturers who introduce complying engines early will want to earn ABT program credits for them. For an OEM to receive additional exemptions from the same engines that an engine manufacturer receives ABT program credits would amount to double-counting of emission benefits. An OEM can receive the benefit of the early-introduction engines by convincing the engine supplier to use the ABT program credits generated by these engines to build more engines designed to meet the previous tier of standards (which do not reduce the OEM's exemption allowance) after the new standards go into effect. The opportunity to arrange ABT program credit exchanges, discussed above, gives OEMs even more flexibility of this sort. Therefore, EPA believes that an exemption banking program is unnecessary, and would

be too complicated to administer and enforce.

k. Recordkeeping and Reporting Requirements

Summary of the Issue

The Agency proposed requirements for keeping and making available records on exempted equipment and engines, stating its desire for a flexibility program that minimizes these requirements while allowing for an enforceable program to discourage abuse by OEMs. EPA made it clear that an OEM choosing not to use any of the flexibility provisions would not be subject to any of the program's recordkeeping requirements. The Agency also requested comment on requiring engine manufacturers who produce engines for the OEM flexibility program to annually provide information on these engines.

Comments

OPEI requested that required OEM recordkeeping be limited to total annual production of older design engines as a portion of total production, and that these records be made available to EPA upon request.

Engine manufacturers stated that EPA should not require engine manufacturers to maintain or annually provide records on the noncomplying engines manufactured for the OEMs' exemption needs. They argued that to do so would impose an undue burden without any real benefit, as the proposed recordkeeping requirements for equipment manufacturers should provide sufficient assurance to EPA. They also requested clarification of how these engines are to be certified and labeled.

Analysis

EPA does not see how limiting OEM recordkeeping to a single calculation would provide any hope of compliance verification. The Agency would need to locate and check labels on a large portion of an OEM's annual production to know if the allowance had been exceeded. The proposed recordkeeping requirements are therefore being retained in the final rule.

After further analysis, the Agency has decided to require engine manufacturers who decide to make engines for the OEM flexibility program to annually submit very basic records on these engines to the EPA. These records would consist of the number of each noncomplying engine model sold annually to each OEM customer or used in the engine manufacturer's own equipment products. Such records would be invaluable in any OEM enforcement auditing that the Agency conducts, and would not create an unreasonable burden for the engine manufacturers.

The Agency is not imposing any special certification or labeling requirements for engines made for use in the OEM flexibility program. For example, a Tier 1 engine used in an exempted

machine in the Tier 2 timeframe need only be certified and labeled as a Tier 1 engine.

l. Application of Exemption Provisions

Summary of the Issue

Clarification was requested on the definition of an equipment manufacturer for the purpose of determining and enforcing compliance with exemption allowances. This is especially relevant for use of the small volume exemption by companies that are affiliated with other companies.

Comments

Cummins recommended that the flexibility provisions be applied at the lowest level of a company/division allowed by the Small Business Regulatory Enforcement Fairness Act.

Analysis

All of the exemption provisions are written in relation to the prohibited acts described in §89.1003 of the regulations, most pertinently paragraph (a)(6), which makes it illegal:

> *For a manufacturer of nonroad vehicles or equipment to distribute in commerce, sell, offer for sale, or introduce into commerce a nonroad vehicle or piece of equipment, manufactured on or after the model year applicable to engines in such vehicle or equipment under §89.112, which contains an engine not covered by a certificate of conformity.*

A nonroad vehicle or nonroad equipment manufacturer is defined in §89.2 as:

> *Any person engaged in the manufacturing or assembling of new nonroad vehicles or equipment or importing such vehicles or equipment for resale, or who acts for and is under the control of any such person in connection with the distribution of such vehicles or equipment. A nonroad vehicle or equipment manufacturer does not include any dealer with respect to new nonroad vehicles or equipment received by such person in commerce.*

The Agency agrees that clarification of these regulations is needed for the application of the exemption provisions but does not agree that exemption allowances should be applied separately to entities within or controlled by a company. Doing so would allow companies to artificially create or utilize small subunits, all of which would qualify for the small volume exemptions even though they are controlled in common. Instead the Agency wishes to make clear that all entities that are under the control of a common entity, and that meet the above definition of a nonroad vehicle or nonroad equipment manufacturer, must be considered together for the purposes of applying exemption allowances. This provides certain benefits for the purpose of pooling exemptions but also precludes the abuse of the small volume allowances.

m. Manufacturers Who Resell New Equipment

Summary of the Issue

The regulations prohibit the sale of new equipment with noncomplying engines except as provided for in the exemption allowance provisions. The exemption allowance provisions are not clear for manufacturers who buy new equipment, modify it such as by adding specialized attachments or relabeling it, and then resell it as new.

Comments

EMI asked that the Agency make clear that such manufacturers receive the same exemption allowances as OEMs. Cummins requested that privately branded equipment, that is equipment manufactured by one OEM but sold by another OEM under their own name, be considered separately from the other equipment produced by the actual manufacturer.

Analysis

The Agency believes that the OEM flexibility provisions should apply only to the manufacturer who installs the engine into the equipment. Other manufacturers who modify or relabel and resell new equipment already introduced into commerce would be subject to the regulations in the same way as independent dealers and distributors. EPA's desire to limit the number of machines using noncomplying engines is therefore satisfied by regulation of the original equipment manufacturers, such that the secondary manufacturers do not need exemption allowances. They may sell as many machines with noncomplying engines as they are legally able to obtain. The definition of a nonroad vehicle or nonroad equipment manufacturer has been modified in the final rule to reflect this position. It should be noted that this approach is not intended to in any way negate the anti-tampering provisions of 40 CFR §89.1003(a)(3).

n. Existing Inventories and Replacement Engines

Summary of the Issue

The existing paragraph 40 CFR §89.1003(b)(4) provides that: "Nonroad vehicle and equipment manufacturers may continue to use noncertified nonroad engines built prior to the effective date until noncertified engine inventories are depleted; however, stockpiling of noncertified nonroad engines will be considered a violation of this section." EPA proposed to update this to apply to the new proposed program with multiple tiers and effective dates. The existing paragraph (b)(7) of this section provides an exception for the sale of replacement engines after the implementation of Tier 1 engines at or above 37 kW.

Comments

OPEI felt that EPA's proposed wording would create a more restrictive provision because the provision as revised appears to limit manufacturers' use of uncertified inventories to one model year. EMA commented that the replacement engine provision should be expanded to include engines covered by the proposal.

Analysis

The apparent restriction identified by OPEI was unintended. EPA is revising the wording to read: "After the date on which a new standard takes effect, nonroad vehicle and equipment manufacturers may continue to use nonroad engines built prior to this date that are not certified to the standard until inventories of those engines are depleted; however, stockpiling of such nonroad engines will be considered a violation of this section." EPA agrees with EMA that extending the replacement engine provision is appropriate and is modifying the regulations accordingly.

o. Flexibility For Post-Manufacture Marinizers

Summary of the Issue

Post-manufacture marinizers produce marine engines by modifying engines purchased from other engine manufacturers. They, therefore, have both the concerns of an engine manufacturer regarding engine certification, as well as the concerns of an OEM regarding timely delivery of redesigned engines from their engine suppliers. EPA requested comment on extending some or all of the equipment manufacturer flexibility provisions to PMMs affected by this proposal.

Comments

Westerbeke, a PMM, expressed support for extending the proposed OEM flexibilities to PMMs. Westerbeke believes that engine marinizers should be treated the same as OEMs since, generally, engine marinizers do not manufacture the engine and they do not have control over the major emission-effecting components and functions of the engine that they marinize. However, Westerbeke also expressed a concern that extending OEM flexibilities to PMMs does not go far enough to address the needs of PMMs, and requested that EPA adopt a design freeze provision as discussed in section 4.i of this document.

Analysis

EPA recognizes that the potential unavailability of certified base engines may make it difficult for PMMs to comply with the proposed emission control program, since they may not be able to obtain base engines in time to adjust their marinization process, especially considering that most of the marine engines affected by this rule are subject to standards beginning in 1999. Therefore, the OEM flexibility provisions are being extended to PMMs, as proposed.

In addition, even where complying base engines are made available, EPA recognizes that the OEM flexibility allowances may not be sufficient for all PMMs to redesign and certify all of their models in time to meet the program requirements. Based on these concerns, EPA has determined that the proposed emission standards would not be feasible without additional flexibility for PMMs who produce marine engines under 37 kW. Therefore, the Agency is adopting another optional provision. Provided they inform EPA in writing before the date Tier 1 standards would take effect, PMMs may elect to delay the effective dates applicable to marine engines under 37 kW for one year, instead of using the OEM flexibility provisions.

Although it provides a substantial boost in certainty to PMMs, the optional 1-year delay provision will have a very small environmental impact. This is because: (1) the marine engines under 37 kW produced by PMMs are a very small part of the total nonroad diesel engine production, (2) these engines produce relatively low emissions due to their small size and low usage characteristics, and (3) the total number of engines potentially exempted under this flexibility provision is not much greater than that possible under the exemption allowance provisions.

5. Averaging, Banking and Trading

EPA proposed a comprehensive new ABT program in tandem with the proposed standards that would replace the existing ABT program. The primary features of the proposed program were that credits generated from engines certified to the proposed standards would have an unlimited credit life and credits would be available for complying with both the NMHC plus NOx standards and the PM standards. As in the current ABT program, there would be no discounting of credits from engines certified to meet the proposed standards. EPA proposed to allow both credit generation and use on a sales-weighted average power basis in lieu of the "buy high/sell low" provisions of the current ABT program. Engines certified under the existing Tier 1 standards could generate NOx credits and PM credits which could be used to comply with the proposed NMHC plus NOx standards and PM standards respectively. The NOx credits from engines certified to the existing Tier 1 standards would be adjusted downward if the emission levels were not below a specified level and the credits could not be used beyond the Tier 2 time frame. The PM credits from Tier 1 engines would be calculated against the proposed Tier 2 PM standards and could only be used to show compliance once the Tier 2 standards take effect.

Because EPA's proposal has, for the first time, set standards for engines below 37 kW, EPA has proposed that the ABT program be expanded to cover those engines as well. Engines from at or above 19 kW to less than 37 kW would be allowed to average, bank and trade credits with other engines rated at or above 37 kW. Engines below 19 kW would only be allowed to average, bank, and trade with other engines below 19 kW. Several other special provisions were proposed to deal with the unique characteristics of the market for engines below 37 kW. These included provisions requiring all engines below 19 kW to generate credits against the proposed Tier 2 standards (even Tier 1 engines), prohibiting the exchange of credits from land-based engines to marine engines, limiting the lifetime of Tier 1 credits from engines less than 19 kW, prohibiting the trading of credits from indirect injection engines at or above 19 kW to other manufacturers, and allowing manufacturers to carry a negative balance of credits in the first four years that the standards take effect as long as these negative credit balances are paid back with interest.

The following is a summary of the comments EPA received on the various aspects of the proposal and EPA's analysis and response to those comments.

a. General Need for and Effects of the Proposed ABT Program

Summary of the Issue

An ABT program allows the Agency to propose and finalize more stringent engine standards than might otherwise be appropriate under the Clean Air Act, since ABT provides flexibility for high-cost manufacturers and improves the technological feasibility of achieving the standards. EPA proposed the changes to the existing ABT program with the intent that the changes would enhance the technological feasibility and cost-effectiveness of the new standards, and thereby help to ensure the new standards would be attainable earlier than would otherwise be possible.

The changes would provide manufacturers with additional product planning flexibility and the opportunity for a more cost effective introduction of product lines meeting the new standards. Also, EPA believes that ABT creates an incentive for early introduction of new technology which allows certain engine families to act as trail blazers for new technology. This can help provide valuable information to manufacturers on a given technology before it needs to be applied throughout their product line. This further improves the feasibility of achieving the standards. EPA viewed the effect of the ABT program itself as environmentally neutral because the use of credits by some engines is offset by the generation of credits by other engines. However, when coupled with the new standards, the ABT program would be environmentally beneficial because it would allow the new standards to be implemented earlier than would otherwise be appropriate under the Act.

Comments

EMA commented that engine manufacturers need the flexibility of an expanded ABT program in order for the proposed standards to be cost-effective and achievable. STAPPA/ALAPCO acknowledged the importance of ABT to manufacturers, however, they want to ensure that the flexibility offered by ABT does not jeopardize the realization of the full potential benefits of the new standards. They do not believe EPA has sufficiently proven that further flexibility is needed compared to the current program. In addition, they believe EPA's justification for increased flexibility is insufficient without an increased commitment to in-use compliance testing and enforcement. Without this commitment by EPA, they argue, manufacturers have an incentive to take advantage of the certification process. Environmental groups commented that ABT undermines the effort to meet national air quality standards as quickly as possible.

Analysis

As described below, EPA has made minor changes to the proposed ABT program in response to comments on particular issues. EPA believes that the final version of the ABT program helps make the final standards appropriate under the Clean Air Act. EPA is able to impose more stringent standards by revising the current ABT program. The more stringent standards are based on the availability of credits, and thus may not have been mandated in the absence of such credits. EPA also continues to believe that, even with the modifications, the effect of the ABT program alone, separate from the level of the standard, is at worst environmentally neutral. Moreover, it is clear that the program provides emissions reductions earlier than would otherwise be achieved. Although all engines would not meet the more stringent standards beginning in the applicable model year, the excess emissions from such engines are offset by engines that are cleaner than the required standard prior to the applicable model year. Furthermore, these early emissions reductions represent the early introduction of emissions reduction technologies or strategies that manufacturers would not otherwise be required to apply, which has the advantages discussed earlier. Manufacturers are able to earn credits for experimentation with advanced technologies. In addition, by spreading out the

emissions reductions, manufacturers are able to optimize their product plans without overall loss of emissions reductions. All of these points help to allow for the adoption of a lower standard than would otherwise be reasonably achievable. The ABT changes therefore should not add uncertainty to air quality planners' ability to rely on these reductions.

As laid out in the technology and cost analyses of the RIA, EPA expects that meeting the final standards will require manufacturers to employ new technologies, heretofore unused in nonroad diesel applications. Such technology has potential operating cost and durability implications which may make it prohibitive to meet the standard for every engine family beginning in 2004. For some engine families, achieving the required emissions reductions will represent a more difficult challenge for engine manufacturers than for others and manufacturers may need additional time for the more difficult engine families. The revised ABT program provides the engine manufacturers with design and implementation flexibility. Eventually, however, when credits have been consumed, all engines will be required to be equipped with advanced emissions controls (not considering the possible effect of averaging).

EPA does not believe that the ABT program results in the loss of emissions reductions as a result of a lack of an in-use compliance threat. EPA currently performs Selective Enforcement Audits (SEAs) that require testing of production line engines to ensure they are meeting the emission levels established by the manufacturer during the certification process. EPA believes this provides a significant deterrent to the manufacturers against gaming the ABT program. In the future, EPA expects to continue performing SEAs and to build upon other methods of in-use compliance testing in the nonroad area as expertise is gained in the on-highway heavy-duty engine compliance arena.

b. Credit Life/Use of Tier 1 NOx Credits beyond Tier 2

Summary of the Issue

EPA proposed that credits earned under the revised program have an unlimited credit life. Under the existing ABT program for engines at or above 37 kW, credits have a lifetime of three years. One exception to the unlimited life for credits was proposed for engines below 19 kW certified to the Tier 1 standards. Due to the potential to earn significant credits from indirect injection engines, EPA proposed that unused credits generated from Tier 1 engines below 19 kW expire on December 31, 2007.

EPA also proposed limits on the use of credits from Tier 1 engines rated at and above 37 kW. Under the proposal, NOx credits generated on Tier 1 engines could be used to show compliance with the existing Tier 1 standards or the proposed Tier 2 standards, but not to show compliance with the proposed Tier 3 standards. In effect, this placed some limit on the use of credits from Tier 1 engines above 37 kW, although they could continue to be used indefinitely for engines between 19 kW and 37 kW, and those above 560 kW, because EPA has not proposed Tier 3 standards for these engine categories.

Comments

EMA and engine manufacturers supported unlimited life for credits. Citing the high expected costs of Tier 1 compliance, EMA also supported an unlimited life for credits from Tier 1 engines below 19 kW, which EPA proposed to expire at the end of 2007. They noted that an unlimited credit life provides the incentive for manufacturers to hold on to their credits rather than use them up before they expire. Rather than waste credits, manufacturers would have an incentive to defer lower emitting technologies in order to use up the credits. EMA also noted that EPA should eliminate the regulatory language that requires the use of credits "expiring in the earliest model year." EMA and engine manufacturers also opposed the proposed restriction on the use of Tier 1 NOx credits from engines above 37 kW for Tier 3 compliance noting they oppose limitations on the use of credits in general.

EPA also received comments that an unlimited credit life was inappropriate. STAPPA/ALAPCO questioned the need for extending credit life beyond three years and noted they do not believe EPA has sufficiently proven that further flexibility is needed compared to the current program. Environmental groups opposed extending credit life beyond three years because credits accrued in the early years could be used by manufacturers to delay real engine improvements far into the future.

Analysis

EPA agrees with the rationale presented by the engine manufacturers for unlimited credit life. There would be an environmental benefit associated with limiting credit life if manufacturers allowed credits to expire. However, credits are not generated without a cost to the manufacturer and/or the consumer and thus they have value to a manufacturer. If faced with credit expiration, manufacturers would likely use the credits if at all possible. Based on experience with the ABT program for on-highway heavy-duty diesel engines, manufacturers have not been inclined to allow credits to expire in the past.[5] Future credits are even more valuable due to the more stringent standards.

For the nonroad CI engine ABT program, EPA believes that an unlimited credit life is appropriate and beneficial for several reasons. There is no environmental advantage to forcing or encouraging credits to be used because credit use results in higher emitting engines. EPA does not agree that allowing an unlimited credit life unduly delays the introduction of technology. While unlimited credit life would create the potential for technology delay on a few families, limiting credit life would encourage technology delay in the near term since it would be "use or lose" for the credits. Allowing for holding of credits delays the incentive to use dirtier technology rather than delaying cleaner technology. Furthermore, EPA believes some

[5] Based on EPA heavy-duty engine compliance records in which manufacturers report to EPA on their credit generation and use. Engine Programs and Compliance Division of the Office of Mobile Sources, 401 M St. SW, Washington DC, 20460.

manufacturers are likely to exercise the option of retaining credits for future use. Credits that are not used, but kept in an account, represent a benefit to the environment.

EPA believes that a limit on credit life would, in this case, to some degree, stifle the development and introduction of new technology. Under the stringent new standards, credits are unlikely to be generated without the application of additional emissions controls. Manufacturers will likely expend significant resources to generate credits. Regulatory provisions which limit manufacturer flexibility in credit use have the effect of reducing credit value and thus reducing the incentive to invest in the development and introduction of new technology. With limits on credit life, a manufacturer would plan carefully and would not generate credits that are not needed in the time frame before they would expire.

EPA recognizes that this is a departure from the current ABT program for nonroad engines but believes that it is warranted given the stringency of the standards being finalized. Initially, the Agency adopted the banking and trading program for Tier 1 nonroad engines without any certification experience with nonroad CI engines. This led the Agency to adopt conservative measures such as limited credit life to limit the program's scope. However, providing the manufacturers with the degree of freedom represented by unlimited credit life will aid them in meeting the stringent standards being adopted. EPA believes the potential for environmental benefits outweighs the environmental risk associated with delay.

Where credits could be easily generated, however, EPA has proposed adjustments for credit life. For example, EPA has recognized the possibility that a large bank of credits could be accumulated from current Tier 1 engines to be used against the Tier 3 standards. EPA expects that credits generated from the existing Tier 1 engines will be used substantially to meet the new Tier 2 standards. However, because there are already Tier 1 engines certifying below the existing Tier 1 standards (but not generating ABT credits currently), there is the potential for significant credits to be generated before the new Tier 2 standards take effect. For this reason, EPA continues to believe that it is necessary to prohibit the use of credits generated from engines certified to the existing Tier 1 standards in the Tier 3 time frame. This would prevent manufacturers from delaying the Tier 3 standards far into the future by producing engines that emit lower than the relatively high, existing Tier 1 standards.

EPA also continues to believe that limiting the lifetime of credits from Tier 1 engines below 19 kW is appropriate. Based on EPA's cost analysis for engines below 19 kW, EPA believes that EMA's estimated cost of compliance for such engines is overestimated significantly. Because of the possibility for manufacturers to generate large numbers of credits from indirect injection engines under the new Tier 1 standards and delay the new Tier 2 standards significantly, EPA believes it is necessary to set an expiration date of December 31, 2007 for credits from Tier 1 engines below 19 kW. This will allow manufacturers to use credits for the first three years that the Tier 2 standards apply, but will not allow their use beyond that point.

EPA agrees with EMA that the regulatory language requiring the use of credits expiring in

the earliest model year should be removed. Such language is unnecessary given the abandonment of the three year credit life and the lack of discounting in the nonroad ABT program. (Discounting decreases the value of credits generated in previous model years relative to those generated in the current model year which are not typically discounted until banked or traded). EPA is therefore removing the language related to use of credits expiring in the earliest model year from §89.204 of the regulations.

c. Adjustment of NOx Credits from Engines Meeting the Existing Tier 1 Standards

Summary of the Issue

Due to concerns that manufacturers could potentially earn significant NOx credits from their current Tier 1 engines and delay compliance with the Tier 2 standards, and to encourage the pull-ahead of newer and cleaner technologies, EPA proposed that banked or traded NOx credits be adjusted downward unless the engine on which the credits were earned has emissions below the Tier 1 standard of 9.2 g/kW-hr by a specified amount. (Credits that were to be used for averaging in that same year were not subject to the downward adjustment.) EPA proposed a NOx level of 8.0 g/kW-hr as the trigger for the adjustment. If the family emission limit (FEL) were at or below the trigger, then no adjustment to the NOx credit calculations would be necessary. If the FEL was above the trigger, EPA proposed to adjust the NOx credits (if they were to be banked or traded) downward by 35 percent. EPA requested comment on the level of the adjustment.

Comments

EMA and a number of engine manufacturers commented that EPA should eliminate the 35 percent adjustment citing the high cost of compliance with the Tier 2 standards. At the very least, EMA commented that EPA should eliminate the adjustment for credits banked from Tier 1 engines and later used by other Tier 1 engines because the current ABT program does not have any similar type of discounting in it.

With regard to the level of the adjustment, the California ARB commented that if EPA believes the 8.0 g/kW-hr level is a reasonable discriminator for pull-ahead technology, then credit generation should only be allowed for engines below that level.

Analysis

EPA believes that an adjustment of the credits for Tier 1 engines above 37 kW is still appropriate for those engines with FELs above 8.0 g/kW-hr. As noted earlier, EPA's cost analysis for the new standards contained in the RIA, shows that the expected cost of compliance for the Tier 2 standards is much lower than projected by EMA. Therefore, the need to eliminate the adjustment for cost reasons is not justified.

The sales-weighted average certification levels of Tier 1 engines are well below the 9.2 g/kW-hr NOx standard for all power categories currently certified. The potential for the manufacturers to earn significant credits remains. While the engines are cleaner than required by the regulations, the type of technology used by many of the engines slightly below the standards could be categorized as incremental improvements in engine technology, such as calibration changes and increased cooling. Contrary to the assertion by the California ARB, EPA believes the reductions from the incremental technologies are real, and should be recognized in an ABT program. However, they represent minor engine changes rather than the step forward in technology that EPA believes an ABT program should encourage and reward fully. For these reasons, EPA is retaining the 35 percent downward adjustment to NOx credits generated from Tier 1 engines rated at or above 37 kW with FELs above 8.0 g/kW-hr.

With regard to applying the adjustment to credits that will be banked and used later by manufacturers to certify another Tier 1 family at or above 37 kW, EPA believes that it would be appropriate not to apply the adjustment as originally proposed. The current ABT program for nonroad CI engines does not include a similar adjustment on credits. It was not EPA's intent to change this aspect of the program for engines complying with the existing Tier 1 standards. Therefore, EPA will not apply any downward adjustment to NOx credits generated by Tier 1 engines at or above 37 kW that are banked and later used to show compliance for other Tier 1 engines at or above 37 kW.

d. Use of Average Power instead of Min/Max Power in Calculating Credits

Summary of the Issue

EPA proposed to allow the calculations for both credit generation and credit use to be based on a sales-weighted average power basis in lieu of the "buy high/sell low" provisions of the current ABT program. The "buy high/sell low" provisions require manufacturers to calculate credits generated based on the lowest power rating within an engine family and credits used based on the highest power rating within an engine family. This results in a penalty to the manufacturer because calculations using lower powers result in fewer credits than with higher powers. As with other proposed revisions to the ABT program, the proposed removal of the "buy high/sell low" provision was meant to enhance the flexibility the ABT program provided to manufacturers in meeting the new standards.

Comments

EMA, two engine manufacturers, and EMI supported the use of sales-weighted average power in credit calculations.

Analysis

EPA agrees with commenters that the penalty imposed under the previous "buy high/sell

low" unnecessarily restricted generation of ABT credits. EPA also believes the change to average power for credit calculations is desirable to simplify recordkeeping and make the calculation methods more consistent between the nonroad and highway programs. For these reasons, EPA is finalizing use of the sales-weighted average horsepower for calculating ABT credits.

e. Discounting Tier 2 and Tier 3 Credits

Summary of the Issue

The 1994 nonroad CI engine emission standards being amended today did not include any discount adjustments for purposes of calculating ABT credits. In revising the current ABT program, EPA proposed to discount the value of NOx credits earned under the Tier 1 standards unless the emissions from the engines are below a specified trigger level. EPA, however, did not propose discounting credits earned under the standards for engines less than 37 kW or under the Tier 2 and Tier 3 standards applicable to engines rated at or above 37 kW.

Comments

STAPPA/ALAPCO stated that it questioned the elimination of credit discounting. No other comments were submitted on EPA's decision not to discount credits beyond the Tier 1 time frame.

Analysis

STAPPA/ALAPCO's comment is slightly unclear because credit discounting is not being eliminated from the current nonroad rule which does not include any credit discounting provision. EPA, however, will read this comment as an objection to EPA's decision not to include discounting for Tier 2 and Tier 3 ABT credit calculations.

EPA believes that the Tier 2 and Tier 3 standards are sufficiently stringent to justify allowing manufacturers to claim full credit for any reductions of emissions below the standards. Unlike the Tier 1 NOx standards where incremental improvements can and have been made to achieve compliance, the Tier 2 and Tier 3 NMHC plus NOx standards will require more significant engine redesigns. Even marginal improvements beyond the newly adopted standards will require advancements in technology and should be encouraged. Discounting ABT credits from Tier 2 and Tier 3 engines is not necessary and would diminish the incentive to reduce emissions below the standards. Therefore, EPA is not requiring any discounting of credits earned in the Tier 2 or Tier 3 time frame.

Although EPA is not finalizing any discounts for Tier 2 or Tier 3 engine credits with this final rulemaking, EPA is concerned that there is some potential for manufacturers to generate unwarranted credits against the Tier 2 standards. For this reason, EPA plans to monitor the

emission levels of engines and use of the ABT program over the next few years. EPA will take this information into account as it reassesses the appropriateness of not having any discounting of credits for both Tier 2 and Tier 3 engines as part of the 2001 feasibility review of the ABT provisions.

f. NOx Credit Surcharge

Summary of the Issue

Due to concerns over the amount of credits manufacturers could earn from currently certified Tier 1 engines and the potential to delay the Tier 2 standard, EPA requested comment on requiring engine manufacturers to pay a ten percent surcharge if they used credits to certify more than 20 percent of their fleet. The surcharge would have been applied in either the first or second year a Tier 2 standard applied in a given power range.

Comments

EMA and two engine manufacturers opposed the ten percent surcharge, calling it a form of discounting. Environmental groups commented that instead of imposing a surcharge, EPA should prohibit manufacturers from using credits to certify more than 20 percent of its fleet.

Analysis

EPA does not believe a surcharge should be adopted in the revised ABT program. Although currently certified Tier 1 engines are well below the Tier 1 standard on average, the adjustment to credits from engines with FELs above 8.0 g/kW-hr should be sufficient to ensure that there is not a significant delay in implementation of the Tier 2 standards. Adding a surcharge to those manufacturers who certify more than 20 percent of their fleet with ABT would not be expected to have a significant impact on the number of credits available to manufacturers because EPA does not expect that manufacturers will use ABT to such a high level. As a result, EPA no longer believes a surcharge on such use is necessary to prevent delay. In addition, EPA believes that adding the requirement for a surcharge on high users of ABT credits would start to overlimit the flexibility offered by ABT and create an even more complicated program. Therefore, EPA is not finalizing the NOx surcharge on manufacturers that certify more than 20 percent of their fleet using ABT credits.

A flat prohibition, as recommended by environmental groups, would also overlimit the flexibility of the ABT program and is not warranted because there may be rare circumstances where a manufacturer needs to certify a percentage of their fleet greater than 20 percent, especially if they have some high volume engine families that are slightly above the applicable standards. EPA wishes to reiterate that in order to have enough credits to certify a high fraction of their sales, the manufacturer would have already had to accumulate a sizeable credit balance by certifying a large number of engines below the applicable standards.

g. Availability of PM Credits

Summary of the Issue

The current ABT program for Tier 1 engines does not cover PM emissions. Because EPA proposed PM standards for all power categories, and because the tight NMHC plus NOx standards will affect manufacturers' ability to comply with the PM standards, EPA proposed to include PM emissions in the revised ABT program. EPA proposed that the PM portion of the ABT program begin with the Tier 2 standards for engines at or above 37 kW, and the Tier 1 standards for engines below 37 kW. EPA also proposed to allow the early banking of PM credits. Engines below 37 kW could generate early PM credits upon finalization of the rule. Tier 1 engines at or above 37 kW could also generate credits upon finalization of the rule provided the engine met the existing Tier 1 NOx standard. EPA requested comments on limiting the availability of early PM credits to the three years before the proposed standards took affect.

Comments

With regard to the proposed inclusion of PM in the ABT program, EMA and one engine manufacturer supported the inclusion of PM. However, environmental groups commented that EPA cannot allow PM credit generation until it can demonstrate an adequate understanding of real world PM emissions.

With regard to the issue of early PM credits, EMA and one engine manufacturer commented that there should be no limits on the availability of early PM credits. STAPPA/ALAPCO commented that the availability of early PM credits should be limited to three years prior to the applicable Tier 2 standards taking affect.

Finally, Case Corporation commented that EPA's proposal to only allow early PM banking if the engine meets the Tier 1 NOx standard is arbitrary and capricious. They believe there is no technical reason to link NOx and PM.

Analysis

EPA continues to believe that including PM emissions in the ABT program is important for ensuring the feasibility of the standards. Based on the certification levels of currently certified Tier 1 engines, manufacturers will be required to reduce PM levels in order to meet the new standards, especially as the NOx standards are reduced, which makes it more difficult to meet the PM standards. Including PM emissions in the ABT program will help provide a greater level of flexibility to manufacturers for complying with the new standards. In response to the comment from environmental groups, EPA believes that engines designed to meet the PM standards on the current steady-state test procedure do achieve in-use PM reductions. However, the level of the in-use reductions is not fully understood at this time. As part of the 2001 feasibility review, EPA is planning to assess the adequacy of the current steady-state test procedure to determine if the

expected level of PM benefit is achieved in-use. Should EPA determine that the current test procedure is inadequate and the expected in-use emission benefits are indeed not being fully realized, it would, of course, be inappropriate to allow the continued use of credits generated under the current test procedure to demonstrate compliance under a future, more appropriate test procedure without considering how to deal with the existing supply of PM credits. EPA would therefore need to reassess the appropriateness of the PM provisions for any Tier 3 standards, taking into consideration the amount of credits generated up to that point and adjusting their value in some manner or taking the expected credit balances into account in setting the Tier 3 standard levels. However, at this time, EPA is finalizing the inclusion of PM emissions in the ABT program.

For early banking of PM credits, EPA will allow manufacturers to begin banking credits as soon as the rule becomes effective. EPA had asked for comment on limiting the number of years manufacturers could accumulate early PM credits due to concerns that manufacturers might be able to accumulate a significant number of PM credits in the two to seven years that will occur before the new Tier 2 standards take affect and a lack of PM emissions data on Tier 1 engines below 130 kW which were not fully certified at the time the NPRM was developed. In the time since the NPRM was issued, more certification information for the Tier 1 program has become available. Beginning in 1997 and 1998, the engines between 37 kW and 130 kW were required to be certified. While these engines are not required to meet a PM standard under Tier 1, a number of manufacturers did submit PM emissions data on their certification engines. The results show that as the power level of the engines is reduced, the PM levels go up. Based on the full set of certification PM data submitted, EPA analyzed the potential for early generation of PM credits before the Tier 2 standards take effect for each category. There was not a significant difference in the amount of early PM credits that could be generated with and without the proposed two-year limitation.[6] In addition, providing for early PM credit generation for all engines at the same time (i.e., as soon as today's action becomes effective) simplifies the program and reduces the oversight necessary, by both manufacturers and EPA, to assure manufacturers are complying with the appropriate provisions. For these reasons, EPA is not finalizing any limitation on the number of years manufacturers can bank early PM credits prior to the new standards taking effect.

EPA also now believes the proposed limitation that would prohibit early PM credit generation for Tier 1 engines at or above 37 kW unless the engines meet the Tier 1 NOx level is overly restrictive. EPA now believes these engines should be allowed to generate PM credits against the Tier 2 PM standards (i.e., a more stringent requirement than now applies to Tier 1 engines at or above 37 kW) and use NOx credits against the Tier 1 NOx standard. As noted later in this Summary and Analysis, EPA is adopting a proposed provision that would prevent manufacturers from earning credits on one pollutant while using credits on another pollutant. However, EPA believes Tier 1 engines at or above 37 kW should be allowed to generate early

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[6] EPA memo from Phil Carlson to Docket A-96-40, "Early PM Credit Generation from Nonroad CI Engines," July 22, 1998.

PM credits while at the same time using NOx credits because these engines would have to be below the new Tier 2 PM levels in order to generate any PM credits, and therefore the engines would already be cleaner than Tier 1 currently requires for PM. EPA is not concerned about possible gaming of the ABT program for such engines since all Tier 1 engines certified between 37 kW and 560 kW are currently meeting the Tier 1 NOx standard without the use of ABT. While it is possible that manufacturers could introduce new Tier 1 engine designs or modify their current Tier 1 engine designs prior to the new standards being implemented, it does not seem likely that such engines would have emissions above the Tier 1 NOx level. For these reasons, EPA is not finalizing the requirement that Tier 1 engines at or above 37 kW meet the Tier 1 NOx standard in order to bank early PM credits.

h. PM Credit Trading Restrictions

Summary of the Issue

Due to the fact that EPA only had limited PM emissions information on Tier 1 engines below 130 kW, EPA requested comment on whether EPA should prohibit trading of PM credits across the regulatory power categories. The numerical levels of the proposed Tier 2 PM standards increase as the power level category goes down. EPA was concerned that lower power engines, which have higher PM standards, could generate large numbers of credits which, in turn, could be used to certify higher power engines with more stringent PM standards and thereby significantly delay implementation of the Tier 2 PM standards.

Comments

EMA, two engine manufacturers, and EMI opposed restrictions on trading PM credits across power categories. They commented that such restrictions will increase costs, decrease flexibility, decrease the incentive to participate in the ABT program, and decrease the potential benefits ABT can provide. Cummins Engine Company commented that, at a minimum, any restriction should apply only to credits generated by Tier 1 engines and should only be restricted such that credits do not cross the 130 kW point.

STAPPA/ALAPCO and environmental groups commented in support of the trading restrictions. In addition, environmental groups commented that EPA should prohibit manufacturers from trading PM credits altogether.

Analysis

EPA does not believe that restricting PM credit trading across power categories is necessary. In the time since the NPRM was issued, more certification information from the current Tier 1 program has become available. Beginning in 1997 and 1998, the engines between 37 kW and 130 kW were required to be certified. While these engines are not required to meet a PM standard under Tier 1, a number of manufacturers did submit PM emissions data on their

certification engines. The results show that as the power level of the engines goes down, the PM levels begin to increase. Therefore, EPA's concerns regarding the potential for significant PM generation from lower power engines due to the numerically higher PM standards for those power categories appears unwarranted. In addition, EPA agrees that trading restrictions unnecessarily limit the flexibility offered by ABT and would not be expected to have any effect on the environmental impact of the program. For these reasons, EPA is not finalizing any restrictions on the trading of PM credits across power categories. (One exception to this is the limitation applied to all trading of credits across averaging sets. Under this restriction, credits cannot be transferred across the 19 kW breakpoint. This exception is discussed below.)

i. Multi-Year Averaging Program for Engines Below 37 kW

Summary of the Issue

Because of the short period of time between the date the standards were expected to be finalized and the 1999 and 2000 model year implementation deadlines for the Tier 1 standards for engines rated under 37 kW, EPA proposed a multi-year averaging program for engines below 37 kW. The program would require manufacturers to keep tab of the credit accounts for two categories of engines - engines less than 19 kW and engines from 19 kW to less than 37 kW. Unlike the current ABT program, manufacturers would be allowed to create a negative balance of credits during the first two years the Tier 1 standards applied and would be required to eliminate the negative balance by the end of the fourth year that the Tier 1 standards applied. However, at the end of each year, a ten percent penalty would be added to the manufacturer's negative balance of credits being carried over to the next year. The credits needed to pay off the negative balances would have to be generated by the manufacturer within the given power category and could not be credits obtained through trading with another manufacturer.

Comments

EMA and OPEI supported the multi-year averaging program. EMA commented, however, that EPA should eliminate the ten percent penalty for carry-over credit balances because it reduces benefits manufacturers gain by participating. Environmental groups did not support allowing manufacturers to generate a negative credit balance because they believe such flexibility is not warranted since manufacturers agreed to the proposed standards. They also noted that if EPA decides to allow multi-year averaging, then manufacturers should be assessed at least a 20 percent penalty to provide a greater environmental dividend.

Analysis

In order to preserve the early implementation dates of the Tier 1 standards for engines less than 37 kW, EPA continues to believe it is necessary to retain the multi-year averaging program. Without such a program, EPA would need to consider delaying implementation of the Tier 1 standards for engines below 37 kW and risk losing the environmental benefit from these engines

for at least one year. Allowing manufacturers to carry negative balances in the first years of the program may result in a small loss of benefit in the short term. However, because they will be required to make up the negative balance, there should be no negative impact. Indeed, applying a penalty to the negative credits carried over as proposed will result in a small improvement in emissions in the long run. Therefore, EPA is retaining the multi-year averaging program for engines below 37 kW.

Regarding the level of the penalty applied to negative credit balances that are carried over, EPA believes having the penalty will ensure the environment receives a small benefit from the program. If EPA sets the level too high, then manufacturers may not be able to take advantage of the program because making up the credits within four years would be too difficult. EPA continues to believe that the ten percent penalty strikes the appropriate balance between the environment and making sure that manufacturers can meet the new standards through use of the multi-year averaging program. Therefore, EPA is retaining the ten percent penalty for negative credit balances carried over in the multi-year averaging program.

j. Credits from Engines Below 37 kW

Summary of the Issue

As noted earlier, EPA proposed several special provisions for engines less than 37 kW that were intended to account for the unique characteristics of the market for these engines. The proposed provisions included a requirement that Tier 1 credits for engines below 19 kW be calculated against Tier 2 standards, a limited lifetime for credits generated from Tier 1 engines below 19 kW, a prohibition on trading credits across the 19 kW power threshold, and a prohibition on trading credits generated from indirect injection engines at or above 19 kW to other manufacturers.

Comments

Environmental groups commented that instead of the piecemeal fixes proposed, EPA should require that credits for all Tier 1 engines below 37 kW be calculated against the Tier 2 standards. The California ARB also commented that all credits below 37 kW should be calculated against the Tier 2 standards.

Analysis

In developing the proposal, EPA proposed both emission standards and the ABT program to go along with those standards. For engines less than 19 kW, where the cleaner, indirect injection engines predominate (roughly 80 percent), EPA proposed to require all credit generation and use against the Tier 2 standards even during the Tier 1 time frame. Therefore, manufacturers would not be allowed to earn credits on their large numbers of relatively clean indirect injection engines unless they were certified below the more challenging Tier 2 standards. At the same time, the

higher-emitting direct injection engines would not be required to meet a level of standard that would be too difficult to meet in the short amount of leadtime available. In the power category from 19 kW to less than 37 kW, where a much more significant fraction of direct injection engines are sold (roughly 50 percent), EPA proposed to require that all credit calculations be made against the applicable standard (i.e., against the Tier 1 standards for Tier 1 credits and against the Tier 2 standards for Tier 2 credits). Because of the larger proportion of direct injection engines in the 19 kW to less than 37 kW category, EPA believes that having a requirement similar to the one for engines below 19 kW could be problematic for manufacturers that produce a large number of direct injection engines since they would not be able to rely on the availability of credits from indirect injection engines if needed. The main benefit EPA sees to adopting the approach suggested by the commenters would be to simplify the ABT program requirements for engines below 37 kW. While a simple program is desirable, the overall concern is the feasibility of the standards, which would definitely be negatively affected if such a change to the ABT program were made. Therefore, EPA is planning to retain the provisions for engines below 37 kW as proposed.

k. Indirect Injection Engine Credit Trading Restrictions

Summary of the Issue

Because indirect injection engines are significantly cleaner than current direct injection engines, EPA proposed to prohibit the trading of credits from indirect injection engines. EPA concluded that most engines below 19 kW use indirect injection. As a result, EPA defined averaging sets for purposes of the ABT program that would prevent emission offsets in engines rated at or above 19 kW using credits generated by engines below 19 kW. EPA also proposed to prohibit the trading between manufacturers of credits generated from indirect injection engines rate at or above 19 kW. Manufacturers would still be allowed to use the credits from indirect injection engines for their own engines at or above 19 kW.

Comments

Case Corporation commented that EPA's proposal to restrict credit transfers across power categories for indirect injection engines is arbitrary and capricious. They believe that EPA should address this concern by setting separate emission standards for indirect injection engines.

Analysis

Case Corporation appears to have misunderstood the proposed provisions. As described above, EPA did propose to prohibit the trading of credits from indirect injection engines between manufactures. However, the only restriction on exchanging credits across power categories was the prohibition on the exchange of credits from engines below 19 kW with credits from engines greater than or equal to 19 kW. That restriction applied to all technologies, not only indirect injection engines. EPA is making no changes to the indirect injection engine trading provisions

as proposed.

l. Marine Engines

Summary of the Issue

As noted earlier, for the first time, EPA has proposed to cover engines below 37 kW in the nonroad CI engine program, including marine engines less than 37 kW. For the purposes of ABT, EPA proposed to prohibit the use of credits from land-based engines to show compliance for marine engines. However, manufacturers would be allowed to use marine credits to show compliance for land-based engines. The remaining details of the ABT program would apply to equally to marine engines.

Comments

EMA supported EPA's proposal to allow the use of marine credits for land-based applications. They also recommended that EPA allow the use of land-based credits for marine applications. The International Association of Drilling Contractors questioned the application of the ABT program to marine engines introduced into international service as the emission reductions may not benefit areas in the United States.

Analysis

EPA continues to believe that trading credits from land-based applications to marine applications is inappropriate. Allowing such trading could allow some manufacturers that make both marine and land-based applications to effectively trade out of the marine portion of the program. This could put those manufacturers at a competitive advantage over small marinizers who only sell marine engines and therefore could not trade out the program as easily, if at all. In addition, if land-based credits are allowed to be used to certify marine engines, port areas may not achieve the levels of emission reductions since land-based applications tend to be spread throughout the nation whereas marine applications are tightly focused in the port areas of the country. For these reasons, EPA is retaining the provisions that prohibit the trading of credits from land-based applications to marine applications.

With regard to the issue of including engines used in international service, EPA believes the comment has some merit. However, EPA also believes that the cost of introducing and managing a tracking program for engines less than 37 kW installed on U.S. vessels engaged in international voyages would far outweigh the benefits of preventing these engines from generating credits. These engines are relatively small and are not used in large numbers on vessels that travel internationally. Therefore their impact on the emissions benefit of the ABT program will be negligible. For this reason, EPA will not require tracking of marine engines to determine if the engines are used in international service. Manufacturers may include all of their marine engines sold in the U.S. in their ABT credit calculations.

m. Prohibition on Credit Generation and Use by the Same Engine

Summary of the Issue

EPA proposed to prohibit manufacturers from earning credits for one pollutant while generating credits for another pollutant from the same engine family.

Comments

Case Corporation commented that EPA's proposal was arbitrary and capricious. They argued that it does not make a difference environmentally, which engines use credits and which engines generate them.

Analysis

EPA does not believe that such a prohibition is arbitrary and capricious. It is a known fact that there is a tradeoff between NOx and PM emissions with CI engines. By Case's own admission, the proposed restriction ensures that the stringency of the standards is maintained and does, therefore, benefit the environment. Without the restriction, manufacturers could overcontrol one pollutant to generate credits at the expense of undercontrolling the other pollutant. This type of gaming of the ABT program could result in a significant relaxation of the standards. Therefore, EPA continues to believe that manufacturers should be prohibited from generating credits for one pollutant while using credits for another pollutant and is retaining the provision. As described earlier, one exception to this restriction is allowed for Tier 1 engines at or above 37 kW which generate early PM credits. EPA will allow those engines to generate PM credits while simultaneously using NOx credits, but only because the PM credits are calculated against the more restrictive Tier 2 PM standards.

n. Inclusion of California Engines in the ABT Program

Summary of the Issue

EPA requested comment on including engines certified to meet the State of California's standards in the ABT program. Manufacturers may not currently include engines sold in California in their credit calculations.

Comments

EMA and two engine manufactures supported the inclusion of engines certified to California's standards in the ABT program citing cost and harmonization issues.

Analysis

The new standards for nonroad CI engines contained in this rulemaking are expected to be adopted by California in the near future. This will result in one harmonized set of standards for the entire United States. Therefore, EPA is modifying the ABT program to allow manufacturers to include engines sold in California in their credit calculations.

o. FEL Upper Limits

Summary of the Issue

Along with the proposed standards, EPA proposed maximum FELs for engines certified using ABT credits to limit the number of credits that can be used to offset emissions for a particular engine family.

Comments

Case Corporation commented that the Tier 2 FEL upper limit of 10.5 g/kW-hr for NMHC plus NOx needs to be at least 12.5 g/kW-hr for all engines at or above 37 kW. They noted that EPA, in proposing the Tier 2 FEL upper limit for engines rated at or above 37 kW, assumed engines had NMHC emissions below 1.3 g/kW-hr when, in fact, not all engines between 37 kW and 74 kW currently achieve that NMHC level. Case Corporation commented that the Tier 3 NMHC plus NOx FEL upper limits and the Tier 2 and Tier 3 PM FEL upper limits should also be raised to account for production variability.

Analysis

For most power categories, EPA set the FEL upper limits at the level of the standards for the previous Tier. For engines at or above 130 kW, where Tier 1 standards currently exist for NMHC, NOx and PM, EPA sees no reason to change this practice. These engines are already meeting these standards without the use of ABT credits. Therefore the Tier 2 NMHC plus NOx FEL upper limit for engines at or above 130 kW shall remain 10.5 g/kW-hr. Likewise, for the Tier 3 NMHC plus NOx standard, EPA is retaining the proposed FEL upper limits which were based on the Tier 2 standards.

For engines at or above 37 kW and less than 130 kW, EPA agrees that some engines could have NMHC emissions greater than the 1.3 g/kW-hr level assumed in establishing the proposed FELs since those engines are not required to meet an NMHC standard under the current Tier 1 program. Based on emission levels for pre-control nonroad CI engines presented in the Nonroad Engine and Vehicle Emission Study (NEVES) report, the maximum hydrocarbon emissions level is 2.3 g/kW-hr. Therefore, for engines at or above 37 kW and less than 130 kW, EPA is revising the Tier 2 NMHC plus NOx FEL upper limit to 11.5 g/kW-hr (i.e., the sum of the Tier 1 NOx standard of 9.2 g/kW-hr and the 2.3 g/kW-hr hydrocarbon level noted above). For the Tier 2 PM standards, EPA is retaining the proposed FEL upper limits which were already based on the previous PM standard for engines at or above 130 kW, and the maximum PM from pre-control

CI engines noted in the NEVES report.

p. Credits from Engines Certified with Special Test Procedures

Summary of the Issue

EPA's current ABT program does not allow manufacturers to include engines certified under special test procedures in their ABT calculations.

Comments

EMA commented that EPA should permit engines certified under special test procedures in the ABT program. They noted that EPA approves special test procedures based on equivalency with established test procedures, and therefore there is no reason to exclude such engines from the ABT program.

Analysis

While it seems reasonable to allow engines in the ABT program if they were certified under a special test procedure approved by EPA as equivalent to the established test procedure, EPA is concerned that there may be some cases where a special test procedure can be approved but it would not be appropriate to grant credits to such engines (or allow them to use credits). Therefore, EPA does not believe it would be appropriate to adopt a blanket approval for inclusion of engines certified under special test procedures in the ABT program. However, EPA believes that manufacturers should be allowed to request inclusion of such engines in the ABT program at the time of certification. Therefore, EPA will allow manufacturers to request inclusion in the ABT program of engines certified under special test procedures at the time of certification. EPA will respond to each request as part of the normal certification process as to whether or not to grant the manufacturer's request.

q. Credit Calculations

Summary of the Issue

Within the regulations for the ABT program, EPA proposed the equations that manufacturers will use to calculate the amount of credit generated or used by an engine family.

Comments

Case Corporation commented that EPA should use annual usage rate and load factor if EPA is trying to tie the ABT credits to in-use emission reductions. They also commented that EPA needs to address the rounding of credits to 0.1 Megagram because it is difficult to even generate 0.1 Megagram of credits in cases of low production volume. EMA commented that EPA should

use metric units throughout the ABT regulations to be consistent with the metric units used for the emission standards.

Analysis

Historically, EPA's ABT programs have relied on an engine's useful life as a surrogate for its usage rate. While it would be most accurate to use actual hours of operation to establish the in-use credits generated by an engine, establishing such a requirement for engine manufacturers to track and monitor the in-use operation of equipment using their engines would be extremely burdensome and make the ABT program unusable. Therefore, EPA is retaining the useful life term in credit calculations.

The current and proposed equations for credit calculations do not include an adjustment for load factor. As noted in the proposal, most types of nonroad CI equipment have similar load factors and therefore load factor was not included in the credit calculation equations. Again, EPA does not believe it would be feasible for engine manufacturers to track and monitor the in-use load characteristics of equipment using their engines. Therefore, EPA is not requiring the use of any load factor in determining ABT credits.

With respect to rounding credits, EPA can see in certain cases, that engines with a low power rating, low sales, and FELs close to the standard could generate, or need to use, less than 0.05 Megagram of credits, which under the current approach would be rounded off to zero. For this reason, EPA believes it would be appropriate to allow manufacturers to round to the nearest 0.01 Megagram so as to assure manufacturers that they do not lose the flexibility offered by ABT and can still certify their engines through the use of the ABT program. Therefore, EPA will allow manufacturers to report their credits to the nearest 0.01 Megagram for both credit generation and credit use.

In regard to the comment on metric units, EPA believes it would be appropriate to require manufacturers to use metric units for all ABT credit calculations. The standards, themselves, are designated in metric units and it makes sense to use metric units throughout the ABT program. Therefore, EPA is revising the credit calculation equations to require the use of metric units for all appropriate terms.

r. Reporting Requirements

Summary of the Issue

Manufacturers are required to keep a variety of records for their engines certified under the ABT program and report certain pieces of the information to EPA on a regular basis.

Comments

Case Corporation commented that EPA should simplify the reporting procedures for ABT. Specifically, they noted that requiring manufacturers to know how many engines will be delivered to customers in the United States when they ship engines to equipment manufacturers results in additional complexity and costs.

Analysis

In establishing the reporting requirement for the ABT program, EPA has attempted to minimize the effort necessary for manufacturers while ensuring the integrity of the program and the accuracy of the emission impact of the program. Because a large amount of nonroad CI equipment is exported overseas, EPA believes it is very important to require engine manufacturers to accurately predict their engine sales for the United States market. Otherwise, manufacturers that have large numbers of their engines exported in pieces of nonroad equipment could inappropriately generate high levels of credits, or conversely, be required to use a higher number of credits than actually necessary. Engines exported out of the country may only be included in ABT calculations if those engines are imported back and sold in the United States in nonroad equipment. Thus, to ensure accurate credit calculation, EPA is retaining the requirement that manufacturers retain records of the number of engines sold in the United States.

s. Averaging Sets

Summary of the Issue

As part of the ABT program, EPA defines averaging sets. A manufacturer is allowed to average, bank and trade credits within the averaging sets but not outside of the averaging sets. EPA proposed four averaging sets in the NPRM.

Comments

EMA noted that §89.204(c) of the regulations needs to be clarified to define the four averaging sets EPA has described in its proposal. They commented that the regulations only define three of the four averaging sets.

Analysis

In response to EMA's comment, EPA has made minor changes to the averaging set definitions to clarify the four averaging sets contained in the ABT program. For clarification purposes, the four averaging sets will be as follows: 1) Marine engines rated at or above 19 kW, 2) marine engines rated below 19 kW, 3) eligible engines rated at or above 19 kW, other than marine engines, and 4) eligible engines rated below 19 kW, other than marine engines.

t. Use of "Credit Shortfall" Terminology in the Regulations

Summary of the Issue

In the ABT regulations, EPA uses the terminology "credit shortfall" to denote the situation where a manufacturer is certifying an engine family with an FEL above the applicable emission standard. In other words, the manufacturer will be required to offset those negative credits with credits generated from engine families with FELs below the applicable emission standard before the end of that year. (Except as proposed under the special multi-year averaging program for engine less than 37 kW, EPA does not allow manufacturers to carry a negative credit balance at the end of a year.)

Comments

Cummins Engine Company commented that EPA needs to improve the choice of wording for "credit shortfall" used in the regulations. They believe it implies the manufacturer fell short of its ABT plans, when it is actually referring to a normal situation that could occur to a manufacturer during a calendar year before they do the necessary credit accounting.

Analysis

The term credit shortfall is used repeatedly in the current nonroad ABT regulations (see §§89.203 and 89.204) as well as the ABT regulations for highway, marine spark ignition, and locomotive engines. EPA wishes to clarify that the term is used to denote the situation where a manufacturer is certifying an engine family with an FEL above the applicable emission standard and generating "negative" credits. That negative credit balance is expected to be paid back before the end of the year, otherwise the manufacturer is violating the requirements of the ABT program. EPA does not believe it is necessary to change the language in the regulations.

u. ABT and the 2001 Feasibility Review

Summary of the Issue

In the proposal, EPA noted that it intends to undertake a review of the current steady-state test procedure as part of the 2001 feasibility review. Should EPA determine as a part of that review that a new test procedure is necessary to achieve the expected in-use emission reductions, EPA noted that it would need to reassess the appropriateness of the PM ABT provisions for any future Tier 3 standards.

Comments

EMA commented that any changes EPA plans to make as a result of the 2001 feasibility review cannot retroactively eliminate or affect credits already generated or used.

Analysis

EPA believes it would be inappropriate at this time to make any commitments related to the potential effects of the 2001 feasibility review on the ABT program. If a switch in test procedures is made, EPA will need to determine whether credits calculated with steady-state test results should be adjusted to account for any differences between the test procedures. EPA may also decide to consider the number of credits, or expected level of credits, in setting a proposed Tier 3 PM standard. By connecting the stringency of the standard to the number of available credits, EPA might indirectly affect the value of those outstanding credits. While EPA will work to avoid unfair results, EPA must leave open available options to ensure that EPA has adequate flexibility to respond to the 2001 feasibility review findings.

6. Technological Feasibility and Projected Costs

Summary of the Issue

In conjunction with the proposed emission standards, EPA completed an assessment of the technological feasibility of meeting the standards and estimated the associated costs to engine and equipment manufacturers. EPA received numerous comments on the methodology and details of the analysis, which are addressed below, with comments grouped into broad categories.

a. Technological Feasibility and Technology Transfer

Comments and Analysis

1. *Commenters wanted EPA to justify reduced R&D estimates for complying with nonroad emission standards relative to highway engines (10%, 40%, 67% for different sizes of engines); they argued that the cost analysis relies too heavily on technology transfer.*

Given the recently completed effort to estimate costs for highway engines, EPA's analysis of nonroad engine costs provided a rationale to justify the various levels of R&D projected for each power category. Specifically, technologies developed for highway engines, typically between 100 and 400 kW, would transfer most readily to nonroad models in the same power range because the engines produced for the different applications have so much commonality in design and construction. Smaller and larger engines are expected to require more design effort than the highway-size nonroad engines, though not as much for the initial development of these technologies for highway engines. This is evidenced by the natural trend of incorporating heavy-duty diesel engine technologies into light-duty applications; once basic improvements in fuel-injection, air handling, etc. are developed, those changes eventually work their way into other engine markets. Commenters offered little or no rationale for the limited potential for cost savings from technology transfer and suggested no quantitative adjustment to the methodology; EPA therefore believes that the approach to determining projected R&D costs still represents the best estimate of the level of effort required to redesign engines to comply with the new emission standards.

2. *Commenters stated that reduced costs for tooling relative to highway engines are only applicable where nonroad and highway engines are identical.*

EPA agrees that tooling costs can only be shared with highway engines in cases where engine components are identical. As discussed in the Draft RIA, EPA believes that in many cases similar nonroad and highway engines will be combined into a single model, or at least share an increasing number of identical hardware components. Differences between highway and nonroad counterpart engines will decrease over time, with minor variations, especially in electronic control software, to account for the different applications. Retooling costs in the Final RIA have been adjusted accordingly.

3. *Commenters believe that EPA needs to re-evaluate the transfer of highway technologies for certain applications such as skid-steer loaders that have unique constraints; e.g., compact equipment may lose its utility if an engine requires more space. Adding a turbocharger and aftercooler was thought to impair the utility and increase operating costs to the point of obsolescence.*

To argue that an application using naturally aspirated engines is pressed to the limit of the engine size that can be accommodated is unjustified. While an engine's "envelope" may change or increase in size, turbocharging a naturally aspirated engine can readily increase its power density by 30 percent or more, allowing equipment manufacturers to specify a significantly smaller engine to do the same work. Adding a turbocharger and an aftercooler generally reduces operating costs and improves performance, as experienced by various current models. Manufacturers have indicated that turbo lag can be problematic in some applications; if turbo lag is an unacceptable compromise for these engines, then similar charge air compression without lag could be achieved with a supercharger.

4. *Commenters believe that EPA needs to demonstrate the feasibility of emission standards or otherwise show that the standards are achievable.*

EPA included in the Draft RIA an assessment of various technologies under consideration in the effort to control diesel engine emissions. The Draft RIA also included a reference to the RIA prepared for the 2004 highway emission standards, which has extensive quantitative information about emission reductions associated with the various technologies. The Agency believes that this information sufficiently supports the feasibility of complying with the new emission standards.

5. *Commenters argued that the anticipated increase in cooling load from increased heat rejection will increase noise, which needs to be addressed.*

As described in the Draft RIA, controlling NOx emissions will correspond with significant reduction in engine noise because of the correlation between NOx emissions and the noise of combustion. Combustion-related noise reductions may be as great as 8 or 10 decibels, which is much greater than that anticipated from increasing the size or speed of the cooling fan.[7]

6. *Commenters felt that EPA inadequately supported the expectation that diesel engine technology would be transferrable to nonroad applications.*

Highway heavy-duty engines will be subject to a 5.4 g/kW-hr (4.0 g/hp-hr) NOx standard

[7] "New Common-rail Diesels Power Alfa's 156," Automotive Engineering International, January 1998 (Docket A-96-40)

beginning in the 1998 model year. For those manufacturers that produce engines for both highway and nonroad service, variations on a single engine model are sometimes sold for both markets. Because these engines have similar emission levels on the eight-mode test, they could likely comply with the proposed Tier 2 NMHC + NOx standards with relatively minor modifications to adapt the technology to nonroad applications. Similarly, Tier 3 standards are intended to follow the highway engine standards proposed for the 2004 model year, with the expectation that technology transfer will be a very important element of achieving compliance with the nonroad standards. Even where engines are dedicated to nonroad applications, the very similar engine design makes clear that much of the technological development that has led to lower-emitting highway engines can be transferred or adapted for use on nonroad engines. Specifically, much of the improvement in highway engines has come from "internal" engine changes such as variation in fuel injection variables (injection pressure, spray pattern, rate shaping), modified piston bowl geometry for better air-fuel mixing, and improvements intended to reduce oil consumption. Introduction and ongoing improvement of electronic controls have played a vital role in facilitating many of these improvements.

Other technological developments for highway heavy-duty engines require a greater degree of development before they can be applied to nonroad engines. Turbocharging is widely used now in nonroad applications, especially in larger engines, because it improves power and efficiency by compressing the intake air. Turbocharging can also decrease PM emissions; however, changing an engine from naturally aspirated to turbocharged may raise concerns about "packaging," since with the added turbocharger the equipment may have to be adapted to accommodate a physically larger engine. The concern for packaging is especially sensitive for small, compact equipment designs. Space constraints, though, are generally a matter of cost rather than feasibility and are further addressed in the discussion of cost to equipment manufacturers. Turbochargers increase the power density of engines, but switching to a smaller engine with equivalent power may require substantial equipment redesign. EPA expects that, over the long term, equipment specifications will be updated to take advantage of the substantial growth in power density from all engines; however, the difficulty of making this transition prevents any straightforward analysis of addressing engine packaging concerns with more compact engines.

Aftercooling is a well established highway engine technology that has only recently been widely used in nonroad engines. The aftercooler chills the hot air coming from the turbocharger before it enters the cylinder, which decreases fuel consumption and helps prevent NOx formation by reducing combustion temperatures. Air-to-water aftercoolers, which use the engine's coolant to provide partial cooling of the the intake air, can fit readily into most engine applications. In the long term, manufacturers are expected to move toward air-to-air aftercooling, which provides much better benefits for fuel economy and NOx control. Because of the additional space required for air-to-air aftercoolers (for a separate heat exchanger and a bigger fan), these improved aftercoolers may in some cases be integrated when equipment manufacturers are ready to rework the overall designs for their equipment models.

In evaluating the feasibility of the proposed nonroad standards, it is helpful to separately consider three broad categories of engines. First, manufacturers of turbocharged nonroad diesel engines, most often rated over 75 kW, generally have the flexibility to incorporate more sophisticated technological innovations for performance, fuel economy, and emission control, including those derived from counterpart highway engines. Electronic controls offer great potential for improved control of engine operating parameters for better performance and lower emissions. Unit pumps or injectors would allow higher-pressure fuel injection with rate shaping to carefully time the delivery of the whole volume of injected fuel into the cylinder. Routing of the intake air and the shape of the combustion chamber can be redesigned for improved mixing of the air-fuel charge. Air-to-air aftercooling will likely gain widespread use in turbocharged engines, primarily for its fuel consumption and durability benefits, though it also lowers NOx emissions. Manufacturers will be able to combine many of these technologies to comply with Tier 2 standards. Tier 3 standards will require deployment of additional technologies. Common rail injection systems provide greater overall control of the fuel injection strategy by maintaining a constant supply of high-pressure fuel at the injectors. Also, exhaust gas recirculation will likely be introduced in highway diesel engines over the next several years, providing valuable experience in developing those systems for nonroad engines. EPA believes these technologies will be important in achieving compliance with Tier 3 emission standards. A more detailed treatment of the feasibility of these engines meeting the proposed standards is included in the regulatory impact analyses, as described above. Because the long-term standards depend on significant progress in technology development, EPA will be reviewing requirements for Tier 3 engines by 2001 to confirm that developments are progressing as expected.

The second category is the set of water-cooled naturally aspirated engines, which are most often rated under 50 or 75 kW. The lack of turbocharging (and aftercooling) and the greater sensitivity to increased costs for these relatively inexpensive engines suggest that manufacturers will likely depend on basic technologies to control emissions to the necessary levels. Expected changes can be divided into two broad categories. First, combustion optimization includes changes to basic engine design for improved air-fuel mixing and management of the combustion process. These changes might include retarded injection timing, re-entrant piston bowl shapes, greater swirl of the intake air, and improved ring design for lower oil consumption. Second, fuel injection parameters provide many variables for the engine designer. Manufacturers might modify fuel pumps, injectors, or controls to achieve higher injection pressures, more rapid injection, better control of injection timing (including rate shaping), and reduced sac volume. In addition to exhaust emission control strategies, emissions from the crankcase of naturally aspirated engines can be eliminated by routing vapors from the crankcase directly to the air intake. These technological developments are well understood and should provide manufacturers with the tools needed to comply with Tier 1 and Tier 2 standards for engines rated under 37 kW. Similarly, engines rated between 37 and 75 kW should be able to comply with Tier 2 standards using these technologies; compliance with Tier 3 standards may in addition require use of exhaust gas recirculation. EPA believes these engines can meet the proposed emission standards without needing to incorporate turbocharging. EPA believes that increasing the numerical NMHC + NOx standard by 0.9 g/kW-hr (0.7 g/hp-hr) relative to the larger engines appropriately

compensates for the design constraints imposed by these engines.

Third, many of the air-cooled diesel engines rated under 8 kW face unique design challenges. The small cylinders and low cost of these engines limit the flexibility of designing or adapting technologies to control emissions. Tier 1 standards for these engines are therefore set at less stringent levels than larger engines. To reach these levels, manufacturers will need to rely on several of the strategies used for other engines. For example, increasing swirl and redesigning piston head geometries can be an effective way of improving fuel-air mixing in small engines, with the additional benefit of allowing higher injection pressures without increasing fuel wetting on the cylinder walls. The position and design of piston rings can be improved to reduce the contribution of engine oil to particulate emissions. Incorporating fuel injectors that provide mechanically controlled rate shaping would allow substantial control of NOx emissions at a low cost. Using injectors with valve-closed-orifice nozzles would similarly control HC emissions. Engines that operate within a relatively narrow range of engine speeds can achieve a degree of charge-air compression with intake manifold designs that rely on pulse tuning. The unique characteristics of the smallest engines pose a challenge to the designer, but these and other technologies are available for complying with the Tier 1 and Tier 2 standards. Also, certification data from the California ARB shows that most direct injection diesel engines rated under 19 kW are currently emitting between 8 and 11 g/kW-hr (6 and 8 g/hp-hr) NMHC + NOx; all these engines will need to improve, but the current best performers support the feasibility of the Tier 1 and Tier 2 standards for all these engines.

Finally, any engines relying on natural aspiration technology are also subject to the proposed requirement to eliminate crankcase emissions. This requirement has long been in place for naturally aspirated highway engines. EPA believes that the technology required to close the crankcase is well established and easily transferrable to any size of nonroad engine.

b. Projected Deployment of Various Technologies

Comments and Analysis

1. *Commenters felt that the costs of adding or modifying turbochargers and aftercoolers should be taken into account; aspiration changes occurring after Tier 1 are a direct result of new emission standards. These changes should include consideration of increased heat rejection, which will require major changes to cooling systems. They contend that EPA's projected cost of cooling system changes (radiator and fan) is therefore low by about an order of magnitude. According to commenters, technology changes that should be included in the analysis are (a) adding a turbocharger, (b) adding an air-to-air aftercooler, (c) converting from air-to-water to air-to-air aftercooling, and (d) adding a waste gate. Also, aspiration upgrades should include consideration of additional cost to intake and exhaust systems to account for the increase in air flow, with cost increases of $30 to $80 per piece of equipment.*

EPA excluded the cost of turbocharging and aftercooling from the analysis for the proposed standards, not because these changes were expected to occur anyway, but principally because these changes carry performance or fuel economy benefits that far outweigh the benefit of improved emission control. EPA now agrees with the commenters that there should be some reflection of turbocharger and aftercooler changes in the costs analysis, though the costs of these improvements need to be adjusted to account for the benefits unrelated to emission controls. For turbochargers, the revised analysis includes the same 50 percent reduction in costs that were used in the draft analysis for electronic controls and fuel injection changes, which provides a cost discount for benefits unrelated to emission control. In the revised analysis, all direct-injection, naturally aspirated engines rated above 37 kW are projected to add a turbocharger with a waste gate. Certification data was used to determine that 50 percent of engines rated between 37 and 75 kW will need to add turbochargers, while only 25 percent of current-model engines rated between 75 and 130 kW are not yet equipped with turbochargers. All bigger engines already employ turbocharging.

Furthermore, EPA projects in the revised analysis that all engines rated between 75 and 560 kW will rely on air-to-air aftercoolers, some for Tier 2 and some initially for Tier 3. Using certification data, EPA was able to determine the fraction of engines needing to change from air-to-water to air-to-air aftercooling and the fraction of engines needing simply to add a new air-to-air aftercooler. Unlike the other technologies considered, which offer benefits for power, power density, fuel economy or otherwise improved performance, aftercoolers offer a predictable improvement in fuel economy as the principal benefit. Rather than relying on a 50 percent discount, the revised analysis therefore attributes the whole hardware cost to emission standards (accounting for the additional cost to intake, exhaust, and cooling systems), but includes a calculated cost credit for the reduction in fuel consumption. In most cases, the fuel savings are significantly greater than the incremental cost of adding or upgrading the aftercooler.

2. *Commenters noted that some Tier 2 engines will include EGR and that projections should include cost estimates for EGR, including secondary EGR costs.*

Not all manufacturers agreed on the likelihood of utilizing EGR in Tier 2 engines. In EPA's judgment, it is sensible to anticipate the use of EGR in engines rated between 37 and 75 kW. Industry sources have indicated that these engines are typically very cost-sensitive products, with less of a priority placed on fuel economy or durability. EPA therefore projects in the revised analysis that all direct-injection engines in this power range will adopt a low level of EGR for Tier 2, with an increasing degree of EGR anticipated for Tier 3 to achieve reductions in NOx emissions without resorting to the expense of adding an aftercooler. Since EGR coolers would also likely not be used for these engines, some fuel economy penalty is expected for both Tier 2 and Tier 3 engines.

3. *EPA's projections of percentage deployment of certain technologies was seen as arbitrary and unsupported. In particular, the specified deployment of electronic controls and radiator upgrades were identified as arbitrary. One commenter noted that nearly all engines between 37*

and 450 kW were expected to use electronics to comply with Tier 2 emission standards. Another commenter questioned the validity of projecting that only 33 percent of engines rated below 37 kW would need to be redesigned.

Commenters have challenged EPA's assessment of technology deployment but have not offered any countervailing information on the direction or magnitude of technology changes. EPA has nevertheless revised some of its projections used in the Final RIA. For example, as described above, aftercooling changes for the majority of equipment have replaced the modest projections for radiator and fan improvements. Also, all direct-injection engines rated over 37 kW are expected to utilize electronic controls, either for Tier 2 or Tier 3, though certification data indicates that 85 percent of Tier 1 engines rated between 450 and 560 kW already have electronic controls. Engine modifications are split between Tier 2 and Tier 3, where applicable, to more accurately reflect engine design improvements. Finally, all engines rated between 450 and 560 kW are expected to make a single fuel system upgrade to common rail for Tier 2 or Tier 3, rather than upgrading unit injection systems as a step toward adopting common rail systems.

As described in the Draft RIA, indirect injection engines, accounting for two-thirds of all engines below 37 kW, are already near or below the Tier 2 standards. Projecting that only 33 percent of engines will see modification is therefore easily supported for complying with Tier 1 standards. The revised analysis incorporates increased use of fuel pump upgrades to ensure that indirect injection engines will comply with Tier 2 standards. All direct injection engines and half of indirect injection engines are projected to need fuel pump upgrades, corresponding with currently measured emission levels from these engines.

c. Cost Projections for Individual Technologies

Comments and Analysis

1. *Commenters contend that cost estimates developed for highway engines are not well documented.*

Commenters are correct that the analysis of costs for nonroad engines relies heavily on the accuracy of cost estimates developed for technologies associated with highway engines. The highway cost estimates were developed by an EPA contractor and included extensive interaction with engine manufacturers. The results of that effort were included in a lengthy and very detailed report, with a summary and compilation of data presented in EPA's Draft RIA for the highway rulemaking and released for public comment. EPA received several comments on this cost analysis, which resulted in numerous changes to the contractor's report and EPA's analysis. EPA therefore believes that these highway cost estimates are well documented and provide a reasonable basis for estimating the cost of today's nonroad rule.

2. *One commenter noted that the EGR system costs in the draft analysis looked reasonable,*

though another commenter encouraged EPA to consider adding a cost item to address control of recirculated soot.

EPA's draft analysis included a cost for improved engine oil to accommodate the particulate loading from recirculated exhaust gases. Other approaches may be preferred over time, but much progress has already been made to develop lubricating oil and additives to accommodate up to a 5 percent loading of particulate matter without significant agglomeration of particles. As long as soot particles remain suspended in oil without agglomeration, low levels of engine wear can be maintained.[8] New standards are being developed by industry to define the performance specifications for engine oils for anticipated diesel engine designs.[9] EPA continues to believe that improved engine oil properties will be adequate to address engine performance and wear issues related to recirculated soot.

3. *Commenters agreed that the projected cost for adopting electronic controls was reasonable.*

While the cost of electronics was found to be reasonable, EPA determined that the draft analysis overestimated costs for adding electronics to engines that utilize rotary fuel pumps. These systems can accommodate electronic controls at a significantly lower cost than other fuel systems because of the simpler level of control required, a smaller number of input sensors with corresponding software simplification, and a lower need for heat removal and shielding. These cost estimates have been adjusted accordingly in the Final RIA.

4. *The unit cost of improving rotary fuel pump designs was found by one commenter to be several times too low. Another commenter wanted EPA to justify the $3 million figure estimated for R&D to upgrade a rotary fuel pump design.*

The cost estimate for a new rotary fuel pump allows for an extensive R&D effort. Translating the estimated $3 million into time, the estimated cost corresponds with a team of three engineers and three technicians working full-time for four years to develop and test out a new fuel pump design. This should be adequate considering the intermediate complexity of these fuel pumps. EPA believes that the estimated incremental cost of the new fuel pumps (nominally $100) is in line with the cost increase associated with a similar, recent upgrade of Bosch's VP-44 fuel pump. If a greater effort or a more expensive upgrade would be anticipated, then EPA would expect manufacturers to abandon rotary fuel pumps in favor of in-line or common rail systems. Yet, fuel pump manufacturers are continuing their development of rotary pump systems. EPA believes the current cost estimates for upgrading rotary fuel pumps are reasonable

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[8]"Understanding Soot Mediated Oil Thickening Through Designed Experimentation—Part 5: Knowledge Enhancement in the GM 6.5L," Ewa A. Bardasz, et al., SAE 972952, October 1997.

[9]"Lube Oil Specs Change to Meet Tighter Exhaust Emission Regulations," Diesel Progress, February 1998.

and is therefore retaining these estimates in the Final RIA.

5. *One commenter believed the cost of converting to common rail should be twice as high.*

It is not clear from the comment why common rail costs were considered inaccurate, whether for the hardware items listed, for the level of R&D, or for the relative costs of the fuel system being replaced. Typically common rail systems are replacing in-line pump or unit injector systems, each of which are themselves complex and expensive systems. EPA attempted in the draft analysis to take all this into account in developing an incremental cost estimate for common rail systems. Lacking any new information or specific suggestions for changing the details of this cost estimate, EPA will maintain the published cost figure.

6. *Several commenters suggested that the draft analysis did not include enough consideration of a fuel penalty associated with the new technologies. One commenter acknowledged that the fuel economy benefits of turbocharging or converting to air-to-air aftercooling can offset some fuel penalties for other technologies.*

The draft analysis addressed fuel economy impacts by stating the general expectation that fuel penalties associated with technologies such as timing retard or EGR would be offset by improvements made possible by improving fuel injection technologies and adding electronic controls. EPA has reviewed the potential fuel economy impacts and made some adjustments in the revised analysis. First, for engines rated between 37 and 75 kW, the analysis now includes a fuel economy penalty. Since these engines are already very close to meeting the Tier 2 standards, EPA believes that manufacturers will attempt to trim NOx emissions as needed while minimizing purchase price. As a result, the revised analysis projects the use of a small degree of hot EGR for all direct injection engines and some timing retard for a small number of engines. Both of these have corresponding fuel penalties of 0.5 percent; the small fuel penalty is reasonable given the fact that little additional control is needed for these engines to comply with Tier 2 standards. For Tier 3 standards, greater use of EGR will add to the fuel penalty, but that effect should be partially offset by the use of electronic controls, improved fuel injection systems, and other engine modifications. Thus, a net penalty of another 0.5 percent was used for Tier 3.

For engines rated between 75 and 560 kW, introduction of air-to-air aftercooling is expected to dominate the fuel economy impact. The expected benefit of upgrading from air-to-water to air-to-air aftercooling ranges from 6 to 8 percent at Tier 1 emission levels. Introducing air-to-air aftercooling to achieve lower emission levels will somewhat compromise the fuel economy benefit, though not in a way that is easy to predict. Also, as described above, other technology changes will likely lead to no net change in fuel economy, or may at worst involve a small fuel penalty. The analysis therefore includes a projected 3 percent improvement in fuel economy for those engines upgrading from air-to-water to air-to-air aftercooling. Engines currently with no aftercooling are projected to see a 6 percent improvement in fuel economy by adding an air-to-air aftercooler. The resulting fuel savings (net present value at the point of sale) in most cases are greater than the total anticipated increase in the purchase price of engine or equipment models. While these projected fuel savings would be a valuable improvement, EPA does not rely on this benefit to justify the new emission standards; in fact, the principal calculations for cost-effectiveness supporting the final rule do not factor in any credit for reduced fuel consumption.

7. *One commenter thought that engine changes falling under the category identified as engine modification should include consideration of variable costs for upgraded systems (injection pressure, etc.); for example, timing retard requires better parts to deal with greater wear potential. Commenters felt that engine capital costs per unit are reasonable for small engines (between 37 and 75 kW), but are several times too low for larger engines.*

Confidential information received by EPA indicated that some manufacturers anticipate variable costs associated with their engine modifications, while others listed only fixed costs. The example cited of increasing variable costs for increasing injection pressure is consistent with EPA's analysis, since those costs are factored into the analysis of hardware improvements to upgrade fuel injection systems. With respect to timing retard, EPA expects that manufacturers will try as much as possible to improve combustion chamber geometry and other air-fuel mixing variables to optimize the system before resorting to timing retard. This difference in approach would account for the varying cost information from the different manufacturers.

EPA has included a provision for multi-million dollar R&D investments for these engine modifications, in addition to the R&D associated with all the other individual technologies. For example, for engines rated between 450 and 560 kW, the total expenditure anticipated for the range of technology development needed for Tier 2 and Tier 3 standards is $4.4 million, which corresponds to eight engineers working full-time for two years (including associated lab and clerical support). Manufacturers with high sales volumes in a product line may be able to recover greater R&D expenditure, which would allow them to more broadly assess engine design and incorporate additional features. EPA believes, however, that the cost estimates in the analysis represent a reasonable projection of the average expenditures required for the whole range of engine manufacturers participating in this market to comply with the new emission standards.

d. Costing Methodology

Comments and Analysis

1. *Commenters contended that EPA's decision to attribute only a portion of the cost of technology to emission standards is not adequately supported and that using a 50 percent (or 100 percent) discount is arbitrary. Commenters believed that EPA has failed to support an argument that these technologies would have come anyway.*

Several commenters misunderstood EPA's approach of attributing less than the full cost of technologies to emission standards. EPA did not intend to discount costs to account for changes that would occur in the absence of another tier of emission standards. The discount applied to selected technologies was intended merely to reflect the fact that some technologies in the package of upgrades needed to meet emission standards carry benefits for improved engines that go beyond reduced emissions. Turbocharging and aftercooling in the draft analysis were

effectively treated as having a 100 percent discount, meaning that these technologies were thought to have sufficient benefits for engine performance and fuel economy that the cost of these systems were warranted without regard to the potential improvement in emission control. As described above, the revised analysis now takes into account the costs of turbocharging and aftercooling.

EPA agrees that supporting a numerical percentage discount is not straightforward. By taking the turbocharging and aftercooling costs into account, EPA acknowledges that no technologies used to control emissions should be completely discounted. On the other hand, the engine performance benefits of certain technologies are so important that it would clearly be inappropriate to attribute the whole cost of these technologies to the tighter emission standards. Highway diesel engines illustrate this effect. Engines meeting current emission standards have incorporated many technology changes over the last fifteen years to better control emissions, while truck drivers and trucking companies enjoy the benefits of using the sophisticated, new, high-performance electronic engines. Thus neither a 0 percent nor a 100 percent discount are appropriate. EPA believes that it is appropriate to provide equal weighting to emission and non-emission benefits of electronic controls, fuel injection changes, turbocharging, and engine modifications, based on the observed value of these performance improvements in the field. This translates into the 50 percent discount generally used in the draft analysis. Lacking any feedback on a better numerical discount, EPA will continue to use the 50 percent figure in the revised analysis.

2. *Commenters felt that applying a learning curve to reduce the variable costs of hardware changes over time is unsupported. They added that the initial quoted cost estimates already reflect expectations for reducing costs through production learning. Commenters believed that EPA's analysis inappropriately counted learning curve benefits.*

In the draft analysis, EPA drew its conclusions about the economic benefits of a manufacturing learning curve from a single reference that compiled 22 separate case studies demonstrating an overwhelming dominance of continuous cost savings over time. The Draft RIA referenced only this single work, but EPA's contractor included an additional 15 published papers supporting the same phenomenon.[10] Moreover, in the public comments on the highway cost estimates, commenters generally supported the concept of the learning curve. EPA believes that its application of a learning curve to the incremental costs is reasonable and adequately supported.

The draft analysis applies the learning curve one time for each engine. In cases of transferring technology to nonroad engines, the learning curve was applied one time to the nonroad engine in parallel, or simultaneously, with the same learning on highway engines.

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[10]"Estimated Economic Impact of New emission Standards for Heavy-Duty On-Highway Engines," Final Report by Acurex Environmental under contract to EPA, March 31, 1997. (Docket A-96-40).

Contrary to commenters concerns, learning curve benefits for highway engines are not counted again for nonroad engines. The two learning curves are treated as parallel and separate.

Absent countervailing cost information from manufacturers, EPA will continue to interpret the initial inputs and the range of costs estimates developed as applying to the first year of production. In fact, it may be justifiable to mark down manufacturers' initial inputs to account for R&D developments that would occur before the first year of production, then continue with the learning curve from the start of production. Preferring to err on the conservative side, EPA will leave unchanged the use of the learning curve in estimating long-term costs.

3. *One commenter argued that EPA has not assessed the technological feasibility or cost-effectiveness of over complying with the proposed standards in order to generate credits. This commenter felt that these costs must be taken into account to judge the merits of averaging, banking, and trading as a feasible compliance alternative.*

As described elsewhere, EPA included an averaging, banking, and trading program with the proposed emission standards because it allowed a schedule of implementing new standards earlier or more stringent than would otherwise be feasible. Engine manufacturers' continuing strong support of a viable ABT program supports EPA's expectation that the ABT program will be used. Moreover, comments from companies advocating the use of their technologies for achieving lower emission levels support the position that engine manufacturers will have the option of selecting from a range of technological solutions to demonstrate compliance with the emission standards. Manufacturers can use varying degrees of expected control technologies, or focus on a staggered introduction of a new technology to more effectively comply with standards across their product lines. The manufacturers' use of ABT justifies EPA's application of representative, or average, cost estimates in assessing the impacts of the new emission standards, because ABT will lower costs for those engines that would otherwise be at the high end of the cost distribution curve, bringing them more in line with costs estimated for other engines.

e. Small Volume Product Lines

Comments and Analysis

1. *Commenters suggested that EPA's assumptions about streamlining engine models were not justified. They believed that some streamlining may occur, but added that reducing total sales by 15 percent would result in keeping only 17 to 31 percent of engine families. They believed that the elimination of engine models would be a loss of some value that should be assessed as a cost to society.*

Engine manufacturers have informed EPA that they intend to simplify their product offering; however, due to the difficulty of accurately quantifying projected changes, EPA has revised its analysis to move away from any such explicit assumption. As an alternative to the streamlined PSR data, EPA has taken engine model and projected sales data directly from the certification

records for Tier 1 engines. This approach takes into account any streamlining that manufacturers have done to comply with Tier 1 emission standards, but assumes no further streamlining. Engines rated below 37 kW and above 560 kW are not yet certified so no sales data from certification is available for these engines. For the largest engines, EPA used the PSR data without modification. For engines rated under 37 kW, EPA used the certification data from 37-75 kW engines to gauge the accuracy of the PSR data for smaller engines. As a result, the number of engine models in the PSR database is decreased by 20 percent and the number of total engine sales is increased by 10 percent.

In revisiting amortization issues surrounding the number of engines models and sales volumes, EPA identified another important and related factor that EPA had not taken into account in the draft analysis: namely, the potential to amortize R&D and other fixed costs over global sales volumes rather than focusing exclusively on the U.S. market to recover costs. NERA tallied up the manufacturers' input data to report that, on average, global sales for an engine family with a common R&D base are 454 percent of North American sales.[11] The number would presumably be higher if sales to Canada and Mexico were excluded from the North American sales volumes. The revised analysis incorporates this effect of global amortization of R&D costs by increasing the sales volumes for the amortization calculations by 450 percent.

2. *Streamlining equipment models was also seen as unrealistic and heavy-handed. One engine and equipment manufacturer compared its product line with that of the PSR database (which formed the basis of amortizing fixed costs), and found that the database had only 63% of its actual equipment models and only half of the actual equipment customers. Moreover, one commenter noted that streamlining equipment models does not provide much cost savings because R&D and retooling costs can be extensively shared between similar models anyway.*

EPA was misunderstood as advocating or requiring wholesale elimination of many nonroad equipment applications. Given the manufacturer's comparison of PSR data with actual sales information, EPA has removed any effect of streamlining equipment models in the cost analysis. EPA has found that the PSR data sometimes overestimates and sometimes underestimates sales information and numbers of models. Comments on the industry characterization contained in the Draft RIA generally supported the figures presented. EPA therefore believes that using the PSR data without modification is the best way of capturing the range of equipment sales and models from all manufacturers.

Based on new information from the National Economic Research Associates (NERA), EPA has also expanded the base for amortization of these costs. The NERA report included averaged data for global equipment sales volumes similar to that for engine families. For equipment, global sales of an engine family with common R&D were found to be 195 percent of North

[11]"Economic Evaluation of Regulations on Exhaust Emissions from Large Nonroad, Compression-Ignition Engines," Final Report by the National Economic Research Associates for EMA and EMI, October 29, 1997 (Docket A-96-40).

American sales. The revised analysis therefore increases sales volumes for amortization calculations by 200 percent.

f. Cost of Redesigning Equipment

Comments and Analysis

1. *One commenter noted that between 200 and 400 engineering hours have been required for past redesigns of a variety of augur equipment models. (EPA's analysis allowed for anywhere from 130 to 1400 engineering hours, depending on the degree of difficulty in redesigning equipment.) One company commented that 1800 man-hours were required to fix a single compressor design. (While EPA's analysis projects total labor requirements from 180 to 3100 man-hours, compressors were included in the "portable" category, which was not expected to require more than 530 man-hours per equipment model on average.) One commenter noted that EPA's high-end figure of $220,000 for fixed costs per equipment model was "conceivable," while another related that past redesigns have cost anywhere from $100,000 to $500,000 per product line. One high-volume equipment manufacturer thought that EPA's projected per-unit cost of equipment capital agreed fairly well with their own estimate, though consideration of all low-volume lines should justify higher unit costs. On the other hand, it was pointed out that by sharing R&D and retooling between similar models, low volume models can be produced relatively cheaply.*

The variety of comments received regarding EPA's estimate of fixed costs for equipment models seem inconclusive. Some comments generally support the accuracy of the published estimates, while others suggest that it would be appropriate to significantly increase the cost figures. One factor that may serve to reconcile these opposing perspectives is the idea that individual models may be more costly, but combining the effort for similar product lines can lead to substantial reductions in the average cost to redesign equipment models. It seems clear that an extensive investment of effort and even retooling to redesign one equipment model would have the potential for greatly reducing the time and expense of redesigning a second model.

EPA understands that the anticipated shift to air-to-air aftercooling will require a very large effort for equipment manufacturers. Accommodating these engines in new equipment models would typically involve development of new or modified parts to support the hardware changes, R&D to ensure that the equipment performs acceptably with the different engine operation, and extra effort to make room for the additional heat exchanger. To account for the effect of air-to-air aftercooling on equipment redesign, estimated total fixed costs for all motive and portable categories of equipment were increased by 50 percent in the revised analysis. Moreover, deployment of air-to-air aftercooling was taken as an indicator of whether equipment model redesigns were considered "extensive" or "moderate." For example, for equipment with engines rated between 75 and 560 kW, anywhere from 70 to 100 percent of models are projected to upgrade to air-to-air aftercooling; the same percentages of equipment models are therefore included in the "extensive" redesign category. The effect of these changes is a significant

increase in the average projected equipment costs.

2. *Commenters claimed that accommodating newly redesigned engines will be such a big effort that no other improvements are expected in equipment design along with the introduction of Tier 2 and Tier 3 engines; it is therefore inappropriate to discount total design time to account for developments unrelated to emission controls.*

The draft analysis states the expectation that R&D improvements unrelated to emission control are expected, but the numerical calculation of fixed and variable equipment costs in fact does not factor in any such discount. The analysis is based on the estimated expenditures for changes or improvements directly related to accommodating engines redesigned to meet new emission standards. Any additional R&D or other expenses for general product development would be in addition to the published cost estimates. EPA continues to believe that there will be substantial effort toward improving equipment designs over the next ten years, but that assumption does not affect the estimate of costs related to new emission standards. The Final RIA has been modified to state more clearly that all cost figures related to equipment redesign are applied to the total cost impact of emission standards.

3. *Commenters argued that including a cost for only one equipment model redesign for two tiers of standards is improper because a single redesign is unlikely.*

EPA considered only a single redesign per equipment model for the two tiers of emission standards. This effort was spread across the tiers to reflect the possibility of delaying significant redesign until the second new tier of standards or splitting the redesign effort for an equipment model between the two tiers. The combination of tiers of standards was developed with the agreement that the 2001 Feasibility Review would consider whether substantial additional equipment redesign would be needed for the second new tier of standards. EPA has already agreed to review the final rule, including emission standards and implementation flexibilities, to determine if the second tier of new emission standards will require a second full redesign of equipment models. It would therefore be inappropriate to include this as a cost under the current program.

4. *Commenters believed the projected use of additional steel should also include consideration of the need for other additional materials such as weldments, plastics, castings, gaskets, seals, and hoses.*

In general, EPA believes that there is a tradeoff between R&D and variable costs in estimating equipment redesign costs. If equipment manufacturers have sufficient time to conduct development work with a prototype engine, then variable costs for additional parts can be minimized. In contrast, a tight schedule prevents the expenditure of adequate R&D resources, which is balanced by the need to make hurried case-by-case decisions, which often result in the need to fabricate new parts to address packaging, performance, or maintenance concerns.

The extensive fixed costs allocated for equipment redesign follow the scenario of having

adequate time to plan and develop new products with minimal impact on equipment variable costs. Adjusting the variable costs for all the material changes that might result from a more hurried effort should only be done in conjunction with a lowered projection of fixed-cost expenditures. This second scenario is much harder to quantify, but would not be expected to increase overall costs.

The introduction of air-to-air aftercooling is the only engine technology expected to have a broad effect on equipment variable costs. To account for this, EPA has included a cost for miscellaneous materials to support the placement of the new engine and aftercooler components in the engine compartment.

5. *EPA's analysis was thought to ignore additional costs associated with servicing field equipment, including time to train repairmen in addition to the actual time for repairs.*

EPA's analysis includes a warranty cost, at 10 percent of the total variable cost, for any technologies thought to have the potential to cause an increase in field servicing. This cost should cover the expenses involved in preparing for and executing repairs of defective units.

6. *Commenters believe EPA is obligated under the Clean Air Act to estimate costs for each class or category of equipment, which requires a cost estimate for most or all equipment types.*

Section 213 of the Clean Air Act requires EPA to set emission standards for classes and categories of new nonroad engines and new nonroad vehicles. The Act further directs EPA to give appropriate consideration to the cost of meeting those standards. Contrary to commenters' assertions, nothing in the Act requires EPA to estimate the cost of compliance for most or all equipment types. In a challenge to the 1994 nonroad diesel engine rule, the court in EMA v. EPA, 88 F.3d 1075, 1097-98 (D.C. Cir. 1996) upheld EPA's grouping of different equipment types into the same category and rejected claims that EPA failed to adequately analyze compliance costs for specific types of large mining equipment. The legislative history of section 213 further supports a rule of reason with respect to the cost analysis anticipated under the Act. See, e.g., Senate Report No. 101-228 at 104 (instructing EPA not to disaggregate the universe of nonroad engines into small subcategories).

EPA believes its analysis of compliance costs for different types of equipment is sufficiently detailed to provide an accurate assessment of costs. For engines, the draft analysis develops and applies a single set of costs for each range of power ratings. Equipment costs, in contrast, were analyzed with an effort to distinguish between different types or applications of equipment. For example, the twenty to sixty different applications listed in the database for each power range were sorted to distinguish between motive and nonmotive equipment. Equipment types that are moved or driven as part of their normal functions, or that may have similar constraints, were expected to require a greater degree of effort to accommodate newly designed engines. EPA attempted to further differentiate between models, both motive and nonmotive, with specific physical constraints, such as limited engine compartment space, that would influence cost. At the time of the proposal, the greatest degree of difficulty was expected for compact, lower-power

units, though the final rule adds consideration of air-to-air aftercooling as an indicator of more difficult engineering challenges for equipment manufacturers. For example, skid-steer loaders (one of the specific examples of equipment that commenters claimed EPA must analyze) would be considered motive equipment, with 70 to 80 percent of models expected to have "extensive" redesign within the range anticipated for motive equipment. These most complex equipment models were anticipated to require $220,000 of fixed costs, compared to only $110,000 for simpler motive equipment, and only $15,000 for the simplest nonmotive equipment. These numbers have been adjusted in response to comments received, as described above.

EPA therefore believes that the cost analysis developed to support the rulemaking represents a reasonable attempt to assess the impact of the new requirements on engine and equipment manufacturers for the range of products affected.

g. NERA Cost Study

Comments and Analysis

1. *Under industry sponsorship, the National Economic Research Associates (NERA) conducted a study to compile estimated costs for complying with EPA's proposed emission standards for engines at or above 37 kW. NERA surveyed several engine and equipment manufacturers for cost and technology projections related to several scenarios of possible future emission standards, then generalized the input data into a set of cost projections for the industry. The study showed cost impacts to be very much higher than those estimated by EPA.*

To assess the validity of the NERA study, EPA reviewed NERA's summary of the survey data it used to project industry-wide costs. NERA's survey requested that manufacturers provide estimated variable costs (dollars per unit) and fixed costs (total outlay without amortization). NERA's variable cost data included data for nine different engine models of varying sizes. EPA plotted this variable cost data versus engine power to generate a curve for projecting cost as a function of engine power. EPA's variable cost estimates were somewhat higher than those generated using the NERA data, but were easily reconciled, given the differing methodologies employed (e.g., EPA presumed a mix of technologies and discounted costs to reflect non-emission benefits, whereas manufacturers projected an undiscounted cost increase for discrete engine models). In contrast, the NERA report developed a methodology for combining the variable and fixed cost data in a way that resulted in predicted Tier 2 variable costs that were at least ten times higher on average than the actual variable cost data for those engine models included in the survey. An attempt to resolve this apparent internal inconsistency is discussed in the next subsection.

Computations with fixed costs are more difficult to compare because of the need to factor in amortization variables such as sales volumes. A review of the data nevertheless led to additional concerns about the NERA study. The confidential data submitted by equipment manufacturers show actual amortized production capital costs to be, on average, one-third as great as capital costs for R&D. NERA's results, however, predict amortized production capital costs to be on

average fifteen times greater than capital costs for R&D.

Given these concerns with the NERA report, EPA is not prepared to rely heavily on NERA's predicted cost estimates. The Agency has, nonetheless, considered the input data collected by NERA and some parts of the NERA analysis to revise the cost projections for the final rule, as described elsewhere in this section. Furthermore, given the importance of cost analyses in the 2001 feasibility review, the Agency is continuing to work with the industry to facilitate better understanding and improvement of methodologies and assumptions used in these analyses.

2. *In response to an EPA letter expressing concerns regarding the validity of the NERA analysis, EMI sent a follow-up letter to EPA containing NERA's attempts to explain the apparent discrepancies and challenging EPA's interpretation of the NERA study. NERA argued that (1) EPA improperly compared "recipes" to the proposed standards; (2) EPA looked at component cost estimates, rather than total costs; and (3) EPA inappropriately compared NERA's overall study results (reflecting the entire population) to the sample data; NERA's recommendation was to evaluate how well NERA's statistical model replicates the actual survey data.*

The additional support offered for the NERA study and the challenge to EPA's interpretation are easily addressed. First, NERA's original survey defined several "recipes" of target emission levels and asked engine manufacturers to estimate costs for each recipe. Recipe 2a clearly corresponds to EPA's proposed Tier 2 standards, except that it includes more stringent smoke levels. EPA's discussions with engine manufacturers about the survey data made it clear that they perceived Recipe 2a as the "Tier 2 recipe." The more stringent smoke levels, if they affected costs at all, would presumably *increase* the costs in the manufacturers' survey responses, such that NERA would need to subtract these incremental costs from the survey numbers to match Tier 2 requirements.

NERA argued, nonetheless, that EPA's use of the Recipe 2a cost data for analyzing NERA's Tier 2 cost predictions was improper. NERA, however, provided no support for its belief that "the proposed Tier 2 standard represents significant additional emission reductions beyond these [Recipe 2a] levels." EPA believes that its use of the Recipe 2a data provides a conservative basis for checking NERA's Tier 2 cost predictions.

Second, NERA determined its total costs by summing various cost components such as engine fixed costs, engine variable costs, and equipment fixed costs. As described for the preceding comment, EPA looked closely at one cost component that made a large contribution to total costs, namely engine variable costs, and found NERA's predictions to be overestimated compared to the survey data upon which they were purportedly based. NERA's argument that EPA should have looked at total rather than component costs would only be justified if NERA could show that the other cost components were underestimated to such a degree as to offset NERA's apparent overestimate of variable costs. EPA has no information that these other component costs are so underestimated.

With respect to NERA's third point, EPA had already done precisely what was recommended, attempting to replicate the actual survey data with the statistical model. Unfortunately, that effort showed that the statistical correlations of cost as a function of engine power do not fit the data points supplied by engine and equipment manufacturers.

NERA's arguments do not remove EPA's concerns with the results of the NERA study. EPA continues to believe that its own revised cost analysis, which factors in valid aspects of NERA's approach and underlying data, provides the most reasonable assessment of the costs associated with the final rule.

h. Small Business Impacts

Summary of the Issue

The Regulatory Flexibility Act was amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Pub. L. No. 104-121, to ensure that concerns regarding small entities are adequately considered during the development of new regulations that affect them. In response to the provisions of this statute, EPA identified industries subject to this rulemaking and provided information to and received comment from small entities and representatives of small entities in these industries. The Agency also convened a Small Business Advocacy Review Panel under section 609(b) of the Regulatory Flexibility Act. The Panel collected the advice and recommendations of representatives of small entities that will be subject to the rule and reported those comments and the Panel's findings to EPA.

EPA prepared an Initial Regulatory Flexibility Analysis (RFA) which analyzed the economic impacts of the proposed rule on small companies and discussed issues related to each of the four elements listed above. The Initial RFA also described EPA's initiatives to involve small entities in developing the proposal and the Agency's responses to the recommendations of the small entities and the Panel for greater flexibility for small entities. In the NPRM, EPA proposed to adopt the provisions recommended by the panel.

In its analysis of the impacts of the proposed rule on small entities, EPA gathered information on a sample of several hundred small equipment manufacturers. Parts suppliers, distributors, end users, and other entities not subject to the rule were not analyzed. EPA used the PSR and Dun and Bradstreet databases to identify and establish economic information on small equipment manufacturers. The projected costs of the proposed rule on equipment manufacturers as developed in the NPRM were then applied to equipment manufacturers in the cross-section of small equipment manufacturers to arrive at an assessment of economic impacts on this industry segment.

Commenters have raised challenges to EPA's analysis and compliance with the requirements of the Regulatory Flexibility Act in three general areas, each of which is discussed below.

1) Small Entities Impacted by the Rule

Comments and Analysis

EMI and NAHB argued that EPA improperly, and against the recommendations of the Small Business Advocacy Review Panel, limited its analysis to those small businesses directly regulated by the rule, underestimating the impacts of the rule. These commenters argued that EPA should consider the impacts on upstream and downstream businesses such as consumers of nonroad equipment. EMI further argued that EPA underestimated the number of small equipment manufacturers by relying solely on the PSR database which includes only 60 percent of equipment manufacturers, and by only looking at manufacturers with 500 or fewer employees despite SBA definitions for certain equipment manufacturers that include companies with up to 1000 employees as "small businesses."

EPA disagrees with commenters' assertion that EPA's analysis should include upstream and/or downstream entities. The Agency believes that the Regulatory Flexibility Act only requires agencies to analyze the impacts of a rule on those small entities subject to the rule. A string of cases supports EPA's interpretation. See Motor & Equip. Mfrs. Ass'n v. Nichols, Nos. 96-1392 and 96-1397, 1998 U.S. App. LEXIS 7848, at *55-60 (D.C. Cir. Apr. 24, 1998); United Distribution Cos. v. FERC, 88 F.3d 1105, 1170 (D.C. Cir. 1996); Mid-Tex Elec. Co-op, Inc. v. FERC, 773 F.2d 327, 342 (D.C. Cir. 1985). Secondary impacts on parties not regulated by the rule involve large uncertainties and are extremely difficult, if not impossible, to project. EPA does not believe such analysis is required and does not believe that it would add value to the conclusions about the impacts of the rule.

EPA also believes that its approach for analyzing the impact on small entities subject to the rule is proper. EPA used in its small business analysis the broadest available databases that included the detailed company data necessary to conduct an economic analysis. EPA was aware of the Department of Commerce data recommended by EMI, but decided not to rely on it because EPA concluded that it did not include sufficient information to be useful in this analysis. While the commenter is correct that the PSR database used by EPA did not cover all companies, the coverage represented a large cross-section of the industry and was sufficient for EPA to be confident in the results of the analysis by its contractor and the subsequent analysis performed by the Agency. EPA did not claim that the number of small entities in the PSR database comprised the total number of small entities impacted by the rule.

EPA's analysis of the impact of the rule on small businesses included small businesses with 500 or fewer employees. Commenters are correct that this is a simplification of the Small Business Administration's (SBA's) definition of small business. The Small Business Administration, in 13 CFR Part 121, defines manufacturers of construction equipment and industrial trucks up to 750 employees and manufacturers of other nonroad equipment up to 500 employees as "small." While EPA did make the simplifying decision for purposes of its primary analysis to look only at businesses with 500 or fewer employees, EPA did, in fact, consider the

impact on the analysis of including larger companies per SBA's definitions. The Initial RFA explains that EPA considered including other industry categories which SBA would consider "small" with greater than 500 employees (like construction equipment manufacturers). However, EPA found that to do this would only add 3 more companies to the list of 283. EPA found that nearly all equipment manufacturers in those industry categories with higher thresholds for defining small businesses actually have fewer than 500 employees. EPA believes that its analysis reasonably takes into account all significant impacts on small businesses subject to the proposed rule.

2) Impact of Assumption of "Streamlining" of Product Lines

Comments and Analysis

EMI and the Compact Loader Council both pointed out that EPA had projected that 2870 of the existing 4343 equipment product lines would no longer be produced if the proposed rule were promulgated. EPA, they claimed, had not discussed the impact on the small businesses that produced some of these eliminated product lines. EMI added that EPA must show whether the proposed flexibility provisions would be adequate to protect those small businesses that produced these eliminated product lines.

As noted earlier in this section, EPA has re-analyzed the overall economic impacts of the rule and has revised its earlier assumption regarding manufacturers' discontinuation of product lines. The Agency believes that these revised costs are more accurate and provide a better assessment of the impact of the rule on small businesses. In light of this change, EPA has reassessed the impact of the rule on small equipment manufacturers based on the higher estimated costs of the revised economic analysis. EPA's re-analysis of the small business impacts of the proposed program is described in the Final RFA found in the Final RIA.

3) Challenges to SBREFA Process

Comments and Analysis

EMI claimed that EPA did not provide adequate information to the panel to allow them a meaningful opportunity to assess the impacts of the rule on small businesses.

EPA believes that the small business panel process worked as intended and provided a meaningful opportunity for small entities to assess the impacts of the rule. The RFA process is intended to provide an opportunity for small businesses that will potentially be affected by a rulemaking to offer input very early in the process, well before a formal proposal is prepared. As described in the Final RFA, EPA was able to provide information about the likely form of the program and potential regulatory alternatives to small businesses. The small business representatives subsequently participated during the Small Business Advocacy Review Panel

process in developing provisions for easing compliance burdens that were ultimately proposed.

In the case of economic information, EPA's detailed cost analyses were underway at the staff level at the time the Panel Report was being prepared. However, it was some time later that these analyses were completed and reviewed, and later still that they were publicly released as a part of the Notice of Proposed Rulemaking. Although detailed cost estimates were not available from EPA, the Panel and the small business representatives were aware of the probable framework and the nature of potential impacts. This information was fully sufficient to support the discussions that led to the flexibility provisions that were proposed and are now in large part finalized.

7. Voluntary Low-Emission Standards

a. Level of the Standard

Summary of the Issue

EPA proposed a set of voluntary standards to provide a program recognizing the potential for a degree of emission control significantly greater than that required for all engines. Three different levels were proposed in order to provide flexibility to recognize varying levels of control for different technology approaches. Any engine meeting one of the proposed voluntary emission standards would be considered a "Blue Sky Series" engine.

Comments

Most commenters supported some form of voluntary low-emission standards. The Manufacturers of Emission Controls Association strongly supported the proposed standards, including the format of the standards and the specific percentage reductions identified. Environmentalists supported the concept of voluntary standards but encouraged adoption of only one, or at most two, levels of standards. These commenters recommended that a 50 percent reduction should be the minimum for qualifying as a Blue Sky Series engine. The Department of Defense (DOD) also urged a simplified scheme of proposed voluntary standards to assist in DOD's eventual procurement of Blue Sky Series engines; DOD suggested either adopting a single qualifying level or creating an indexed classification system. The indexed system would allow for recognizing varying levels of control, but would rely on the index to communicate the degree of control (more so than the proposed Class A, Class AA, etc.).

The Engine Manufacturers Association recommended an alternative approach which would allow any engine with emissions below the mandatory standards to qualify as a Blue Sky Series engine, as long as the credits generated by the engine were not used to allow another engine to emit above the mandatory standards. Finally, Euromot commented that the proposed program will mislead consumers as to the intent and ability of engine manufacturers to produce clean engines. Euromot also raised concerns that the program could give highway engine manufacturers an unfair advantage in the nonroad market. Euromot recommended that the whole arrangement of voluntary standards should be revised to reflect the low-emission targets in the Nonroad Statement of Principles.

Analysis

Several factors are involved in developing a successful program of voluntary standards. First and most importantly, 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, EPA believes it is best to establish a single qualifying threshold for the Blue Sky Series engines. To best align with future emission standards, Tier 3 emission levels, where applicable, are believed to be the best level of control for defining Blue Sky Series engines. This represents a reduction of approximately 40 percent beyond the Tier 2 NMHC + NOx levels. For PM emissions and for engines with no Tier 3 standards, a calculated level corresponding to a 40 percent reduction beyond Tier 2 levels will be used to qualify as a Blue Sky Series engine.

EPA is not at this time formalizing a plan to recognize a level of emission control going beyond the single qualifying level. As part of the 2001 feasibility review, EPA will reevaluate the voluntary standards, both to review the effectiveness of the Blue Sky program as adopted, and to decide what changes would be needed as Tier 3 standards are implemented. 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. If EPA adopts voluntary standards in the Tier 3 time frame, the voluntary standards will need to be tightened to correspond to the more stringent mandatory standards. In the near term then, even with only one level of voluntary 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.

EPA does not believe Euromot's concerns regarding public perception warrant changes to the Blue Sky approach. As with any program defining an alternative, more environmentally friendly, voluntary product, consumer education is critical to the success of Blue Sky Series engines. While some consumers may conclude that a defined voluntary standard implies that manufacturers are unwilling or unable to achieve an adequate level of emission control, this concern does not affect the appropriateness of adopting the voluntary standards.

EPA is also unconvinced that the Blue Sky program will create unfair competitive advantages for highway engine manufacturers. For highway engine manufacturers to substantially increase market share as a result of the voluntary low-emission standards, they would need to be able to deploy very advanced technologies of a broad scale at a relatively low cost, with sufficient incentive provisions in place to address the cost premium for the superior engine design. Such a technology scenario is overly optimistic. More realistically, EPA expects that a small number of engine manufacturers may introduce advanced technologies on a few engines on a demonstration basis. By the time EPA completes the 2001 Feasibility Review, there will be a clearer picture of the market potential for any of the current candidate technologies.

b. Test Cycle

Summary of the Issue

EPA proposed a requirement that manufacturers use the highway heavy-duty transient test cycle to demonstrate attainment of voluntary emission levels, primarily to ensure adequate control of PM emissions during in-use operation.

Comments

MECA and the California ARB expressed support for transient testing to demonstrate low emission levels.

Analysis

EPA will retain the provision specifying use of the highway heavy-duty transient test cycle for Blue Sky Series engines. Any changes for testing nonroad engines considered as part of the 2001 Feasibility Review will also be considered for possible inclusion for qualifying as a Blue Sky Series engine.

c. Incentives to Introduce Low-Emitting Engines

Summary of the Issue

EPA proposed to allow Blue Sky Series engines to generate credits under the proposed ABT program, intending to provide an incremental incentive to develop and introduce low-emission control technologies. In addition, EPA requested comment on other incentives that may lead to successful implementation of the voluntary standards.

Comments

Some commenters wanted equipment manufacturers or users to receive emission credits, instead of, or in addition to, credits generated by engine manufacturers. Another commenter echoed EPA's concerns regarding potential double-counting of emission reductions by providing ABT credits for emissions reductions that are also counted in emission inventories.

Environmentalists strongly supported a labeling program, both to provide an incentive for consumers and to help educate the public that there are low-emitting engines available. Other incentive ideas were also promoted. Environmentalists referred to "Green Construction Projects," developed by the Northeast States to factor reduced engine emissions into construction bidding procedures. DOD made several suggestions for Blue Sky Series engines, including (1) exempting engines from local permitting requirements, (2) excluding engines from conformity analysis calculations, or (3) defining a life-cycle cost index or payback period to help potential purchasers understand any possible long-term cost savings from the advanced technology. Fundamentally, DOD was interested in directing incentives at the purchaser of the equipment.

Analysis

The Agency has concluded that granting federal ABT credits to engine manufacturers for Blue Sky Series engines would not be appropriate. Providing federal ABT credits for Blue Sky Series engines, while creating an incentive for the early development of clean technology, would send an improper message that the environment is benefitted when in fact the emission reductions from these engines may be offset by increased emissions from other engines using those credits. EPA believes there may be some merit in shifting an emission credit program from engine manufacturers to equipment manufacturers or users. EPA also believes, however, that states or other groups are best positioned to manage a credit program that would recognize the potential for emission reductions from Blue Sky Series engines.

For voluntary programs related to consumer products, labeling is very important to communicate information to actual and potential purchasers. For nonroad diesel equipment, however, purchasers are generally not individual consumers, but companies or agencies with very different procurement practices. The value of owning a low-emitting engine on its own merits, or for intangible benefits, is not expected to be a significant factor in procurement decisions. Moreover, nonroad diesel equipment has much less exposure to the public than highway vehicles or other consumer products. EPA is therefore not finalizing a labeling program with the voluntary standards.

The other incentive ideas raised by commenters are outside the scope of EPA's activities. EPA therefore encourages states and other groups to consider these other suggested provisions as possible incentives to encourage the production and sale of low-emitting engines.

8. Other Certification Issues

a. Crankcase Emissions

Summary of the Issue

EPA proposed that no crankcase emissions would be allowed from naturally-aspirated Tier 2 nonroad engines rated at or above 37 kW, or naturally-aspirated Tier 1 nonroad engines rated under 37 kW beginning in 2001.

Comments

EMA generally supported the proposal, but stated that delaying the requirement for engines rated under 37 kW until Tier 2 would be preferable. They also stated that EPA should allow crankcase emissions to be routed into either the intake air or the exhaust stream. American Augers and Kubota requested a delay in the applicability of these requirements. Euromot also requested that certain crankcase emission controls be imposed "at the introduction date" and not in 2001, which is in between the effective dates for the Tier 1 and Tier 2 standards for engines rated under 37 kW, to avoid giving open crankcase engines a competitive advantage in controlling emissions. Euromot also stated, however, that they have safety concerns related to the potential for engine runaway with closed crankcases on engines less than 19 kW. Euromot explained that because of the potential for these small engines to be overturned, there is a risk that crankcase oil could be introduced into the cylinder through recirculation of the crankcase emissions causing the engine to continue to operate after shutdown. They argued that EPA should exempt all engines below 19 kW from this requirement because of these safety concerns.

Analysis

EPA agrees that it would be appropriate to delay the closed-crankcase requirement for all naturally-aspirated engines until the Tier 2 standards take effect. Some manufacturers, especially those that produce engines rated under 19 kW, are likely to need additional time to resolve all of their concerns related to safety. While EPA did not receive comments specifically related to safety concerns for engines rated between 19 and 37 kW, EPA believes that the concerns about potential safety problems are equally relevant. This delay in requiring control of crankcase emissions will not have a substantial adverse environmental impact. Crankcase emissions of CO and NOx (g/kW-hr) are typically much less than one percent of the total exhaust emissions of CO and NOx. Crankcase emissions of hydrocarbon (HC) are somewhat higher, but still less than 5 percent of total exhaust HC emissions. (EPA's best estimate is that crankcase emissions of HC represent about 2 percent of total exhaust HC emissions.[12]) EPA also believes that this approach will have the least competitive effect since it treats all engine power classifications the same with

[12] "Basic Evaporative Emission Rates for Nonroad Engine Modeling", EPA, February 13, 1998, Docket A-96-40.

respect to crankcase emissions.

EPA agrees with EMA's recommendation to allow routing of crankcase emissions into the exhaust stream. Manufacturers choosing this option would effectively be required to reduce their engine-out exhaust emissions further than other manufacturers that choose to route the crankcase emissions into the engine intake. It is important to note that this optional approach will require that the engine (and vehicle) be designed so that the routing would also occur under all in-use conditions. Manufacturers using this approach will be required to modify their deterioration factors to account for potential increases in crankcase emissions over time. EPA is also considering using this approach in the future for controlling crankcase emissions from turbocharged engines, which are currently uncontrolled. The advantage of this approach is that it allows manufacturers the flexibility to either route crankcase emissions into the engine intake, thereby combusting the crankcase emissions of HC and CO, or to route the emissions into the exhaust (where they would be measured as part of the exhaust emissions) and to reduce the total exhaust emissions using other means.

b. Test Fuel

Summary of the Issue

In the proposal, EPA discussed several different options for changing the test fuel specifications. However, EPA proposed to maintain the existing specifications for sulfur in test fuels. The proposed regulations would allow the use of low-sulfur California fuel, but eliminated the particulate adjustment for tests using federal fuel.

Comments

EMA emphasized that changing test fuels will affect the stringency and feasibility of the proposed standards. They suggested that EPA adopt an approach similar to the European approach (i.e., adjust to 0.15 weight-percent (wt%)). In support of this, they provided some data which indicated that the current sulfur content of "high-sulfur" fuel is about 0.2 wt%, and an analysis claiming that the average sulfur content for fuel used in nonroad engines is about 0.15 wt%. EMA members and Euromot also supported adopting the European approach. The California ARB, STAPPA/ALAPCO, and MECA all supported an *in-use* low sulfur requirement for nonroad engines, the same as is currently applicable to on-highway engines.

Analysis

Section 206(h) of the Clean Air Act requires EPA to ensure that vehicles are tested under circumstances reflecting actual in-use conditions including conditions related to fuel. The sulfur level of in-use fuel used in nonroad engines is highly variable. Nonroad engines use both low sulfur (<0.05 wt%) and high sulfur fuel (typically 0.1 to 0.4 wt%). Unfortunately, EPA does not

have reliable data regarding the relative amounts used by nonroad engines. EPA does have two independent references (surveys) indicating that the average sulfur level of in-use "high-sulfur" fuel is about 0.3 wt%. This is higher than the average level claimed by EMA (0.2 wt%). From these data, EPA can determine only that the vast majority of in-use nonroad engines fuels have a sulfur level of 0.03 to 0.4 wt%, and that the average value is probably between 0.15 and 0.25 wt%. Therefore, EPA is finalizing test fuel specifications with a sulfur specification of 0.03 to 0.4 wt%, which covers the range of sulfur levels observed for most in-use fuels.

The final sulfur specification is slightly different from that proposed (0.03 to 0.5) because EPA believes the final specification more appropriately covers the range of sulfur levels found in the majority of in-use fuels. Manufacturers will be free to test using any fuel within this range. Thus, they will be able to harmonize their nonroad test fuel with either on-highway testing (<0.05 wt%) or with European testing (0.1 to 0.2 wt%). Testing conducted by EPA would use test fuels typical of in-use fuels.

At this time, EPA believes that the average sulfur level of diesel fuel being used in current nonroad engines is on the order of 0.2 wt%. In order to provide manufacturers with some certainty regarding how EPA will implement its test fuel policy, the Agency is including a regulatory provision specifying that it will use test fuels with sulfur levels no greater than 0.20 wt% when it performs testing of Tier 1 engines and Tier 2 engines rated at or above 37 kW. EPA is not applying this provision to Tier 3 engines or Tier 2 engines rated under 37 kW because those standards do no take effect for some time, and EPA has no basis for determining what the properties of in-use fuels will be for these engines. Moreover, EPA has not determined that it would be an appropriate long-term policy to specify a narrow range for the sulfur specification. This would be especially true for engines utilizing catalytic aftertreatment to reduce particulate emissions. Such engines may comply with the emission standards when tested using a moderately low sulfur fuel, but have much higher particulate emissions when using a higher sulfur fuel with a sulfur level between 0.3 and 0.4 wt%. EPA intends to examine test fuels for Tier 3 engines and Tier 2 engines rated under 37 kW in its 2001 feasibility review.

EPA is eliminating the particulate adjustment factor for test fuels with different sulfur levels. Such an adjustment, while potentially appropriate for the initial modest particulate emission control program of a newly regulated industry, is not appropriate as a long-term policy. Moreover, EPA has significant concerns regarding the accuracy of the previously used adjustment factor equation, which was based on limited data. However, even if more complete data were available, it would not be possible for a single adjustment factor equation to accurately predict the effect of different sulfur levels on particulate emissions for each engine model. This is because the effect of sulfur levels on particulate emissions can vary significantly from engine to engine, especially for engines with and without aftertreatment.

EPA recognizes that the sulfur level of test fuels has an effect on the stringency of the standards, and that the elimination of the particulate adjustment factor has the effect of making the particulate standards more stringent than they otherwise would have been. However, EPA

has considered this effect in making its determination that the standards being adopted in this rulemaking are feasible.

c. Test Cycles

Summary of the Issue

EPA proposed to continue to rely on the International Standards Organization (ISO) 8178 C1 test cycle, but to allow the use of other ISO 8178 cycles for certain types of engines having unique operating characteristics (i.e., D2 for constant speed, G2 for engines rated under 19 kW, and E3 for marine engines), as shown below. EPA also proposed to eliminate the specification for a maximum stabilization time for each test mode (as part of a series of technical amendments to the test procedures.)

Table 8-1 - 8-Mode Test Cycle For Variable-Speed Engines (C1)

Test Segment	Mode Number	Engine Speed	Observed Torque (percent of max. observed)	Minimum Time in mode (minutes)	Weighting Factors
1	1	Rated	100	5.0	0.15
1	2	Rated	75	5.0	0.15
1	3	Rated	50	5.0	0.15
1	4	Rated	10	5.0	0.10
2	5	Int.	100	5.0	0.10
2	6	Int.	75	5.0	0.10
2	7	Int.	50	5.0	0.10
2	8	Idle	0	5.0	0.15

Table 8-2 - 5-Mode Test Cycle For Constant-Speed Engines (D2)

Mode Number	Engine Speed	Observed Torque (percent of max. observed)	Minimum Time in mode (minutes)	Weighting Factors
1	Rated	100	5.0	0.05
2	Rated	75	5.0	0.25
3	Rated	50	5.0	0.30
4	Rated	25	5.0	0.30
5	Rated	10	5.0	0.10

Table 8-3 - 6-Mode Test Cycle For Engines Rated under 19 kW (G2)

Mode Number	Engine Speed	Observed Torque (percent of max. observed)	Minimum Time in mode (minutes)	Weighting Factors
1	Rated	100	5.0	0.09
2	Rated	75	5.0	0.20
3	Rated	50	5.0	0.29
4	Rated	25	5.0	0.30
5	Rated	10	5.0	0.07
6	Idle	0	5.0	0.05

Table 8-4 - 4-Mode Test Cycle for Propulsion Marine Diesel Engines (E3)

Mode Number	Engine Speed (percent of max. observed)	Observed Power (percent of max. observed)	Minimum Time in mode (minutes)	Weighting Factors
1	100	100	5.0	0.20
2	91	75	5.0	0.50
3	80	50	5.0	0.15
4	63	10	5.0	0.15

Comments

EMA generally supported EPA's proposal, but argued that EPA should adopt the alternate test cycles (D2 and G2) as primary test cycles (instead of the C1) for constant speed and small engines, and that it should be the manufacturer's option to use the C1 cycle as an alternative for those engines. They also argued that EPA should allow constant speed engines certified over the D2 cycle to be grouped in the same engine family as similar engines certified over the C1 cycle. Individual manufacturers also supported this approach. States, environmental groups, and MECA encouraged EPA to continue its efforts to adopt a transient test cycle as soon as possible,

since it would better control in-use particulate emissions. The California ARB also argued that EPA should not eliminate the maximum stabilization times since it might create a potential for abuse by manufacturers.

Analysis

EPA agrees with EMA's suggestion to specify the D2 and G2 cycles for constant speed engines and engines under 19 kW, respectively, with the C1 cycle as an optional alternative for the manufacturer. However, if the C1 cycle is used by the manufacturer, any testing conducted by EPA could use either the alternative C1 cycle or the specified primary cycle. EPA also agrees that manufacturers should be allowed to certify such engines within the same engine family as engines certified using the C1 test cycle data. EPA is also finalizing the proposal to use the E3 cycle for marine propulsion engines, with the allowance for a manufacturer to certify marine propulsion engines in a family with land-based engines using the C1 cycle. The Agency is being more restrictive with marine engines in this respect (i.e., allowing it only for marine engines in land-based engine families) because there are no common modes in the E3 and C1 cycles. The E3 cycle is based on fractions of maximum *power*, while the C1, D2, and G2 are based on fractions of maximum *torque*.

EPA is in the process of considering the need for a transient test cycle. Until this work is completed, EPA will continue to use the steady-state test cycles that were proposed. EPA is also eliminating the maximum stabilization times as proposed. EPA agrees with the California ARB that there is some potential for manufacturers to use unreasonably long stabilization times in an attempt to gain some emission advantage, and will therefore retain its authority to perform emission testing with stabilization times as short as five minutes. Thus, any manufacturer that relied on long stabilization times for compliance would run the risk of failing tests performed by EPA with shorter stabilization times.

d. Smoke Testing

Summary of the Issue

EPA proposed continuing to use 40 CFR, Part 86, Subpart I test procedures and standards for smoke from nonroad engines. EPA also discussed the possibility of using the ISO smoke procedure after it is finalized. (The ISO TC70/SC8 committee is currently balloting a nonroad diesel engine exhaust gas smoke emissions test procedure (8178-9). However, this balloting procedure is not yet completed and thus there is no final ISO technical voluntary consensus standard that the Agency can adopt at this time.) EPA proposed to extend the application of the current procedures and standards to nonroad engines rated under 37 kW. EPA also proposed the following modifications to the existing test procedure: 1) exempting single cylinder engines and marine engines under 37 kW from smoke testing; 2) allowing two-cylinder engines to be tested using a muffler to dampen pulsations; and 3) adjusting the exhaust pipe size requirements for different size engines. Finally, EPA asked for comment on the need for an in-use smoke test.

Comments

Manufacturers generally supported EPA's proposal, but argued that all engines should be tested using a muffler, that two-cylinder engines and constant speed engines should be exempted from testing, and that EPA should modify its specifications for exhaust pipe diameters. They also supported adoption of the ISO procedure after it is finalized. Westerbeke commented that smoke requirements should be eliminated for marine auxiliary engines as well as marine propulsion engines. They argued that smoke, like noise, is addressed in response to consumer demand for all marine engines, and thus, the reduction of smoke is adequately addressed by market forces alone. STAPPA/ALAPCO and the California ARB argued for more stringent standards, and for an in-use test.

Analysis

EPA is generally finalizing the smoke regulations as proposed. EPA received no comments opposing the use of the Subpart I procedures until the ISO procedure is finalized. EPA also received no comments opposing the exemption for single-cylinder and marine engines.

In response to EMA's request for additional modifications, the Agency is not allowing all engines to use mufflers during testing, nor is it revising the standard pipe diameters. The original Subpart I procedure and the applicable standards were developed for testing engines without mufflers. Thus, since the use of mufflers can affect the stringency of the standards, allowing all engines to use mufflers would require that EPA reconsider the levels of the standards. The Agency is allowing two-cylinder engines to use mufflers during testing, as proposed, only because it believes that the special needs of such engines warrant special consideration. With respect to the standard exhaust pipe diameters, EPA does not believe that any revision is necessary. The only significant differences between EPA's proposed diameters and EMA's suggested diameters are for engines between 175 and 200 horsepower (where EPA's diameter results in a slightly less stringent standard) and for engines between 500 and 600 horsepower (where EPA's diameter results in a slightly more stringent standard). The Agency believes that it is more important, at this time, to maintain consistency with the existing power categories of the Subpart I regulations, than to be consistent with the nonroad power categories applicable for gaseous and particulate standards. EPA agrees that the current smoke test cannot effectively be performed on constant speed engines, and so is dropping smoke requirements for them until an adequate smoke test becomes available. The Agency believes the air quality impact of this action will be minimal because these engines do not often experience acceleration modes, which are the principal focus of smoke standards.

EPA is finalizing no smoke requirements for marine propulsion. However, a smoke requirement will remain for variable speed marine auxiliary engines. This is reasonable both because these engines can be tested for smoke and because they are expected to be simple derivatives of land-based engines.

The Agency expects to revisit the issue of smoke testing in the near future. EPA has analyzed the draft ISO procedure (8178-9) and concluded that most of its elements would be appropriate for adoption. Thus, the Agency expects that it will adopt the ISO smoke measurement procedure after it is finalized. At that time EPA may also reconsider the issues related to the use of mufflers, single-cylinder and two-cylinder engines, and standard exhaust pipe diameters. It is important to note that the ISO 8178-9 smoke emissions test procedure is very different from the procedure specified in Subpart I of Part 86. As a consequence, if EPA adopts the ISO 8178-9 procedure, EPA will also need to revise the numerical limit values to be associated with the ISO procedure.

The existing smoke procedure (Subpart I) allows for three different numerical standards (i.e., acceleration, lugging, and peak), while the most recent draft of the ISO cycle allows only for two different numerical standards (i.e., lugging and peak). This is important because with the current Subpart I cycle, it is the numerical standard associated with the acceleration phase of the cycle (20 percent opacity) that provides the most significant control of smoke puffs from diesel engines. The current standard associated with the Subpart I peak measurement is 50 percent opacity and this provides less effective smoke puff control. Thus, in order for a control program based on the ISO cycle to provide comparable or better smoke control relative to the current program, the peak smoke standard associated with the ISO cycle would need to be much lower than the current peak smoke standard (based on Subpart I) of 50 percent opacity. Moreover, the current standards associated with Subpart I were established in the early 1970's and were appropriate for diesel engine technology of that era. Current technology is possibly capable of lower smoke emissions and thus a lower numerical standard may be appropriate. EPA believes the appropriate numerical standard that should be associated with ISO 8178-9 peak measurements is likely to be within the range of 20 to 30 percent opacity. It is important to note, however, that this is only a preliminary estimate.

Finally, EPA recognizes the strong interest of states regarding the need for an in-use smoke test in order to better control emissions from nonroad engines. EPA is continuing to consider this issue. As noted above, EPA is likely to revise its certification smoke testing and standards in the near future, and EPA believes that the development of an in-use smoke test would be more appropriate in conjunction with its reconsideration of the certification test and standards.

e. Rated and Intermediate Speed Definitions

Summary of the Issue

The large CI nonroad engine rule allowed the manufacturer to specify rated and intermediate speeds for purposes of determining certification test points. Allowing manufacturers to specify the rated speed can have the result of different manufacturers running different test cycles. For example, an engine governed at 2100 Rpm may produce maximum horsepower at 1600 Rpm. One manufacturer may choose to specify a rated speed of 2100 Rpm while another may specify 1600 Rpm. The test cycles developed from these two definitions can produce significantly

different emissions results. Since the definition of rated speed defines the test cycle, EPA believes that there should be only one definition. Each manufacturer should run the same test cycle in order to have the same stringency of emission standards. EPA proposed a definition for rated speed as the maximum full load speed for governed engines and the speed of maximum horsepower for ungoverned engines. The definition proposed for intermediate speed was based on peak torque speed and would limit intermediate speed to 60 to 75 percent of rated speed. EPA proposed to apply these new definitions to nonroad engines immediately, including to Tier 1 engines covered by the large CI nonroad engine rule.

Regarding marine engines, the proposed definition of rated speed is different than the definition adopted by the IMO in Annex VI to MARPOL 73/78. The IMO's NOx Technical Code defines *rated speed* as the crankshaft revolutions per minute at which the rated power occurs as specified on the nameplate and in the Technical File of the marine diesel engine, where *rated power* means the maximum continuous rated power output as specified on the nameplate and in the Technical File of the marine diesel engine to which regulation 13 of Annex VI and the NOx Technical Code apply.

Comments

Caterpillar commented that the proposed definition of rated speed differs from the proposed EU nonroad machinery directive. Caterpillar also commented that bringing power curves or sales or service literature into the determination of rated speed only complicates the matter and increases the chance of confusion or error. Euromot recommended that the rated and intermediate definitions not be changed because they are currently in line with ISO 8178 and the European NRMM directive. Caterpillar, EMA, and Cummins commented that the proposed definition should not take effect until Tier 2. EMA commented that immediate implementation would cause manufacturers to recertify.

IADC noted that the discrepancy in the definition of rated speed between EPA and IMO could become a source of confusion for manufacturers seeking certification of engines to both IMO and EPA standards, and to the purchasers of such engines.

Analysis

Because of the importance of these parameters, EPA believes that there should be only one definition. Since ISO definitions allow the manufacturer to specify rated speed, harmonization can be accomplished by testing to EPA's definition. EPA is not aware of any engines which would need to be recertified as a result of this definition. However, EPA realizes it may be difficult for manufacturers to prove that all the engines within an engine family meet this requirement. Because certification of many of the Tier 1 engine families is accomplished by carrying over previous data, EPA is not requiring manufacturers to meet the rated speed and intermediate speed definitions for Tier 1 engines certified prior to January 1, 1999. Engine families that are certified prior to January 1, 1999 may carry over certification under the old

definitions into subsequent Tier 1 model years. All Tier 2 engines must meet the definitions for rated and intermediate speeds.

EPA is linking the definition of full load governor speed to horsepower curves and sales and service literature because this is currently the best method for defining rated speed. Using sales and service literature eliminates the need to experimentally determine the speed. Manufacturers may use the designed speed for peak torque and governed speed for the purpose of developing the test cycle. EPA is not requiring manufacturers to account for engine to engine variability in the development of the test cycle.

EPA recognizes that the definition of rated speed proposed in the NPRM and the definition of rated speed adopted by IMO are different. However, this discrepancy does not pose a problem for this rule, because the IMO program only covers engines over 130 kW. Therefore, EPA will finalize the definition of rated speed as proposed. EPA may revisit the differences between the definitions in the large CI marine rule.

f. Marine Engines

1) Marine Definitions

Summary of the Issue

In the proposed regulations, EPA defined *propulsion marine diesel engine* as "a marine diesel engine that is intended to move a vessel through the water or direct the movement of a vessel" and *auxiliary marine diesel engine* as "a marine diesel engine that is not a propulsion marine diesel engine."

Comments

One commenter requested two clarifications regarding the propulsion marine diesel engine definition. First, this commenter wanted to know if an engine driving a generator that provides power to an electric distribution system that provides both general service electrical power and propulsive power to a vessel would be considered a "propulsion marine diesel engine." Second, this commenter requested an explanation of the phrase "direct the movement of a vessel," especially with regard to a diesel engine driving a generator producing power for the vessel's steering system.

Analysis

Because of the many ways in which power is used on board a marine vessel, EPA acknowledges the need to clarify the definitions for propulsion marine diesel engine and auxiliary marine diesel engine. However, it should be noted that the marine engines subject to this rule are very small (less than 37 kW). Consequently, EPA may revisit the following explanations in the

context of the large CI marine rule, when more comments are expected regarding their application. Finally, it should also be noted that the application of these definitions is important primarily insofar as it affects the duty cycles on which the engines must be certified. The stringency of the numerical emission limits is not a function of engine application.

With regard to the first point raised by the commenter, it is EPA's intention that any engine for which the primary function is to provide mechanical power to propel or direct a vessel would be considered a propulsion engine, regardless of whether that power is applied directly to the propeller shaft or indirectly by way of an electrical system. The clearest example of the proposed definition is an engine which is directly connected to the propeller shaft and for which the sole function is to provide mechanical power to turn that shaft. However, diesel engines on some vessels are used both to propel and position the ship. This is the case for vessels that have primary propulsion azimuthal screws. EPA intends that these engines also be considered propulsion engines, even though they propel "directional propellers" because the primary function of the engine is to propel/position the vessel. Similarly, some large ocean-going vessels have supplemental "shaft generators" that can be clutched to the main propulsion shaft once the engine is up to full speed. These shaft generators are also intended to be considered propulsion engines because their primary function is to propel the vessel.

Some vessels are propelled by engines that are used as generators, with the power being provided to the propeller shaft indirectly through an electrical circuit. This is often the case on large passenger vessels (e.g., cruise ships), which may be fitted with a bank of several diesel engines that provide electricity both for propulsion and for general service. In this case, each of those engines would be considered a propulsion engine because the vessel cannot be propelled without the operation of at least one of them.

On the other hand, engines that provide power to thruster systems (i.e., bow and stern thrusters) are intended to be considered propulsion engines only if they provide power to those systems via a circuit that is normally not connected to the ship's auxiliary electrical system. Typically, however, thruster systems are powered via the ship's auxiliary electrical system. In this case, the fact that the auxiliary engine is used to provide power to a thruster system will not qualify the engine as a propulsion engine, unless the auxiliary engine also provides power to the ships propeller.

With regard to the second comment, the phrase "direct the movement of a vessel," is not intended to cover auxiliary diesel engines which drive a generator that furnishes power to an electrical system that also provides power for the vessel's steering system. However, an important exception are those engines described above that provide power to bow thrusters. Engines that provide power to parts of the vessel's steering system (e.g., power systems that are connected to rudders or that regulate the speed or direction of bow thrusters) and that are used for other auxiliary power purposes are not intended to be propulsion engines.

As a final point of clarification, EPA intends a marine auxiliary engine to be a diesel engine

installed on a vessel that is not a propulsion engine. An auxiliary engine will be considered to be installed if its fuel, cooling, or exhaust system are an integral part of the vessel or require special mounting hardware. A portable auxiliary engine of any size not installed on a marine vessel (e.g., a hand-held auxiliary engine or an auxiliary engine mounted on a pallet that can be easily removed from a vessel) is not considered to be an auxiliary engine; instead, such an engine will be subject to the land-based nonroad requirements, regardless of its use on a marine vessel. This approach is intended to reduce the certification requirements; by considering auxiliary engines that are not installed on board a vessel as land-based nonroad engines, engine manufacturers will not be required to recertify them as marine engines.

2) Streamlined Certification

Summary of the Issue

During outreach efforts with small businesses, several post-manufacture marinizers expressed concern over the new certification burden they would be facing as a result of the proposed emission control program. They requested EPA to explore ways to reduce this burden, possibly through the development of a streamlined certification process. One suggestion would allow a small marinizer to rely on the original engine manufacturer's certificate of conformity, provided that the marinizer demonstrates it has not altered the engine's performance or combustion parameters.

Consequently, EPA raised the idea of streamlined certification for marinizers in the NPRM. However, EPA noted at least two problems with the above suggestion that would need to be resolved before such a provision could be finalized. First, there may be a compliance problem in that the original engine manufacturer may challenge its presumed liability in an EPA enforcement action directed at these engines. Second, a simple demonstration of equivalent emissions performance on pre- and post-marinized engines would not be sufficient to address the Agency's primary concern, which is the possibility of degradation of in-use emission performance over time. Nevertheless, EPA expressed interest in pursuing such a solution, and sought comment on how the certification process could be streamlined.

Comments

EPA received only one comment on the issue of streamlined certification for post-manufacture marinizers. This commenter, however simply expressed support for the suggestion that post-manufacture marinizers be allowed use the original engine manufacturer's certificate. The commenter also asked that post-manufacture marinizers be exempt from testing their engines and only be required to meet minimum record keeping requirements.

Analysis

While EPA acknowledges the desirability of streamlined certification for post-manufacture

marinizers, it continues to believe that any program that would allow a post-manufacture marinizer to rely on another manufacturer's original engine compliance certificate must be designed to mitigate the concerns EPA raised in the NPRM regarding manufacturer liability and potential emission deterioration. The program suggested during small business outreach and discussed in the NPRM continues to suffer from these and other critical problems.

First, for such a program to work it would be necessary for EPA to evaluate whether the processes performed by a post-manufacture marinizer are likely to alter engine emission performance. It is not clear how this could be done, particularly since the same alteration may have different emission effects on different engines.

Second, marine diesel engines are expected to comply with the numerical emission limits throughout their useful life. By allowing a post-manufacture marinizer to rely on the base engine certificate to demonstrate compliance, EPA will be creating a presumption that emissions will not, in fact, increase over time. At this time, however, EPA is not convinced that this is the case. On the contrary, the marinizer may replace or modify original components, or otherwise modify the engine in ways that will reduce emissions durability. Evidence of such deterioration will not be immediately available, and would likely have to be addressed through a compliance action. Consequently, such a program could be less protective of the environment.

Finally, even if the above two concerns could be resolved, an enforcement problem would continue to exist. Specifically, in a compliance action, both the base engine manufacturer and the post-manufacture marinizer would be motivated to argue that the emission violation is the result of processes performed by the other. Because the enforcement action would occur years after the engine is manufactured, it may not be possible to determine which party is at fault.

Consequently, EPA will not be finalizing streamlined certification provisions for post-manufacture marinizers at this time, although it will consider revisiting the issue in the large CI marine rule. Any post-manufacture marinizer who adds, replaces, adjusts, or modifies any engine component that may have an impact on emissions (including, but not limited to, cooling system, fuel system, turbocharger, and electronic controls) will need to recertify the engine as meeting the requirements of this emission control program. On the other hand, those companies whose "marinization" process consists solely of activities that do not violate the diesel engine anti-tampering provisions will not have to recertify, provided the original engine certification label remains on the engine.

3) Standards for Marine Engines Not Exclusively Engaged in Domestic Voyages

Summary of the Issue

The proposed numerical emission limits are intended to apply to all engines entered into commerce in the United States. With regard to marine engines, all engines installed on vessels registered or flagged in the United States must meet the requirements.

Comments

One commenter expressed concern regarding the equity and potentially anti-competitive effects of EPA imposing standards that are more stringent than those adopted by IMO on engines used on U.S. vessels engaged in international and offshore operations. Engines installed on foreign-flagged vessels would not have to comply with EPA's requirements, even though they may be larger contributors to U.S. air quality problems than engines installed on U.S. vessels that go abroad. The commenter argued that unless similar requirements are imposed on non-U.S. vessels, EPA should differentiate its requirements between U.S. vessels operating under "registry" and those in domestic service as identified by the vessel documentation laws.

Analysis

EPA does not believe that the requirements of this rule impose an undue burden on U.S. ships that engage in international voyages. This is primarily because the requirements of this rule cover only marine engines under 37 kW. Given the relatively low costs associated with the purchase of compliant engines and the fact that these vessels are unlikely to have large numbers of these small engines, this rule should not affect operating costs and thus competition with vessels that are not subject to these requirements.

g. Incorporation By Reference of ISO Test Procedures

Summary of the Issue

EPA did not propose to adopt by reference the test procedures adopted by ISO TC70/SC8 committee. EPA instead proposed to continue to rely upon the existing federal test procedures with some modifications.

Comments

The manufacturers commented that EPA should adopt by reference the emission measurement procedures of ISO 8178 Part 1. They argued that EPA is required by the National Technology Transfer and Advancement Act (NTTAA) to adopt such "voluntary consensus" standards. EMA did recognize that "some minor issues may need to be addressed in the ISO 8178 language", and stated that it was willing to work with EPA to resolve them. Some manufacturers also stated that if EPA does not incorporate the ISO procedures by reference, then it should makes its test procedures identical to the ISO procedures.

Analysis

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 (NTTAA), Pub. L. No. 104-113, § 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless to do so would be inconsistent with

applicable law or otherwise impractical. Voluntary consensus standards are technical standards (e.g., materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. The NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards. While ISO's test procedures may be considered voluntary consensus standards, EPA has decided not to adopt these procedures in this final rule. The Agency has identified several aspects of the existing ISO procedures which it believes are inappropriate and would make use of these procedures impractical. For example, the ISO procedures do not have test fuel specifications for representative in-use fuels. The ISO procedures also specify a minimum stabilization time of ten minutes for each test mode, while EPA has specified a minimum time of five minutes. In other areas, such as the engine intake air specifications, the ISO procedures are too vague. In general, the ISO procedures as currently specified are better suited for research applications than for in-use compliance purposes. EPA considered taking the approach recommended by EMA, that is adopting the ISO procedures "with adjustments." However, under the NTTAA this would be equivalent to EPA continuing to rely on its own existing procedures. EPA has determined that it is more appropriate at this time to continue to use the existing EPA procedures.

EPA believes that it is an important fact that the procedures included in this final rule are part of the current nonroad rule and were adopted before ISO procedures existed. It is equally important to note that this decision by EPA to not incorporate the ISO test procedures by reference at this time is not a final decision on the use of ISO procedures. This decision does not prevent EPA from allowing ISO procedures to be used by manufacturers as alternate test procedures. Moreover, EPA continues to believe that the test procedures should be harmonized to the greatest extent possible, and is committed to working with the ISO committee to address the outstanding issues. It is very possible that EPA and the ISO committee will be able to resolve these issues, and that EPA will thus be able to incorporate the ISO procedures by reference at some later date.

h. Nonmethane Hydrocarbon Measurement

Summary of the Issue

EPA proposed to allow three options for determining NMHC emissions: 1) assume that NMHC emissions are equal to calculated THC (total hydrocarbon) emissions; 2) assume that NMHC emissions are equal to 98 percent of the calculated THC emissions; or 3) measure NMHC using a manufacturer-specified method with prior approval from the Administrator.

Comments

Cummins recommended allowing manufacturers to use "any NMHC measurement method, based upon good engineering judgement, without a need to seek EPA approval". EMA also supported such an allowance. CARB recommended that EPA adopt a gas chromatographic (GC) approach, such as the one that they currently use for diesel vehicles. Westerbeke specifically

supported the option of assuming that NMHC emissions are equal to 98 percent of the calculated THC emissions.

Analysis

The Agency has determined that there is no single method that has been proven to accurately measure NMHC emissions from nonroad diesel engines, and is thus not finalizing any specific method in these regulations. EPA does not agree with the recommendation that manufacturers be allowed to use NMHC measurement method without a need to seek EPA approval. NMHC measurement procedures can potentially have an effect on the stringency of the standards, and therefore, the Agency must approve such procedures in advance. EPA recognizes that it could be inconvenient to require each manufacturer to individually seek approval for a specific new method, and therefore will generally issue guidance to all manufacturers when it approves a specific method for measuring NMHC emissions. For example, while EPA it not currently convinced that the CARB method will work for all diesel engines, it could approve it, at some later time, and allow it for all nonroad diesel engines so that manufacturers would not need to petition the Agency separately. Finally, EPA has decided to combine options 1 and 2 (as described above) into a single option; that is to allow a manufacturer to assume that NMHC emissions are equal to 98 percent *or more* of the calculated THC emissions. EPA expects that, under this option, manufacturers will assume in nearly all cases that NMHC emissions are equal to 98 percent of the calculated THC emissions, but the Agency does not want to prohibit a manufacturer from assuming that NMHC emissions are equal to 100 percent of the calculated THC emissions (as was allowed by the proposal).

i. Engine Family Definition

Summary of the Issue

Engines are grouped into families which are expected to have similar emissions characteristics throughout their useful lives. EPA's regulations list a number of characteristics, including bore and stroke, which distinguish engine families.

Comments

EMA commented that EPA should revise the current engine family definition to allow engines with a per cylinder displacement within a range of 15% to be in the same family. EMA commented that this would harmonize the definition with California and Europe. Wis-Con Total Power requested expanding the engine family definition to allow engines which are marginally outside a specific horsepower category to be allowed to certify in an adjacent category, where these engines are similar enough to engines in the adjacent category that they would otherwise be grouped together. They argued that not providing this flexibility would cause costly design changes to engines rated at under 37 kW that are subject to EPA's Tier 1 standards with short leadtime schedules.

Analysis

EPA's current regulation allows engines which differ in any of the listed specifications, including cylinder displacement, to be grouped in the same engine family if their useful life emission characteristics are shown to be similar. Provided this is demonstrated, a manufacturer can have an engine family certified for EPA, California, and Europe without need for a 15% displacement discriminator in the regulations. EPA will retain the current definition.

EPA is sympathetic to manufacturer concerns about the costly multiplying of engine families due to power category definitions that were created to aid implementation of the standards, although the Agency notes that only one manufacturer commented on this and this manufacturer was concerned about one specific engine model rated under 37 kW. The Agency believes that this issue has particular relevance for Tier 1 engines below 37 kW because of the short leadtime provided for the certification of these engines, and because this group is comprised of 3 rather narrow power bands. Although these categories have an approximate connection to meaningful groupings, the exact cutpoints are somewhat arbitrary. On the other hand, a very flexible approach to creating engine families would likely lead to abuse. A manufacturer could group engines to take advantage of the least stringent emission standards applicable to the engines in the "family." This could also create competitive disadvantages for manufacturers who produce similar engines but whose engine ratings do not allow an opportunity to group families in this way.

Therefore, EPA is allowing the creation of Tier 1 engine families that straddle the power band cutpoints at 8, 19, and 37 kW, subject to EPA approval. To avoid potential abuse of this provision by a manufacturer attempting to take advantage of the least stringent emission standards applicable to the engines in the family, such grouping will be allowed only if: (1) most of the engine family's sales in each year are from engines with rated power in the power band with which the engine family is certified, and (2) all power ratings in the engine family that are not within the power band with which the engine family is certified are within 10 percent of one of the two power levels that define this power band. The limitations would not apply if the emission standards for the power band in which the engine family is being certified are at least as stringent as those of the power band that the included engines would otherwise be in. EPA may extend this provision beyond Tier 1 in a future action, but first wishes to examine its effectiveness over time in providing sufficient flexibility without leading to abuse.

j. Conversion of Horsepower Ratings to Kilowatt Ratings

Summary of the Issue

EPA proposed to apply its emission standards to nonroad engines based on their rated power expressed in kilowatts (kW), but did not specify how manufacturers who define their products in terms of horsepower (hp) should convert their hp ratings into kW ratings.

Comments

Cummins recommended that rated horsepower values be multiplied by 0.7457 to convert them to kW values. They also recommended that the resulting kW value should be rounded to the nearest whole kW using ASTM rounding protocol.

Analysis

EPA agrees that it is appropriate to convert hp to kW using a 0.7457 conversion factor and ASTM rounding protocol.

k. Technical Amendments

1) Oxygen Calibration Gas Purity

Summary of the Issue

§89.312 specifies a purity for oxygen calibration gases.

Comments

EMA commented that this reference should be deleted and the section reserved.

Analysis

Paragraph (b)(2) is reserved to remove references to O_2 gases. Oxygen analysis is not required.

2) Tables 3 and 4 of Subpart D

Summary of the Issue

Table 3 of Subpart D specifies measurement accuracies and calibration frequencies. Table 4 contains fuel specifications.

Comments

EMA commented that a number of the changes described in the technical amendment support document for the NPRM had not been made in the two tables.

Analysis

EPA agrees with this comment. The items corrected are listed below for each table.

Table 3

The changes to items 2, 7, 8, 12, 15, and 21 correct errors in the NPRM. The technical amendment support document for the NPRM documented these changes, however, they did not appear in the NPRM .

Table 4

The changes to the cetane, 10 % point, 50% point, and API gravity did not make it into the NPRM but were in the technical amendment support document. Additionally, the ASTM D5186-91 is added as optional method to determine percent aromatics in the fuel. This method was also inadvertently left out of the NPRM but was included in the support document.

3) Measurement of Fuel Flow

Summary of the Issue

§89.401 and §89.404 specify the measurement of fuel flow.

Comments

EMA commented that the reference to fuel flow should be struck.

Analysis

Determination for fuel flow is required for raw analysis only. The term raw analysis is added in parentheses after fuel flow for clarification.

4) Test Segment Zero Trace

Summary of the Issue

§89.405 specified the identification of the zero trace for each test segment.

Comments

EMA commented that the term segment should be omitted.

Analysis

EPA agrees with this comment. The zero and span may be checked at the beginning and end of the test. The wording is changed to identify the zero and span for each range used.

5) Emissions Sampling Calculations

Summary of the Issue

In §89.418, EPA lists the equations for raw emissions sampling calculations.

Comments

EMA commented on the position of the equation for determining fuel air ratio. EMA commented that this equation should be moved to after the definition of α. Also EMA suggested the addition of two equations, one for G_{aird} and the other for G_{exhw}.

Analysis

EPA agrees with these comments and the changes are made. These changes do not change the required calculations. They make the section easier to read and add intermediate steps in the calculations.

6) NOx Correction Equations

Summary of the Issue

EPA proposed to eliminate one of the NOx correction equations in §89.418. EPA retained the equation which was originally for use in uncontrolled conditions as the only NOx correction equation both for raw and dilute sampling.

Comments

EMA commented that EPA's proposed NOx correction factor equation added unnecessary complications for those manufacturers who are using the dilute sampling method. EMA also commented that the equation which calculated fuel air ratio from exhaust concentrations is appropriate only for raw analysis. Therefore, manufacturers doing dilute sampling would also have to measure fuel flow and air flow rates.

Analysis

EPA agrees that the use of the NOx correction factor in the NPRM would add complications for manufacturers doing dilute sampling. The proposed NOx correction factor requires calculation of the fuel to air ratio. The equation for calculating fuel to air ratio from exhaust concentrations is appropriate only for raw sampling. Therefore, EPA is finalizing the NOx correction equation which is dependent only on intake humidity. This equation will be used for both raw and dilute sampling. Laboratories may get approval for the use of other equations under the alternate test procedure provision.

7) Emission Results Summation

Summary of the Issue

The equation for calculating emission results in §89.418 and §89.424 contains a summation to i=n-1.

Comments

EMA commented that this equation needs to be corrected so that the summation is now i=n.

Analysis

EPA agrees with this comment and makes the necessary correction which should have been made in the NPRM. The summation of i=n-1 does not correctly sum power for constant speed engines.

8) HC Analyzer Zeroing and Spanning

Summary of the Issue

§89.412 requires the HC analyzer to be zeroed and spanned through the overflow sampling system for raw gas analysis.

Comments

EMA commented that the requirement for overflow zeroing and spanning will consume excessive amounts of calibration gas during raw sampling.

Analysis

EPA agrees with this comment. Zero and spanning can now also be done through the analyzer port.

9) Background Sample

Summary of the Issue

§89.420 describes the method for obtaining a background sample.

Comments

EMA commented that background sampling should occur simultaneously with dilute

sampling.

Analysis

EPA agrees with EMA's comment and the change is made.

10) CFV Calibration Parameters

Summary of the Issue

§89.422 includes a table of CFV calibration parameters.

Comments

EMA commented that this table is not consistent with recent technical amendments to the on-highway rule.

Analysis

EPA agrees with this comment. The table is changed to agree with the on-highway requirements. This will allow one test cell to meet the same requirements for on-highway and nonroad engines.

11) Definition of M^1

Summary of the Issue

§89.424 defines the term M^1.

Comments

EMA commented that this term should be defined as the fuel consumed for each mode.

Analysis

EPA agrees that M^1 is the fuel consumed in each mode not the fuel consumed for the test. The change is made.

12) Concentration Conversion Equations

Summary of the Issue

EPA proposed equations to convert dry concentrations measured during dilute sampling to

wet concentrations.

Comments

EMA commented that EPA should adopt ISO equations which correct for both humidity in the dilution and ambient air.

Analysis

Correcting for the humidity in the intake and dilution air is technically correct. The appropriate equations are added to §89.424.

13) Test Cycle in Subpart E Table 4

Summary of the Issue

EPA proposed a new test cycle in Table 4 in Appendix B to Subpart E.

Comments

EMA commented that the power for mode 4 should be 25% not 10%.

Analysis

EPA agrees with this comment. The test cycle is the same as ISO test cycle E3. The correct power for mode 4 is 25%.

9. Other Regulatory Issues

a. Nonroad Statement of Principles

Summary of the Issue

EPA worked with the California Air Resources Board, and nonroad diesel engine manufacturers on a joint Nonroad Statement of Principles (Nonroad SOP) as a way to develop a framework for a proposed rule. After releasing the text of the SOP in a supplemental advance notice of proposed rulemaking, EPA received and addressed comments in developing the NPRM. During the development of the NPRM and the FRM, the Agency followed all required notice and comment procedures and met with all key parties in the rulemaking, several more than once.

Comments

Environmental groups expressed concern that the SOP process may not meet the requirements of the Administrative Procedures Act, and regardless, they believed that EPA "ended up with poorer public process and a weaker rule which limits the agency's ability to protect public health." EMA and California ARB expressed their view that the NPRM is generally consistent with SOP framework, although they point to several issues in their comments where they believe the NPRM needs to be adjusted for full consistency with the SOP.

Analysis

The SOP provided a vehicle for developing a framework for an NPRM, but had no binding influence on the Agency during the formal rulemaking process. EPA has adopted many provisions in the final rule that are consistent with the SOP, where the rulemaking record indicates this is the most appropriate course, and has adopted provisions that differ from the SOP in some other cases where comments were persuasive. The Agency distributed the SOP as a part of a Supplemental ANPRM (62 FR 199, January 2, 1997) and accepted extensive comment before formally proposing a program based on the SOP. The Supplemental ANPRM, NPRM, and now this final rule reflect a process of continuing refinements based on broad public input. The Agency believes that the Nonroad SOP was an appropriate and useful step in this process.

b. Hobby Engines

Summary of the Issue

The proposal would establish regulations for nonroad CI engines of all sizes. Many extremely small engines used to power model airplanes, model boats, and other such hobby equipment fit the proposed definition of a nonroad compression ignition engine. Regulation of these engines raises some special concerns.

Comments

Commenters claimed that manufacturers of hobby-type engines would have great difficulty in testing, designing, and producing compliant engines under the proposed program. They described differences between these engines and larger engines used in other applications that could cause emission controls to be infeasible, therefore greatly impacting the ability of people to pursue this hobby. These differences include the need for extremely small size and light weight, high compression ratios and engine speeds, simple fueling and starting systems, frequent repair and adjustment by the user, and unique fuel compositions. They commented that these engines have a low average annual hours of usage. This, combined with their extremely low power output, would result in their contributing very little to the emissions inventory.

Analysis

EPA is unable to establish an emission standard for these small hobby engines at this time. The Agency agrees that these engines are designed and operated very differently than larger engines used in other applications and is not aware of information about them that would allow an assessment of the feasibility of the proposed standards, or help to establish feasible alternative standards, taking into consideration the factors relevant under section 213(a)(3) of the Act. Also, it is not clear whether such small engines could be appropriately and consistently tested with existing equipment, or, if so, whether any of the available test cycles would adequately represent the in-use operation of these engines. Furthermore, EPA could not realistically impose the proposed useful life requirements or the warranty and maintenance interval provisions on these engines given their limited durability and frequent adjustment by the user.

Although there are many distinguishing features of this class of engines, the comments received indicate that per-cylinder displacement provides an adequate and simple basis for distinguishing it from other types of engines. Even though the Agency lacks the information that would allow a precise determination of the displacement level above which the proposed standards can be considered feasible, a displacement of 50 cubic centimeters per cylinder is well above the displacement level that is typical of this class of engines, and well below that of the smallest engines outside this group. Therefore, the final rule excludes engines with a displacement of less than 50 cubic centimeters per cylinder from the emissions standards in Part 89.

10. Emissions Modeling

a. General Comments

Summary of the Issue

EPA developed a computer model as part of the NPRM for predicting the emissions benefit of the proposed standards. The model relied primarily on information from the NEVES report and information from a nonroad database developed by PSR. EPA developed its own model in support of the NPRM because EPA did not have an official model for predicting nonroad emissions similar the MOBILE model which is EPA's official model for predicting on-highway emissions.

Comments

EPA received a number of general comments on the emissions model used to develop the environmental impact results for the NPRM. Environmental groups commented that EPA should improve the estimates of number, type and age of nonroad engines/equipment. They noted that EPA should assess the seasonal flux in activity patterns for construction equipment, especially in urban areas. In addition, they said EPA should characterize engine population data according to fleet size, end-use, and use patterns. Last, environmental groups commented that EPA should develop a national vehicle population database using common classification schemes.

American Augers submitted comments questioning the validity of the database EPA used to create the computer model for predicting nonroad emissions. They provided no further details in support of their concerns.

EMA commented that EPA should reassess its assumptions concerning the emissions inventory and provide adequate data to support those assumptions during the 2001 feasibility review.

Analysis

In the time since the NPRM was published, EPA has been developing a new emissions model for the purpose of predicting the in-use emissions inventories for nonroad engines and equipment. This model, known as the NONROAD model, is expected to be officially released by EPA late in 1998. For the final rulemaking, EPA has used the draft version of the NONROAD model to predict the emissions impact of the new standards. The NONROAD model uses the same methodology for predicting nonroad CI emissions as the model developed for the NPRM. However, the NONROAD model has been updated with new information on emission levels of more recent pre-control engines, as well as updated nonroad equipment populations from the PSR database as commenters suggested. At this time, EPA is not aware of, and commenters have not identified, any other nationwide source of detailed information on

nonroad equipment other than the PSR database. Therefore, the NONROAD model continues to use the PSR database as the source of population and all activity and usage values with the exception of median useful life. Values for the median useful life were taken from a February 1997 report entitled, "Documentation of Input Factors for the New Off-Road Mobile Source Emissions Inventory Model," which was prepared by Energy and Environmental Analysis, Inc. (EEA) for the California ARB. The median useful life values developed by EEA were based on information contained in the PSR data base. The Final RIA contains more information on the NONROAD model and the updated emissions modeling performed in support of today's action.

The results from the draft NONROAD model presented in the final rulemaking do not present any seasonal breakdown of benefits. It should be noted that the final release version of the NONROAD model will allow users to determine emissions on a seasonal basis as well as on a geographical basis.

In response to EMA's comment regarding the 2001 feasibility review, EPA intends to update its assessment of the environmental impact of the nonroad standards as part of that review. This reassessment will, as EMA recommended, involve a revised inventory analysis. Because the inventory analysis will not be performed for at least another two years, EPA expects to have a large amount of new information that can be factored into that analysis. The public will have the chance to provide comments on that analysis as a part of the normal rulemaking process following the review.

b. Growth Rates

Summary of the Issue

In the NPRM analysis, EPA presented two sets of emission inventories based on different assumptions regarding future growth in the use of nonroad equipment. The first growth scenario was based on economic statistics developed by the Department of Commerce's Bureau of Economic Analysis (BEA). The growth rates used in the first scenario varied by nonroad segment (e.g., agricultural and construction) and ranged from 0.9% to 1.7% for all years. The second scenario used one growth rate for all segments of 3% for all years. This higher growth rate assumption was developed based on growth in diesel fuel sales to the off-highway sector and information from the PSR database showing nonroad equipment sales to be increasing at rates higher than those predicted by BEA.

Comments

EMA commented that the growth of nonroad equipment, which is primarily agricultural and construction equipment, will remain fairly flat. They noted that farming acreage in the United States is not getting larger and that the construction activity of the last 20 years, which was marked by flat nonroad equipment usage and growth, is unlikely to increase in the future. American Augers questioned EPA's growth assumptions noting that fleets are continuously

replacing old products because new products render old products non-economical for continued use. They did not provide any supporting information on alternative growth rates.

Analysis

EPA continues to believe that there is growth in the nonroad market. The prospective growth indicators developed by BEA and EPA's more recent analysis of nonroad equipment population estimates from the PSR database show growth in the various nonroad segments. Without any detailed information to support an alternate rate, EPA is continuing to present emission inventories under two different growth scenarios. The first scenario continues to use growth rates based on an updated analysis of the BEA information. The annual growth rates based on BEA vary from 1.0% to 7.4% per year depending on the market segment (e.g., agriculture, construction, etc.). The second scenario is based on the growth in nonroad equipment populations based on a retrospective analysis of populations for the years 1989 to 1996, as determined from the PSR database. The PSR-based growth rates tend to be higher than the BEA-based growth rates and vary from 3.1% to 9.1% depending on the market segment. The RIA for the final rulemaking contains a more detailed description of the growth assumptions used in the analysis as well as the actual emission inventories under the two growth scenarios.

11. Cost Effectiveness

a. Discount Rate

Summary of the Issue

To determine the cost effectiveness of the proposed standards, EPA divided the discounted lifetime cost of complying with the standards by the discounted lifetime emission reductions from a typical piece of nonroad equipment. EPA used a discount rate of seven percent in determining the discounted cost of complying with the standards and a discount rate of three percent in determining the discounted lifetime emission reductions.

Comments

EMA, EMI and Ingersoll-Rand commented that EPA should use consistent discount rates for both the cost and emission reduction calculations when determining cost effectiveness. The methodology used by EPA leads to cost effectiveness values that are lower than if the same discount rate is used for both cost and emission reductions calculations. They did not recommend one rate over the other, just that EPA should use a consistent rate.

Analysis

EPA agrees with the commenters that it is appropriate to use a consistent discount rate for both cost and emission reduction calculations when determining the cost effectiveness of the standards. EPA believes the seven percent discount rate used in the NPRM analysis for the cost analysis is the appropriate rate to use for all calculations. (As noted in the comments, the cost effectiveness value will be the same if EPA uses either the three percent or the seven percent rate consistently in all calculations.) The seven percent rate is representative of the opportunity cost of raising capital whereas the three percent rate is meant to represent the consumption rate of interest. Because the opportunity cost of raising capital is tied to real-world interest rates, EPA has revised its cost effectiveness analysis to use a seven percent discount rate for both cost and emission reduction calculations.

b. Emission Reductions Attributable to Other Factors

Summary of the Issue

In determining the cost of compliance, EPA predicted the menu of technologies that manufacturers would use to meet the proposed standards. EPA then determined the cost of each of the individual technologies. For some of the technologies, EPA assumed that manufacturers would have used those technologies even in the absence of tighter emission standards. For those technologies, EPA adjusted the cost downward by a certain fraction to reflect the cost of

compliance attributable to the standards only and not the cost of ongoing improvements in general engine design. EPA did not make any similar adjustments to the emission reductions attributable to the standards.

Comments

EMI commented that if EPA plans to continue adjusting the cost of compliance downward for the market-driven technologies, EPA should also make a consistent adjustment to the emission reductions when determining the portion of emission reductions attributable to the emission standards. They noted that the methodology used by EPA leads to lower cost effectiveness than if consistent adjustments to both the cost and emission reductions were used.

Analysis

In concept, EPA agrees with the comment submitted by EMI. Any emission reductions that would normally have occurred with improvements in technology should not be considered in determining the cost effectiveness of new emission standards. However, EPA believes that as manufacturers modernize and improve the technologies used on nonroad engines, they are faced with many choices on how to employ the new technologies to the greatest advantage for their customers. Many times, in the absence of requirements to meet tighter emission standards, the manufacturer will design the parameters of a new technology, or similarly, redesign the existing engine, to minimize fuel consumption or some other desirable trait, while not taking advantage of the emissions control capability of the new technology.

In the cost analysis for the final rulemaking, EPA has assumed that the cost of the following technologies can be attributed, in part, to benefits unrelated to emissions: engine modifications, electronic controls, improved fuel injection systems, and turbocharging. EPA believes that without new emission standards, however, manufacturers will design these technologies, or redesign other engine parameters to maximize engine performance without regard to emission levels. Because none of these technologies leads to inherently lower emissions, EPA will not make any adjustments to the emission reduction calculations to account for emission benefits that would have occurred independent of the new standards.