SUMMARY AND ANALYSIS OF COMMENTS
ON THE
NOTICE OF PROPOSED RULEMAKING
FOR
GASEOUS EMISSION REGULATIONS
FOR 1983 AND LATER MODEL YEAR LIGHT-DUTY TRUCKS

ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR, NOISE, AND RADIATION
OFFICE OF MOBILE SOURCE AIR POLLUTION CONTROL

MAY 1980

EPA-420-R-80-101

SUMMARY AND ANALYSIS OF COMMENTS ON THE NOTICE OF PROPOSED RULEMAKING FOR GASEOUS EMISSION REGULATIONS FOR 1983 AND LATER MODEL YEAR LIGHT-DUTY TRUCKS

MAY 1980

STANDARDS DEVELOPMENT AND SUPPORT BRANCH
EMISSION CONTROL TECHNOLOGY DIVISION
OFFICE OF MOBILE SOURCE AIR POLLUTION CONTROL
OFFICE OF AIR, NOISE, AND RADIATION
U.S. ENVIRONMENTAL PROTECTION AGENCY

Important Notice

At the time we performed the analyses found in this document the rulemaking was intended to be applicable to the 1983 model year. In the very late stages of the rulemaking, EPA decided to delay the requirements of the regulations until 1984. Since the conclusions we reached remain virtually the same for 1984, the analyses and recommendations have not been changed. For this reason, the model year 1983 is used as a reference point thorughout the document.

Table of Contents

I. Introduction

The Environmental Protection Agency (EPA) published a Notice of Proposed Rulemaking (NPRM) on Thursday, July 12, 1979, proposing new light-duty truck emissions regulations for 1983 and later model years. The proposed rule prescribed more stringent hydrocarbon and carbon monoxide emission standards, and established a revised assembly-line testing program and nonconformance penalty system for 1983 and later model year light-duty trucks as mandated by the Clean Air Act Amendments of 1977. Substantial changes were also proposed to the definition of useful life, and the procedures used to verify the durability of emission control systems over their useful life. Crankcase emission standards for diesel engines were also proposed.

This document presents a summary and analysis of comments received in response to the NPRM.

II. List of Commenters

1.	Alaska Department of Environmental Conservation	ADEC
2.	American Motors	AM
3.	Glen F. Brammeier, NHTSA, DOT	
4.	Robert Chivvis, EPA Alaska Air Coordinator	
5.	Chrysler Corporation	Chrysler
6.	Cummins Engine Company	Cummins
7.	Council on Wage and Price Stability	COWPS
8.	United States Department of Commerce	DOC
9.	Ford Motor Company	Ford
10.	General Motors Corporation	GM
11.	Doug Hansen, Director, Air and Hazardous Materials Div., EPA	
12.	International Harvester Company	IH/IHC
13.	Motor Vehicle Manufacturers Association	MVMA
14.	Municipality of Anchorage, Alaska	
15.	New Mexico Cattle Growers Association	
16.	Toyo Kogyo Co, Ltd. (Mazda)	Toyo Kogyo
17.	Toyota Motor Company, Ltd.	Toyota
18.	Volkswagen of America, Inc.	Volkswagen

III. Analysis of Issues

A. Issue: Redefinition of Useful Life

1. Summary of the Issue

In the July 12, 1979 NPRM, EPA proposed to amend the current definition of "useful life" for light-duty trucks. Currently, light-duty truck useful life is defined as five years or 50,000 miles (or the equivalent) whichever occurs first. This definition, which applies to all light-duty trucks, was found to be inadequate due to deterioration of the emission controls of vehicles that are beyond 5 years or 50,000 miles. The proposed revision defines the useful life as the "average period of use up to the vehicle retirement or engine replacement or rebuild." Since this period may vary among manufacturers, and among vehicle types produced by a single manufacturer, EPA proposes that the manufacturers of a vehicle determine the duration of this period. The useful life is, however, constrained to be not less than five years or 50,000 miles whichever comes first, or the period of the basic mechanical warranty on the engine assembly, whichever is longer.

2. Summary of the Comments

A large number of comments were received regarding the EPA's justification for changing the useful life definition by noting that the half-life concept has been a part of vehicle emission regulations since the 1966 (HEW) rules applying to 1968 model year vehicles. In that rulemaking, 100,000 miles was defined as the basis for "lifetime emissions." Under the assumption that emission deteriorations would be linear, HEW established a procedure for calculating average lifetime emissions at the approximate half-life (50,000-mile) point. All subsequent regulations for light-duty vehicles, light-duty trucks, and heavy-duty engines, except for the recently adopted heavy-duty engine regulations, have used half of the expected life as the useful life. The commenters imply that the average lifetime emissions concept has embodied the intentions of Congress throughout the years and that the proposed redefinition of the useful life directly contravenes Congressional intent. They contend that Congress in drawing up the 1970 Clean Air Act (where the term "useful life" first appears) was fully aware that the 50,000 mile "lifetime" they chose for durability and warranty purposes approximated only half of the expected life of a light-duty vehicle. The half-life concept was therefore specifically woven into the Act. In further support of these contentions one commenter states that an analysis of legislative history of the 1977 Clean Air Act Amendments clearly shows a rejection of the total life concept now being proposed by EPA.

Most commenters argued against the concept of a full-life useful life on the basis that it acts to increase the stringency of the emission standards. As the light-duty truck regulations are presently constructed, manufacturers must design their engines so that during approximately the first half of the lifetime their emissions do not deteriorate past the level of the standards.

It was argued that this situation requires the emissions of a new engine to be somewhat below the standard in order that deterioration may be accommodated. The proposed full life concept would purportedly require lifelong emissions compliance and hence shall require lower low mileage targets (LMT's). This is the "increased stringency" referred to in the comments. Some of the commenters went on to claim that EPA is in effect requiring emission reductions in excess of the 90 percent set by Congress.

The two remaining major areas of comment were directed at specific problems which were expected to arise during implementation of the full-life concept. The first of these is the language of the NPRM that requires the manufacturers to determine an "average" period of engine use for each engine line. The comments imply that half of the engines subject to an average useful life will require rebuild or retirement before they reach that useful life. Most commenters said a flurry of warranty claims could be expected to result from decay in emission-related components toward the end of the useful life.

The last set of comments were procedural in nature and centered around the difficulties that the manufacturers would expect in defining a useful life number under the proposed full-life concept. First, data concerning actual engine usage periods is largely unavailable at this time. Secondly, it was argued that the decision when to retire or rebuild is reached by the user on largely economic, as opposed to mechanical grounds. Thus, manufacturers would find it difficult to arrive at an average period for this event for an engine. The problem would be further compounded by the wide range of vocational applications seen by many engine families.

3. Analysis of the Comments

Many of the issues concerning useful life were previously raised in connection with the 1984 heavy-duty engine gaseous emissions rulemaking. These issues are analyzed in depth in the Summary and Analysis of Comments document accompanying the final heavy-duty rulemaking, and are incorporated herin by reference.

The Clean Air Act did not place a half-life constraint on light-duty trucks' useful lives. Quite to the contrary, Section 202(d)(2) clearly provides the Administrator with the discretionary authority to define the useful life of light-duty trucks as greater than that set by Congress for light-duty vehicles if he "determines that a period of use of greater duration or mileage is appropriate." Given the disireability of manufacturers' building emission control components as durable as the rest of the traditionally long-lasting engine parts, and given the significant air quality benefits that will be realized if the proposed definition of useful life is adopted, adoption of the full useful life concept is appropriate and well within the discretionary authority explicitly granted to the Administrator by the Act.

Legislative history shows no evidence of a Congressional commitment to impose a half-life limit on the useful life of heavy-duty vehicles or light-duty trucks. While the 1977 Clean Air Act Amendments deliberately defined light-duty vehicle useful life as half of the expected actual life, that decision was a result of forces that were present at that specific time with respect to that specific class of vehicles. A 100,000-mile/10-year requirement was seriously considered by a Senate Committee, but was subsequently halved based upon the EPA staff's analysis of economic and technological feasibility. Compliance with full useful life standards is indeed possible and economically feasible in 1983 for light-duty trucks. (See Section 1 of this Summary and Analysis of Comments).

Several comments implied that past regulatory practice should constrain future rulemaking. It is EPA's belief, however, that regulations must be the best attempt possible at any given time to fulfill the wishes of Congress within the context of feasibility, cost, and other factors. It was such constraints as these which initially resulted in use of a half-life useful life by HEW; and which led to EPA's recent adoption of full life useful life for heavy-duty trucks in the rulemaking for 1984 heavy-duty engine gaseous emissions.

The final area of comment which affects the full-life concept itself is the stringency issue. This idea might be better treated in the broad context of how it fits into the total full-life useful life plan. Given the fact that the Administrator has the authority to adopt a full-life useful life, then a lower zero-mile emission level is simply a practical result of applying that requirement to the certification process. Thus, we agree that in a narrow sense, the design-goal emission level is more stringent under a full useful life concept. However, the standards themselves are not more stringent; they are simply met for the lifetime of the engine. The staff cannot accept the stringency issue as an argument against the full-life useful life. In any event, Congress required standards representing a reduction of "at least 90 percent", thus indicating that more stringent standards could be promulgated, provided they are technologically feasible.

The remaining discussion will deal with the practical difficulties associated with the full-life useful life concept. The first of those is the proposed requirement that the useful life value supplied by the manufacturer be the "average" for that engine family. The staff has considered alternative methods of establishing the useful life number, though no commenter offered suggestions along those lines. For example, the alternative of allowing complete latitude in defining the useful life is likely to encourage unrepresentative values. There would be a somewhat natural trend for manufacturers, favoring short durability programs and few warranty claims, to gravitate toward a lower useful life limit. Another alternative could be for EPA to establish that some percentile of the retirement/rebuild distribution be used instead of a straight average. This option, however, suffers from a complete lack of data to support the selection of any specific percentile.

The staff has concluded that the useful life value supplied by the manufacturers should be an "average" for a given engine family. This appears to be the best way to determine useful life keeping both industry and EPA's best interest in mind.

Regarding the large number of warranty claims anticipated by the commenters, the staff disagrees that the proposed rule will result in half of the manufacturers' engines requiring emissions warranty work. Although it is clear that half will reach their individual retirement/rebuild points, this does not necessarily mean an emissions violation will exist in every case. Certainly there could be additional warranty claims attributable to the extension of the useful life period. The staff does not, however, expect this number to be substantial. Rather, we expect manufacturers to make needed changes in components to provide full life durability equivalent to their present 50,000 mile durability. Costs for these changes have been included in the economic analysis of the rulemaking. Additionally, it was commented that the proposed regulations imply that the manufacturer would be responsible for post-rebuild emissions compliance. To alleviate this problem the staff recommends a change in the proposed rule which defines the end of an engine's useful life as the average period of use <u>or</u> the point at which the engine needs rebuilding, whichever is reached first (provided that the 50,000 mile/5 year minimum has been passed). Thus, the cost of rebuild, as well as all subsequent repairs, will be borne by the owner and not the manufacturer.

4. <u>Staff Recommendations</u>

On the basis of comments and their analysis above, the staff recommends that the useful-life provisions as proposed be retained largely intact. Three significant changes are offered, however, which respond to a wide range of comments.

As we concluded during the discussion above, the staff believes that the full-life useful life concept should remain a part of this Rulemaking. Within the context, we advocate that the language "average period of use" be kept intact for the sake of practicality. Since the manufacturers will be setting the useful life values, EPA's requiring that value to be an average appears to be the most reasonable method of encouraging accurate useful lives.

Several of the difficulties associated with an "average" useful life, however, will be reduced or eliminated if certain staff recommendations are adopted. Specifically, we support 1) a set of more objective criteria for determining when rebuild is necessary, 2) a manufacturers' option to supply for the owner alternate expected useful lives depending on service application, and 3) modifying the "useful life" definition to be less restrictive of the manner in which the useful life is determined.

The first of these suggested changes is the most significant and would remove much of the uncertainty in defining an "average period of use up to engine retirement or rebuild." The major criterion for determining whether an engine is due for a rebuild would appear on the label and would be, for the purposes of this rulemaking, a compression test, along with a measure of oil consumption and of bearing failure. Those tests will cover nearly all mechanical situations which normally signal the need for a rebuild. Since the actual test values will be determined by the manufacturer for each engine family, establishing the average useful life should be easier and more acurate. Another implication is that an "actual useful life" will exist for each individual engine; there will be a measureable endpoint to the manufacturer's obligation for an engine with respect to both durability testing and the emissions warranty. Thus, the regulations clearly will not require post-rebuild emissions compliance.

The second recommendation amounts to allowing a qualifying statement on the label to indicate to the owner that the useful life of this particular engine can be expected to vary from the "average" due to a lighter or heavier service application. The label could also direct the reader to the operator's manual for information about vocation-specific average useful lives, about how the emissions-related warranty differs from the mechanical warranty, etc. The purpose of the label change is to promote user understanding of the "average useful life" concept and hence to reduce the threat of warranty conflicts.

The final recommendation is to remove from the definition of useful life the restriction that for new engines the useful life be determined from durability testing. We see this provision as an unnecessary complication of the process of establishing a useful life value.

Some of our recommedations, particularly the first two, will to a certain extent add to the complexity of portions of the regulations and the certification process as compared to the original proposal. However, the staff is firmly convinced that by making these adjustments to the proposal, EPA will not only answer a range of reasonable comments but will improve the workability, versatility, and fairness of the full-life useful life concept. We urge the adoption of these provisions.

B. Issue: In-Use Durability Testing

In order to better respond to comments on the proposed in-use durability testing procedure and to optimize all components of the program, EPA is delaying the finalization of the in-use durability testing requirements. Further analysis of the design of the durability program will continue and finalization of the program is expected to occur at the same time as the statutory NOx reduction. The Summary and Analysis of Comments on this component of the proposal are not included in this document. Instead, comments received will be addressed when the in-use durability regulations are finalized.

Beginning in 1984, and continuing until finalization of a revised durability testing procedure, the burden of durability testing will be shifted to the manufacturers. Under this concept, the manufacturers will determine their deterioration factors in programs which they design. EPA will not approve the programs which the manufacturers design but will require that they: 1) describe their durability testing program in the certification application, 2) certify that their durability testing procedures account for deterioration of emission related components and other critical deterioration processes, and 3) adhere to the maintenance requirements as applicable specified in the allowable maintenance regulations. These requirements are the same as those proposed for the determination of the preliminary deterioration factor.

Manufacturers are encouraged to begin small-scale in-use durability programs in the near future so they can gain some meaningful experience with in-use durability testing. This will benefit the manufacturers and EPA in that they could generate in-use durability data which could verify the feasibility of and need for an in-use type durability testing program.

C. Issue: Allowable Maintenance

1. Summary of the Issue

Included in the NPRM were newly-proposed provisions to limit the amount of maintenance which can be performed on light-duty truck durability-data engines. Emission-related maintenance must be technologically necessary and must have a reasonable likelihood of being performed by owners in the field. Specific minimum maintenance intervals are proposed which EPA has determined to be technologically feasible. Additionally, "emission-related maintenance" and "non-emission-related maintenance" are defined. These provisions will help ensure that in-use engines do not exceed the emission standards as a result of control technology which requires more frequent maintenance than the users will actually perform.

2. Summary of the Comments

Many of the comments received are similar to the comments given on the allowable maintenance provisions of the Proposed 1983 Heavy-Duty Engine Regulations.1/ The three categories which encompass most of the comments are: 1) concerns over EPA's justification, both legal and logical, for imposing maintenance restrictions, 2) criticism of certain of the maintenance intervals, and 3) comments on the four criteria for assuring "a resonable likelihood of maintenance being performed in-use."

Beginning with the legal issues, several commenters questioned EPA's authority to establish "technologically necessary" intervals for maintenance. The commenters' interpretations of §207(c)(3)(A) and §206(d) of the amended Clean Air Act (CAA) cited in the NPRM as the basis of the provisions differed from the interpretation of the agency. IHC interprets §207(c)(3)(A) to mean that the manufacturer shall furnish written instructions for the proper maintenance of the vehicle and does not indicate that the Administrator is to make any decisions as to what constitutes proper maintenance. Ford commented that EPA's scheme for controlling engine maintenance would introduce an "impermissible degree of uncertainty into the emission certification process." Ford felt that the manufacturers would have no means to ascertain in advance of their certification applications whether EPA would classify engine maintenance operations as "emission related" or not. This degree of uncertainty is unlawful, Ford states, according to the recent Paccar decision,2/ in which the court noted:

> "Manufacturers are entitled to testing criteria that they can rely upon with certainty."

In addition to the legal criticisms commenters questioned the logical and factual basis of EPA's proposed revisions. General Motors criticized the substitution of EPA's judgement as to what maintenance intervals are necessary in lieu of the manufacturer recommending maintenance intervals to the customers. The basis for criticism is that the reduction of vehicle maintenance has been and will continue to be a goal of the manufacturer. Discussing the manufacturer's role in recommending maintenance intervals AMC stated, "Restricting maintenance is counter-productive to air quality goals and the manufacturer should have the final say on what recommended maintenance schedules should be followed by the owners." AMC went on to say that requiring the manufacturer to demonstrate the reasonable likelihood of in-use performance of maintenance is totally unrealistic and the fact that maintenance may not be performed does not mean that it is unnecessary. Both Ford and IHC stated that the maintenance schedule, as set up by the manufacturer, is part of the competitive process in marketing because the customer is constantly demanding a product which requires less maintenance. Allowing EPA to recommend maintenance intervals would destroy an incentive to minimize required maintenance.

One manufacturer commented specifically on the definitions contained within the proposal as being illogical. Ford criticized the definitions of "emission related" and "non-emission related" maintenance and "new technology" as being inadequate to inform manufacturers whether specific maintenance operations, in addition to those listed in the NPRM, may be performed at intervals recommended by the manufacturer, or not at all. The "new technology" definition is objected to as being a roadblock for a manufacturer to introduce technology which is new to the manufacturer. In applying this technology, if it were deemed by EPA as emission related, the manufacturer would be precluded from performing reasonable maintenance.

Basically all manufacturers that commented responded that the technology does not exist to meet the proposed interval requirements. Toyota commented that they are not confident that they can comply with the 1980 model year California light-duty vehicle maintenance intervals which are less stringent than the EPA proposed intervals. AMC is not aware of any proven technologies which reflect with any degree of certainty that oxygen sensors will last for 50,000 miles or that catalysts will last for 130,000. Ford further criticized EPA for failure to outline either a description of the improvements required or the basis for its conclusion that such improvements are feasible.

Commenters expressed concern that EPA has arbitrarily and incorrectly fixed the maintenance intervals because there is not any data upon which EPA may reliably predict that all 1983 and later light-duty trucks will require emission-related maintenance no more frequently than the specified intervals. Cummins criticized EPA for setting maintenance intervals exactly the same as the heavy-duty diesel engines. Toyota indicated that EPA did not describe in the proposal any basis for lengthening the intervals. Toyota claimed it does not have enough data or experience in the field to meet the proposed intervals and can only assure performance with the current maintenance services.

A substantial volume of comment material was directed at the more technical issue of the proposed intervals themselves. For gasoline engines, comments concentrated on the intervals proposed for spark plug and catalyst replacement; on diesels, the comments addressed the turbocharger and injector maintenance intervals. Other areas of comment included the oxygen sensor and EGR system.

The proposed 30,000-mile maintenance interval for spark plugs was criticized as being unjustified and unrealistic. GM had concern about spark plug life in higher mileage engines where a plug misfire could lead to the damaging of the catalytic converter. GM also mentioned that light-duty truck operation produces more ignition events in 30,000 miles than does a passenger car because of the generally higher N/V ratios. No commenter believed that 30,000 mile spark plugs were feasible over the entire useful vehicle life. During the first 30,000 miles, the condition of the engine is excellent and deterioration is neligible. However, as mileage is accumulated wear takes place which in turn could cause shorter acceptable spark plug life intervals.

All commenters agreed that they are unaware of the required technology to guarantee the 100,000 mile maintenance interval for catalytic converters in LDTs. GM proposes that a lesser interval of 75,000 miles would be more logical considering the extended vehicle life of 130,000 miles. Catalyst replacement at 75,000 miles will provide a fresh catalyst much earlier in the service life. Several commenters believe that EPA has not established the need or the feasibility of the proposed 100,000 mile requirement for catalysts. They contend that EPA data on two passenger cars (reported in MSAPC-79-211-B-4) are inappropriate for LDTs due to the more severe service environment. GM mentions that even in less severe passenger car service occasional replacement of catalysts is required in order to comply with the 50,000 mile requirement. The U.S. Department of Commerce also took issue with the 100,000 mile catalytic converter replacement interval as being unrealistic. DOC believes that the LDT environment is more demanding and that technology does not exist for 100K mile catalysts in passenger cars. Therefore, they say, it is unreasonable to believe LDTs can meet the 100,000 requirement.

GM comments that in their investigations on improving catalytic converter life, they discovered that oil off the cylinder walls had a greater degree of phosphorus toxicity for a catalyst than oil that comes down through the intake valves. They stated that reduction in oil consumption is being worked on with the final goal being longer converter life. GM also states that catalyst deterioration evidence shows exponential decay, so catalyst decay is expected to be less in the second 50,000 miles than in the first 50,000 miles of vehicle operation.

Comments were also received on other maintenance intervals proposed by EPA. Many manufacturers, and the U.S. Department of

Commerce, criticized the minumum life requirements of oxygen sensors. GM particularly has concern for the absence of maintenance on the EGR system over the 130,000 mile useful life of LDTs. IHC and Cummins questioned the maintenance intervals for turbochargers and injector tips. Cummins believes the maintenance interval for turbochargers on LDTs should be investigated and may be different than turbocharger maintenance intervals for heavy-duty engines.

The final area of comment is directed at the four satisfaction criteria which were proposed to assure maintenance performance in the field. Criteria (A), (C), and (D) were criticized for vague or confusing language and criteria (B) for being illegal.

If the only option available to a manfacturer is criterion (B), then it would be required to pay for the maintenance. Both Ford and GM suggests that such a requirement contradicts §207(g) of the CAA by placing the maintenance burden on the manufacturer rather than the owner.

Ford also comments on the aspects of two other criteria (in addition to the use of vague terminology). Criterion (C), they say, will not be applicable to a situation where the only change in the recommended maintenance is to adjust the interval. Also, Ford reads criterion (D) to mean that when a signal is used to encourage maintenance performance, the signal must be removed after survey data has been collected. The data is of "doubtful utility" in such a case.

GM commented that the options other than the manufacturers paying for maintenance are illusory. Regarding criterion (A), GM felt the purpose of scheduled maintenance is to prevent the deterioration of the part to the point that irreparable harm is done to other components and to insure this result, the maintenance is scheduled with an adequate safety margin. Based on the safety margin, it is very unlikely that the part will fail "precipitously" at the proposed interval.

GM went on to criticize criterion (C) claiming that even if a manufacturer could demonstrate that enough service parts are sold each year, there is no way that maintenance performance can be demonstrated in view of the multi-faceted aftermarket industry and do-it-yourself maintenance. Additionally, such maintenance data is simply not available and is not likely to be available.

Criterion (D) is criticized by GM as being illogical in that there would be no possibility of obtaining the necessary data for seven to ten years. GM further pointed out that the instrument panel is space limited for the placement of such a visual signal and only minimum necessary information should be required.

2. Analysis of the Comments

This section presents the EPA staff's discussion and analysis of the comments summarized above. The comments will be treated in the same order that they appear in the Summary of Comments. Since many of the comments are the same as comments received on the recent heavy-duty rulemaking proceedings, the reader is referred to the analysis done in support of that action as a further reference.3/ This section begins with an overview of EPA's position on allowable maintenance in general to provide a context for the discussion.

By restricting the amount of emission-related maintenance allowable during durability testing, EPA is primarily trying to encourage an effort on the part of the manufacturers to reduce the amount of owner attention that their emission systems require. This encouragement fits into the larger strategy of sustaining the air quality benefits of regulatory actions as the vehicles/engines are actually used. Indeed, both the U.S. General Accounting Office and the Automobile Association of America have recently pointed to increased light-duty vehicle emission system durability as an approach to better in-use emission performance in those vehicles.4/ 5/

Certainly a functioning network of inspection-and-maintenance programs will help achieve proper maintenance in the field, but a complete network does not yet exist for light-duty trucks. Likewise, the providing of clear maintenance instructions to the user will also help to some extent. Again, this in itself is not a total solution because the nature of emission control systems is often such that the operator is not aware that maintenance is due or that it is necessary. Thus, manufacturers have a real opportunity to help ensure in-use emission-system performance by pursuing long-lived designs that require little attention. EPA expects that once resources are directed toward these design goals, manufacturers will be able to reduce required maintenance well below that necessary for current technology components.

Section 206(d) of the 1977 Clean Air Act Amendments (CAA) directs that "[t]he Administrator shall by regulation establish methods and procedures for making tests under this section," (i.e., tests to determine emission compliance). It is on the basis of Section 206 that EPA's entire certification and durability programs have been built, as well as the Selective Enforcement Auditing regulations.

The commenters show concern that there is no specific Congressional mandate for EPA to establish minimum technologically feasible maintenance intervals for durability test engines. However, the proposed maintenance requirements easily fall within the rather broad wording of §206. Even certification and durability testing as they appear in present regulations are not specifically described in §206, yet they have never been successfully challenged. The requirement for the design of a certification program is that vehicles and engines be tested "in such a manner as [the Administrator] deems appropriate" (Section 206(a)(1)). The "appropriateness" of the proposed changes is discussed later in the context of the "factual basis" comments.

Among the responsibilities of the Agency under §207(c)(3), is to make certain that the maintenance instructions provided to owners require no more maintenance than necessary to assure emission compliance. A manufacturer should not be allowed to avoid its warranty obligations by requiring excessive maintenance that is not performed widely in the field. This would result in the voiding of many warranties because of a failure to properly perform the maintenance even though such maintenance was not actually necessary to keep the vehicle or engine in compliance. Therefore, except under adverse driving conditions, the maintenance required of the owners to retain their warranty should not be more than that performed during the certification testing. The conclusion, then, is that the maintenance instructions should be based on the maintenance done during §206 durability testing.

Addressing specifically Ford's comment that the scheme for maintenance introduces an "impermissible degree of uncertainty into the emission certification process," the staff feels that the comment is justified. Therefore, the staff recommends a provision be included specifying a sufficient notification, similar to 86.084-22 (e)(1) (ii), to reduce the degree of uncertainty on new or adjusted maintenance intervals of "emission related" components. The new provision would allow the Administrator to specify new or adjusted emission related maintenance intervals only if the Administrator has previously notified the manufacturer of the said maintenance interval no later than September 1 of the given calander year two years prior to the model year. Provisions for an appeal process should the manufacturers disagree with EPA's decisions should also be included.

The logical and factual basis for establishing technologically feasible maintenance intervals was challenged from several directions, but little information to substantiate the claims was provided. We are not convinced that the degree of maintenance required to maintain emission compliance is widely performed, especially when component designs require frequent attention and when performance of the maintenance does not improve driveability or fuel economy.

Clearly at the emission levels proposed in this package, proper maintenance is a key part of an overall in-use emissions control plan. The weakness of the present regulations is the lack of incentives for the required maintenance to actually get done. The regulations here being challenged address one facet of the problem by encouraging all manufacturers to use the best technology components possible from a low-maintenance requirement standpoint.

The staff views the argument regarding market pressures on component durabilities to be somewhat misdirected. If lower maintenance in some components indeed provides a powerful competitive advantage, then the market should be an important factor in designs beyond today's technology. Generally, however, we do not believe that the market pressures for improved durability in emission-related components is strong. (The durability of emission controls has not been widely stressed in advertising, for example.) The staff is also concerned with the implication that manufacturers would be willing to trade off improved maintenance characteristics and durability (and hence, a degree of better maintenance in the field) for commercial purposes. We cannot accept the argument of the existence of market pressures as a rationale for allowing more frequent maintenance than present technology has been shown to require. Conversely we do hope that the pressures will, in the future be a strong factor in encouraging continuing reductions in the amount of maintenance required on emission-related components.

The issue of spark plug maintenance intervals will now be addressed. A majority of the manufacturers currently recommend a maintenance interval range from 22,500 miles to 30,000 miles for light-duty trucks using unleaded fuel. Ford specifies a 30,000 mile spark plug maintenance interval for all of their 1980 light-duty trucks. The 1984 heavy-duty vehicle regulations specify a technologically necessary spark plug replacement interval of 25,000 miles. This interval came as the result of a fairly extensive analysis of heavy-duty engine operating conditions and current intervals.3/ Light-duty truck application is less severe than heavy-duty application. Thus, the minimum necessary interval for light-duty trucks will be greater than 25,000 miles. The current use of a 30,000 mile interval by Ford argues strongly in favor of that number.

Commenters criticized the spark plug replacement interval in two major areas: higher N/V ratios when compared to light-duty vehicles, and increased oil consumption on vehicles with high mileage causing spark plug deterioration.

There is no justification to reduce the spark plug replacement interval because of the higher N/V ratios of light-duty trucks over light-duty vehicles. The manufacturers' recommended interval ranges of 22,500 miles to 30,000 miles for light-duty trucks is the same as for light-duty vehicles. Clearly, if higher N/V ratios of light-duty trucks over light-duty vehicles are a concern, the manufacturer would have specified a lesser, different interval than those specified for light-duty vehicles.

G.M. and IHC point out that light-duty trucks with high mileage tend to burn more oil and cause increased spark plug deterioration. This comment is unjustified when reviewing the current manufacturer recommended spark plug replacement interval. Current practice in the industry does not recognize high mileage as a factor calling for reduced spark plug intervals. While the manufacturers recommend a reduced maintenance interval for the checking, cleaning and regaping of spark plugs under severe operating conditions, the manufacturers' maintenance schedules do not specify a reduced replacement interval on spark plugs as vehicle mileage increases, but indicate only one spark plug replacement interval. Additionally, G.M., in another area of comment, states "[T]he maintenance is scheduled with an adequate safety margin to accommodate some portion of the variation in part and in the manufacturer assigns "an adequate safety margin" in the replacement interval and does not indicate a replacement interval reduction with increased vehicle mileage in their current maintenance schedule, then the manufacturer's concern about increased oil consumption causing increased spark plug deterioration must be overstated.

Considering the spark plug interval for the 1984 heavy-duty regulations and the arguments given above, the staff does not see any need to reduce the proposed 30,000 mile spark plug replacement interval.

We now turn to an analysis of the comments relating to the proposed 100,000 mile catalyst replacement interval. The comments generally took issue with EPA's extrapolation of light-duty vehicle catalyst technology to light-duty truck application and the lack of data supporting the proposed interval. However, not one manufacturer supplied data supporting arguments that 100,000 mile replacement intervals are unrealistic and cannot be achieved.

The staff rejects the contention that light-duty trucks are significantly different than light-duty vehicles. The manufacturers, with exception of IHC, use engines and catalysts that are the same as in light-duty vehicle installations. Obviously, the manufacturers cannot claim a significant difference between light-duty vehicles and light-duty trucks and yet use identical catalysts for both applications.

To determine catalyst replacement intervals, a best estimate must be obtained from the information available. The methodology used to determine the interval is well documented in the heavy-duty vehicle analysis.3/ A review of the specified heavy-duty vehicle catalyst replacement interval shows that the light-duty truck interval is conservative. Additionally, AMC recently provided 100,000 mile certification data on four light-duty vehicles that substantiated the proposed interval is technologically feasible. Three out of the four vehicles indicated no catalyst failure over 100,000 miles. The catalysts used on these AMC vehicles are considered to be lightly loaded, i.e., a low amount of catalyst material per unit volume. Lightly-loaded catalysts are considered to be less durable than the heavy-loaded catalysts which may be used on light-duty trucks. Clearly, if the technology exists to produce a lightly loaded catalysts that lasts for 100,000 miles, a catalyst design for light-duty truck application capable of lasting 100,000 miles is also feasible.

The staff disagrees with GM's recommendation that a lesser replacement interval of 75,000 miles be used on catalysts. The 75,000-mile replacement interval would happen after 60 percent of the new anticipated "useful life" of 120,000 miles occurs. Clearly, the replacement interval should be placed as close to the vehicles' "useful life" as technologically feasible in order to accomplish EPA's intent of reducing the amount of owner attention to emission systems and sustaining the air quality benefits as vehicles are actually used. It is doubtful the recommended 75,000-mile interval catalyst change with 60 percent of the vehicle's useful life over would be done by the owner. By specifying the replacement interval, i.e., the 100,000-mile interval, close to the anticipated useful life, the staff's concerns that the catalyst may not be replaced are minimal. In fact, it is most likely that such a well designed catalyst would perform for the full useful life without any replacement.

In addition to the spark plug and catalyst interval, commenters showed concern over the absence of maintenance on the EGR system for the useful life of light-duty trucks. The absence of an EGR maintenance interval was accidental. A 50,000 mile maintenance interval will be placed on the EGR valve. This interval is supported by previous studies and is the same interval specified in the 1984 heavy-duty vehicle regulations.7/

The minimum replacement interval of oxygen sensors was criticized by the U.S. Department of Commerce and many manufacturers, but data arguing against the 50,000 mile interval were not presented. To the contrary, Ford specifies a 50,000 mile replacement interval for their oxygen sensor used on light-duty vehicle applications and therefore demonstrates that a 50,000 mile oxygen sensor is technologically feasible for light-duty vehicles. Additionally, the 1984 replacement interval for heavy-duty vehicle oxygen sensor as set by the 1984 heavy-duty vehicle regulations is 50,000 miles. Light-duty truck application is considered to be less severe than heavy-duty vehicle application. With the technologically feasible replacement interval for oxygen sensors of 50,000 miles established for both light-duty/heavy-duty vehicles, the need to alter the 50,000 mile replacement interval for light-duty trucks can not be justified.

The final area of comment regarding maintenance intervals is specific to diesel engines and was directed to the maintenance intervals of the turbochargers and injector tips. Cummins commented that the maintenance intervals may need to be different than the intervals specified for heavy-duty vehicles. The staff recognizes that light-duty truck engines have shorter lifetimes than heavy-duty engines and therefore will reduce the maintenance intervals from 200,000 miles to 100,000 miles for both turbochargers and injector tips.

We recommend that EPA delay the requirement that manufacturers must demonstrate "a reasonable likelihood" that proper maintenance will be performed in-use. Our recommendation arises not from specific comments about these proposed provisions but from a belief that such a requirement is not necessary at this time. It appears to us that the manufacturers would reasonably easily be able to show that required maintenance was indeed being performed on the emission-related components which these regulations will require. With respect to the forthcoming NOx regulations, however, the situation is different. It is possible that three-way catalyst technology will be used, in which case oxygen sensors will control the feedback systems. It is for this type of component that the staff believes some sort of assurance of in-use maintenance will be necessary. Regarding catalysts, assuming they cost more than 2 percent of the vehicle cost to replace, then the manufacturer is required to bear the cost of replacement with or without these provisions.

4. Summary of Recommendations

The staff has concluded that the proposed maintenance requirements (Section 86.083-25 of Subpart A) should be retained in their proposed form with the following exceptions:

a. A 50,000-mile EGR system maintenance interval should be included.

b. Include a provision to specify a sufficient notification to the manufacturer on new or adjusted maintenance intervals of emission related components.

c. Delete the requirement that manufacturers must demonstrate "a reasonable likelihood" that proper maintenance will performed in-use.

d. Change the diesel engine turbocharger and injector maintenance intervals to 100,000 miles.

References

1/ 1983 and Later Model Year Heavy-Duty Engines, Proposed Gaseous Emission Regulation," 44 FR 9494, February 13, 1979.

2/ "Paccar, Inc. V. National Highway Traffic Safety Administration, 573 F.2d 632 (1978).

3/ "Summary and Analysis of Comments to the NPRM 1983 and Later Model Year Heavy-Duty Engines Proposed Gaseous Emission Regulation," EPA, OMSAPC, December, 1979.

4/ "Better Enforcement of Car Emission Standards -- A Way to Improve Air Quality," Report by the Comptroller General of the U.S. General Accounting Office, Report IICED-78-180, January 23, 1979.

5/ American Automobile Association letter to Rep. Henry Waxman, August 13, 1979 (EPA Central Docket Section #OMSAPC-78-4).

6/ See Issue G - Technological Feasibility.

7/ "Control of Air Pollution from New Motor Vehicles and Motor Vehicle Engines: Gaseous Emission Regulations for 1984 and Later Model Year Heavy-Duty Engines, 45 FR 4136, January 21, 1980.

8/ "Emission-Related Maintenance Intervals for Light-Duty Trucks and Heavy-Duty Engines," R. A. Rykowski, EPA, OMSAPC, Technical Report No. SDSB-79-09, January, 1979.

D. Issue: Idle Test and Standards

1. Summary of the Issue

EPA has proposed separate certification standards and test procedures for the idle mode for both gasoline and diesel light-duty trucks.

2. Summary of Comments

The manufacturers agree unanimously that both the proposed idle test and the idle standard are redundant since the Federal Test Procedure (FTP) currently includes the idle mode as approximately 18 percent of the transient cycle. Furthermore, most manufacturers agree that their vehicles, since they comply with FTP, will inherently meet the idle standards and that EPA should therefore withdraw both the idle test and the idle standard as applied to light-duty trucks.

Several manufacturers identified the proposed idle test as confusing and insufficiently defined. Another major concern was that poor correlation between the FTP and the idle test would result in the requirement that manufacturers certify vehicles to two different sets of standards.

The intent of EPA in requiring the idle test/standard was also questioned. One manufacturer indicated that if the standard was designed to evade test correlation requirements as required under section 207(b) it was, "against the intent of the Clean Air Act." If designed for Inspection/Maintenance (I/M) purposes, the question was raised concerning the development of a specific I/M test that would not require adjustment of the certification process; an adjustment that would, according to the commenters result in increased certification costs.

The MVMA identified two major concerns with regard to the "supposed desirability" of separate idle requirements. First, was the claimed lack of control over testing conditions, equipment calibration and personnel training which would, in their opinion, result in questionable test validity. Secondly, according to the Association, any short test that does not measure all regulated parameters, "could not be employed to invoke the warranty requirements of Section 207(b)," since the proposed test does not measure all regulated emissions.

Additional comments include that:

a. EPA has not established that CO "Hot Spots" exist (justification is a requirement if these "Hot Spots" are the basis for the idle test).

b. EPA has not established that a 90 percent reduction in HC and CO during idle is required to improve air quality.

c. EPA has not established that HC analysis is required for the idle test.

d. EPA has not established that a separate idle test is a necessity for diesel vehicles.

3. Analysis of Comments

Based upon available data the staff agrees with the manufacturers that catalyst equipped vehicles have the capacity to meet the idle standards as applied to light-duty trucks. The staff does not, however, view the idle standard/idle test as redundant, but rather as a method of assurance that the available technology is actually controlling idle emissions. The idle test serves as a design criteria to insure against any tradeoff of idle vs non-idle emissions. This criteria, we believe can be met easily and for little or no cost.

The current FTP for light-duty trucks was designed with measurement of hydrocarbons as the prime consideration. By its nature as a representative driving cycle, such a procedure would also be an accurate measure of other pollutants being emitted (such as CO). However, at the same time, it may not be the optimum procedure for all pollutants in terms of their environmental impact, because different pollutants have different mechanisms of operation. HC emissions combine on a fairly broad scale, and over a period of a few hours participate via photochemical reactions in the formation of ozone. CO on the other hand, is toxic in its own right. Highest concentrations are typically associated with morning and afternoon rush hour traffic, and can be highly localized. The driving conditions associated with central business district rush hour traffic would have a lower average speed and higher amount of idle than does the FTP. Also, at very low speeds, tailpipe emissions can be substantially affected by carburetor idle settings. The idle test for CO contained in this rulemaking is a direct way of insuring that reductions in CO seen on the FTP will also occur during low speed, high idle fraction operation characteristic of urban rush hour driving.

Furthermore, costs of compliance with the certification idle test are minimal. As discussed above, catalysts effective on the transient certification procedure should easily meet the certification idle standard as a matter of course, therefore, requiring no additional development costs. The only attributable costs to the idle test procedure are those associated with performance of the actual test for certification, which is insignificant on a per engine basis.

Diesel engines, however, will not be equipped with emissions sensitive catalyst systems. Use of an idle test procedure for diesels, with or without in-use compliance testing, is expected to have little or no effect.

The staff also agrees that the necessity for HC analysis in the idle test has not been established. Therefore, it is recommended that the HC idle standard be eliminated.

The concern that was expressed that EPA is evading the 207(b) requirements should be dispelled by the fact that warranty regulations and the associated short test procedure have been recently adopted in a separate rulemaking (45 FR 34802). We do not rely on §207(b) for authority for this idle test procedure.

A number of specific technical issues on details of the idle test procedure were raised during both this comment period and the earlier comment period on the heavy-duty gaseous emission regulations. As a result, a number of changes are suggested for the final version of the test procedure of Subpart P:

a. The idle HC standard for gasoline engines will be deleted.

b. The limitations called for in 86.1511-83(a)(1)(i) and (ii) will be adjusted from 45 to 90 percent, to 15 to 100 percent.

c. The interference gas called for in 86.1511-83(a)(7) should be NO_2 at a 100 ppm concentration not NOx at a 1000 ppm. Diesel comments do not apply here since Subpart P will apply only to gasoline-fueled engines and vehicles.

d. A temperature controlled environment as referred to in 86.1511.83(b) is defined as the interior of a normally heated room.

e. Section 86.1514-83(a)(2) is adjusted by the heavy-duty procedure.

f. Utilization of the word "calibration" in section 86-1516(b) is incorrect; "calibration " should be replaced by "span."

g. The average ambient temperature of the vehicle environment should be changed from -20°C to 45°C (-4°F to 113°F), to 2°C to 43°C (35°F to 110°F).

h. Identification of operators in section 86.1542-83(a)(5) and (6) will not be deleted.

i. Additive deterioration factors (DFs), are to be substituted for multiplicative DFs in the case of the idle test. This adjustment is being made due to nondetectable or very low emission levels during LDT idles.

In summary, the high percentage of time that all vehicles spend at idle, the ease of an in-use idle procedure, the improved effectiveness of an in-use idle procedure in detecting failed catalyst systems, and the virtually nonexistent costs of a certification idle standard support its promulgation. No compelling data at this time, however, support implementation of any idle standard for diesel engines, and a delay in its promulgation is warranted. This decision could be reconsidered in the future, should the need become more evident.

4. Recommendations

Retain the idle CO standard for gasoline engines. Delete the idle test requirements for diesel engines; delete the idle HC standard for gasoline engines.

E. Issue: Leadtime

1. Summary of the Issue

In the NPRM, EPA proposed to implement the new light-duty truck regulations for the 1983 model year. This was based upon EPA's belief at that time "that sufficient leadtime is available to develop and apply the necessary emission control technology and to conduct compliance testing by 1983." (44 FR 40792, July 12, 1979). The NPRM went on to say, "(t)herefore, EPA cannot make the findings under Section 202(a)(3)(C) necessary to permit consideration of revised standards at this time." At the same time, however, manufacturers comments on the feasibility of compliance with the proposal in 1983 were solicited. The request for such comments stated that "in order that EPA may fairly evaluate the technical merit of all comments on feasibility, the Agency requests that comments be accompanied by supporting data or other information."

2. Summary of the Comments

EPA received a number of comments on the feasibility of complying with the proposed 1983 deadline. These comments fall broadly into two areas: (a) technical feasibility, and (b) legal requirements of the 1977 Clean Air Act Amendments.

a. Technical Feasibility of the 1983 Model Year

Comments on the technical feasibility identified the proposed standards as achievable for 1983 if viewed in the context of currently existing certification procedures. The additional aspects of the proposal dealing with allowable maintenance, in-use durability, redefined useful life, and SEA were seen by commenters as making the available leadtime marginally or wholly infeasible. An example of this position is the following comment by GM:

> "General Motors is concerned that there is inadequate leadtime to asure compliance with the entire regulatory package. While we do not foresee any insurmountable leadtime obstacles in incorporating the "best effort" hardware described in Section IV in time to meet start of production for 1983 MY light-duty trucks, this does not imply that there is adequate leadtime allowed. If this "best effort" does not succeed in meeting the regulations as finally adopted, further changes would have to be made. At this point in time, we do not know what this would entail. It may include further hardware changes, revisions to production techniques, further improvements in quality control procedures, or other things we are not now aware of. Until we have experience with the "best effort" system under the proposed 1983 certfication procedures, we do not "know"--we can only speculate."1/

Comments of the above sort expressed a lack of information from which to determine whether currently envisioned emission control system changes would be capable of meeting the overall requirements of the proposal. These comments are set forth in greater detail in the analysis of feasibility elsewhere in this Summary and Analysis of Comments.

IH and Ford developed and submitted specific timelines for their compliance programs. No other manufacturers provided such timetables.

The IH schedule, reproduced here as Figure E-1, led IH to conclude that "such timing greatly jeopardizes a manufacturer's chances of ensuring a certified produceable product line."2/ The major time elements of the IH timetable are devoted to establishing full life deterioration rates. IH projected a need for a two phase testing program to establish durability data and design systems for extended life. Each phase involves the generation of high mileage data from a fleet of vehicles. The first phase is intended by IH to establish basic system requirements. The second phase would involve a fleet of production prototype vehicles run for the full usefull life to determine preliminary DF's. Together, these two phases would require two years to complete.

The schedule as developed by IH was predicated upon promulgation of the final rulemaking by January 1, 1980. It contained a four month interval between the two phases of the durability program for supplemental development or redesign required as a result of the first phase testing. That four month interval was "not considered feasible" to accomplish the necessary work.

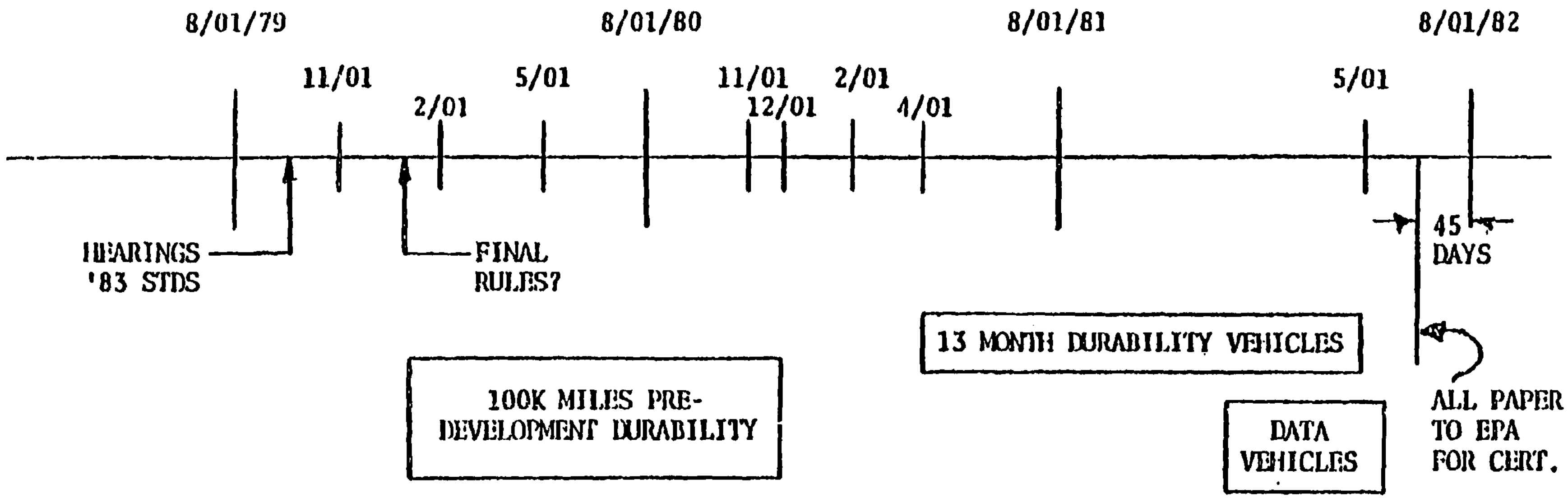
Figure E-2 presents the timing plan developed by Ford. As with IH, the largest single element of the timetable is the program for development of durability data (labeled "useful life emission development"). Ford projects that this would take approximately two and a half years to complete. The first six months are consumed in assembling the prototype vehicles to be used in the durability fleet (six per engine family). This is followed by mileage accumulation on a staggered basis to reduce the testing facility load. Completion of mileage accummulation would then occur over a six month timespan from the first to the last vehicle. Ford indicates that procurement of prototype durability vehicles would have had to begin by May 14, 1979 to allow time for certification to the 1983 model years.

American Motors and IH both argued that they were vendor dependent for development of new control systems. They indicated that their corporations lacked the resources needed to develop these systems for themselves. AM stated that "the overall regulation would be unachievable even with the most advanced concepts presently under development of our passenger cars."5/ IH indicated their suppliers might be their own competitors.

Both manufacturers indicated that being vendor dependent led

Figure E-1

IH LEAD TIME SCHEDULE 3/



24

25

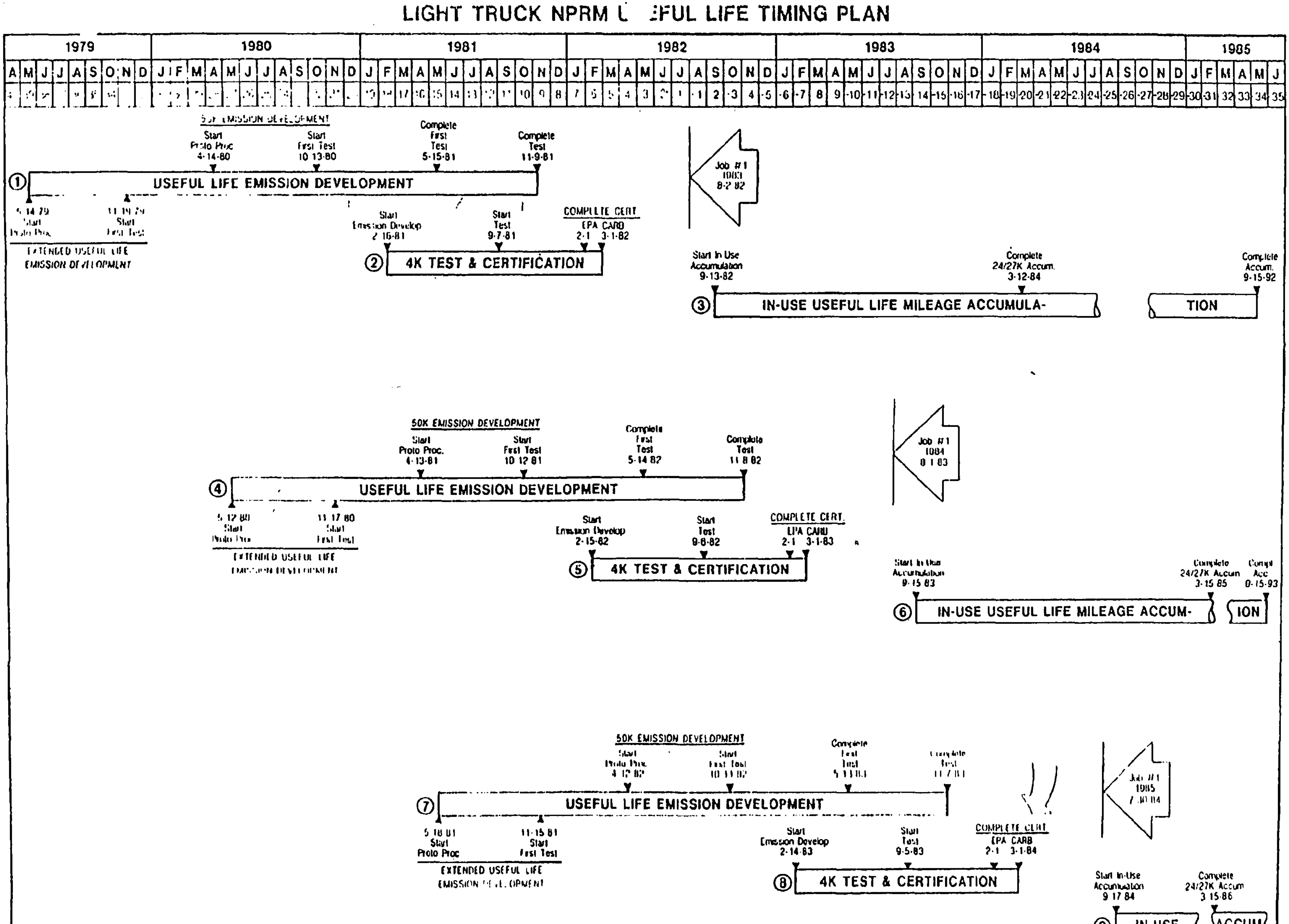


Figure E-2

FORD LEADTIME SCHEDULE 4/

to longer leadtime requirements than would otherwise be the case. This they felt placed them at a significant disadvantage. AM stated that they would need "at least two extra years of leadtime...from the time such demonstrated components are made available to us from our suppliers."

Lastly, the Department of Commerce expressed the belief that "(t)he advanced engineering phase of the manufacturers' 1983 light-duty truck program is now well underway with production engineering scheduled to start within the next few months. Therefore, it is essential to establish regulations to meet the 90 percent reduction objective that introduce a minimum of uncertainty."6/

b. Legal Requirements of the 1977 Clean Air Act Amendments

Commenters expressed the belief that in the 1977 Clean Air Act Amendments, Congress mandated a minimum four year leadtime applicable to those light-duty trucks which fall within the statutory heavy-duty truck class. (The statutory heavy-duty truck class includes light-duty trucks in the 6,000-8,500 lbs GVW class.) As stated by MVMA, "the 1977 Amendments and the accompanying legislative history unequivocally demonstrate that Congress intended to require EPA to promulgate 1983 standards so as to provide at least four years leadtime to manufacturers. There is not a single statutory provision or element of legislative history to the contrary." They stated that other provisions of the Amendments (such as those for temporary or permanent revisions under Sections 202(a)(3)(B) and 202(a)(3)(E)) "indicate that Congress in fact intended to override the discretion as to leadtime otherwise accorded to EPA by Section 202(a)(2)."7/

To support this position, commenters cited provisions of the Act, and items of legislative history. Section 202(a)(3)(B) states that "(d)uring the period of June 1 through December 31, 1978, in the case of hydrocarbons and carbon monoxide,...the Administrator may, after notice and opportunity for a public hearing promulgate regulations revising any standard prescribed as provided in subparagraph (A)(ii) for any class or category of heavy-duty vehicles or engines. Such standard shall apply only for the period of three model years beginning four model years after the model year in which such revised standard is promulgated." The standards of subparagraph (A)(ii) referred to here are the statutory 90 percent reductions applicable to 1983 and later model years. These provisions are taken by commenters to mean that EPA was to have finalized by the end of 1978 those standards which manufacturers would be required to meet in 1983 - thus allowing four years of leadtime for compliance. Commenters believed that this timetable was to be followed by EPA even if the revision procedures of Section 202(a)(3) (B) were not being invoked. If EPA was required to allow four years for a relaxed (less stringent) standard, they argued, then it would be illogical for EPA not to have to provide four years for the more stringent statutory reductions to be implemented.

As further support for the Congressional intent argument, the following excerpt from Section 202(a)(3)(E)(ii) (which provides for "permanent" changes in the statutory standards) was cited: "No such changed standard shall apply for any model year before the model year four years after the model year during which regulations containing such changed standard are promulgated." This citation is considered a further example of what commenters identified as clear Congressional intent for provision of four years leadtime.

Commenters also felt that if a choice had to be made between four years of leadtime and implementation for 1983, that the four years requirement must be met. As stated by the Department of Commerce, four years "is the time considered by industry and this Department as the minimum in which compliance can be obtained without risking undue market disruption."8/

MVMA cited testimony provided before the House and Senate by both heavy-duty manufacturers and EPA in 1977 as the Amendments were being considered. The citation indicated that manufacturers stressed, and EPA recognized, the need for sufficient leadtime. MVMA also cited a statement by Senator Muskie in November of 1977 which indicated a conference agreement for four years leadtime. As originally adopted, the 1977 Amendments had specified June 1 through December 31, 1979 as the period during which standards could be revised. This was later amended to be June 1 through December 31, 1978. Senator Muskies' explanation of this change was that it was made "so as to conform to the conference agreement for four years leadtime."9/ MVMA acknowledged that the 1977 Amendments do not expressly provide for promulgation of the statutory standards in 1978, but felt that this was the clear intent of Congress.

3. Analysis of the Comments

a. Technical Feasibility of the 1983 Model Year

Aside from IH and Ford, both of whom alleged specific timing problems in meeting a 1983 compliance date, commenters presented more of a feasibility problem than a leadtime one. For example, the comment from GM indicated sufficient time available to apply hardware changes. The doubt expressed by GM was over the adequacy of their "best effort" hardware to do the job. Other commenters supported this position.

The issue of feasibility is addressed elsewhere in this Summary and Analysis of Comments under "Technological Feasibility." The analysis presented there demonstrates clearly the feasibility of the final rulemaking in the form recommended by the technical staff. Thus, the staff does not consider the comments of this sort as affecting the viability of the 1983 model year, as proposed in the NPRM, for implementation of the final rules. However, the other leadtime questions raised by specific commenters do need careful consideration.

1) International Harvester

The bulk of the time in the IH leadtime schedule (Figure E-1) is devoted to mileage accumulation on durability vehicles. The first phase (pre-development durability fleet) is scheduled to require 11 months, and the second phase (production prototype fleet) is scheduled to require 13 months. Both the need for two phases of testing and the time required are questionable. The need for this program was determined largely by the proposed in-use durability requirements. IH felt that "the jeopardy inherent in the in-use scheme mandates that every attempt be made to simulate ahead of time, and as accurately as possible, the estimated final DF's" In light of the staff recommendation to defer the in-use durability program at this time, it is likely that IH would no longer feel the need for a dual durability program. The staff believes that even with an in-use program, the need for such two phase testing was not demonstrated by IH. No other manufacturer indicated an intent to duplicate their pre-certification durability testing. The staff believes that the IH timetable should be revised to eliminate the first phase testing.

In conducting its durability testing of prototype vehicles, each manufacturer will be able to design the type of testing program it feels is most appropriate. Because of the latitude available to the manufacturer it is not possible to quantify the exact amount of time this process will require. However, the staff believes that IH would have no incentive to undertake a testing program more rigorous or time consuming than the current light-duty truck mileage accumulation procedure. Therefore, to estimate the maximum amount of time to prove system durability and establish deterioration factors the time to accumulate full useful life mileage on the current light-duty truck durability schedule will be used. A review of records on durability data vehicle mileage accumulation from 1980 engine families indicates 3 1/2 - 5 months as typical times for accumulating 50,000 miles on the EPA durability schedule. This time includes related aspects of mileage accumulation such as maintenance and testing. Allowing the maximum of 5 months would give an average accumulation rate of 10,000 miles per month. The average useful life of light-duty trucks has been estimated by EPA as 120,000 miles.10/ However, in view of the uncertainty of this estimate, coupled with an allowable catalyst change interval of 100,000 miles, the technical staff believes that the useful life used by most manufacturers for certification will fall at approximately 100,000 miles. If a manufacturer indeed chose a lifetime longer than 100,000 miles, he would still be able to end mileage accumulation at the catalyst change point. A new catalyst would substantially reduce exhaust emissions.

At 10,000 miles per month, it would take 10 months to accumulate 100,000 miles. Allowing 1 month to prepare the durability vehicle would bring the total time to 11 months. IH would have sufficient time to conduct this program and development work in time for the 1983 model year if the final rules are promulgated by June 1, 1980. Development time would be restricted, however, if the final rules are promulgated after June 1, 1980.

2) Ford

Turning now to the Ford leadtime schedule of Figure E-2, leadtime for development of durability data is once again the major factor. As with IH, Ford's extensive two and one half year durability program was principally motivated by the proposed in-use durability program. Ford proposed testing a sizeable fleet of six vehicles per engine family, staggering the mileage accumulation over six months. With the deferral of the EPA in-use durability fleet requirements, Ford would be expected to return to a mileage accumulation program characteristic of current practice, which, as noted, could be completed in 11 months. Thus, Ford could accomplish the desired 11/9/81 completion date of Figure E-2 by starting durability testing before December 1, 1980 and also have six months development time if the final rules are promulgated before June 1, 1980. Promulgation after June 1, 1980 would restrict this development time.

3) Vendor Dependency

Both AM and IH claimed that their dependence upon vendors for development and supply of new control systems posed a significant leadtime problem. The EPA technical staff believes that these claims are greatly exaggerated.

IH stated that "(c)ompliance with the proposed standards will require technological improvements in the major areas of catalysts, fuel system, air injection, and basic engine design and control system parameters." Contrary to this position, the staff analysis of feasibility (see Issue G: Technological Feasibility) indicates that no major innovations are required. In fact, many 1980 California light-duty truck models appear able to comply with the recommended final rulemaking. Data submitted by AM for high mileage catalyst equipped vehicles indicates the capability of their current systems to perform for at least 100,000 miles.11/

Vendor dependency may create some time penalty even though no major emission control system changes appear to be required. However, all manufacturers experience this problem to one degree or another. For example, most manufacturers use vendor supplied catalysts and must work with their suppliers when changes are needed. While smaller manufacturers such as IH, AM and to some extent possibly Chrysler, may be somewhat more vendor dependent than larger manufacturers, such dependence is minor in consideration of the available leadtime.

The question of vendor dependency and supply leadtimes also arises in connection with the Electronic Engine Controls (EECs) which the staff is projecting to be used to meet these regulations without incurring a fuel economy penalty. The staff forsees no supply problem in adopting EECs as early as the 1983 model year. In fact, in its recently proposed fuel economy standards for light-duty trucks, NHTSA indicated its belief that EECs would be available for the 1982 light-duty truck fleet--one model year earlier than needed here. Respondents to NHTSA's proposal did not challenge the feasibility of that date.

4) Advanced Engineering

The Department of Commerce comment concerned the meshing of EPA's final rulemaking requirements with the advance engineering which DOC felt was already well underway, and with production engineering which DOC felt was scheduled to begin "within the next few months." EPA technical staff agrees that each manufacturer is entitled to as much advance notice of requirements as is reasonably possible. In evaluating the adequacy of timing in the present case, the staff turns to comments of the affected manfacturers. Apart from the DOC, there were no other comments on this issue. No manufacturer felt the need to raise it as a concern from the manufacturer's viewpoint. Therefore, the staff concludes that this concern is not a valid issue in the context of the present rulemaking.

b. Legal Requirements of the 1977 Clean Air Act Amendments

The technical analysis just completed in Section a above indicates that compliance with the recommended final rulemaking provisions can readily be attained in approximately two years of leadtime before the model year of introduction. However, we must now turn to an analysis of any legal constraints placed on allowable leadtime by the Clean Air Act as amended in 1977 (the Act). If, as maintained by commenters on the proposed rulemaking, Congress mandated a four year minimum leadtime for those light-duty trucks in the 6,000-8,500 lb. GVW range, then the earliest model year for which the final rulemaking could be applicable for those vehicles would be 1985. The EPA staff believes that four years leadtime is not mandated for those vehicle. Of course, vehicles below 6,000 lbs. GVW are not considered heavy-duty vehicles under the statute, and as to them, there is no issue concerning a statutorily prescribed amount of leadtime.

The comments received on this issue focused on the meaning of several portions of Section 202(a)(3) of the Act. As indicated in the Staff summary of these comments, the commenters believed that such provisions must be interpreted as requiring four years of leadtime for heavy-duty engines or vehicles. The staff rejects this interpretation of the Act. EPA interprets the statute and its legislative history as strictly requiring four years leadtime only in the case of revisions to the statutory standards. Although it could be said Congress anticipated that standards under §202(a)(3)(ii) would be promulgated at such a time as to be in place by the last half of 1978, this assumption was never transformed into a direct requirement. Rather, what was expressly required was that the statutory standards apply to the 1983 model year.

The same issue has previously been raised in comments on EPA's proposed gaseous emission regulations for heavy-duty engines (44 FR 9464, February 13, 1979). In promulgating the final regulations, EPA delayed the year of implementation to 1984 based upon feasibility considerations, thus making the legal issue moot. However, EPA explained the relationship between the need for leadtime and the 1983 implementation date as follows:

> "It should be noted that it is the Agency's view that had it been clearly evident that sufficient leadtime existed to permit the manufacturers to comply with the statutory standards in 1983, Congress' desire to have the standards take effect in the 1983 model year would have taken precedence over any expressions concerning leadtime to which the manufacturers might otherwise have been entitled to under Section 202." (45 FR 4144, January 21, 1980)

Indeed, this view is consistent with Congress' instructions concerning the possible reduction of emissions in excess of 90 percent of baseline levels. See H.R. Rep. No. 95-294, 95th Cong., 1st Sess. 273 n. 13 (1977). There, Congress recognized that if technology were to be available to achieve reductions greater than 90 percent, EPA was expressly authorized to require its use. Similarly, if technology will be available for implementation in the 1983 model year, Congress would not have intended that its implementation be delayed.

Clearly, EPA cannot satisfy both the 1983 implementation date and provide four years leadtime in this rulemaking. At such a point, the Agency must find the optimum policy for balancing the environmental benefit versus the burden on manufacturers. The goal which Congress surely had in mind in incorporating leadtime guidelines into the act was to insure manufacturers adequate time to respond to new standards without undue disruption of their operations.

The four year requirement for revisions to the statutory standards undoubtedly reflects consideration of the relatively major changes in control technology facing manufacturers of heavy-duty engines (over 8,500 lb. GVW). These engines currently use pre-catalyst technology and face the adaption of catalyst systems into the heavy-duty environment. The technical analysis of leadtime requirements for these manufacturers completed as part of the final heavy-duty rulemaking concluded that four years would indeed be required to accomplish those tasks.

Those light-duty trucks which fall into the statutory heavy-duty class (6,000 to 8,500 lb. GVW) face a totally different situation than that just described. Indeed, Congress recognized in 1977 that vehicles below 8,500 lb. GVW present a somewhat different set of regulatory problems and accordingly, expressly authorized EPA to promulgate separate regulations for the class of light-duty trucks. See Clean Air Act, Section 202(a)(3)(A)(iv); H.R. Rep. No. 95-564, 95th Cong., 1st Sess. 164 (1977) (Conference Report). Even though most engines used in these light-duty trucks are also used in heavy-duty vehicles, the light-duty truck applications are more characteristic of light-duty vehicles than heavy-duty trucks. Light-duty trucks are already employing oxidation catalyst systems, and in some cases three-way catalyst systems. Their emissions are measured using the same test procedure as light-duty vehicles. In actual use they are treated more like cars than like heavy-duty trucks, with most owners tending to view them as "big cars."

For all these reasons, the task facing light-duty truck manufacturers in complying with the statutory 90 percent reductions is much less difficult than that facing heavy-duty trucks. Therefore, it is possible to provide adequate leadtime as Congress desired without needing a full four years.

4. Recommendations

The EPA staff believes that in balancing Congress' desire to implement the standards for 1983 with its desire to provide four years of leadtime, the situation at hand dictates that the 1983 deadline should take precedence providing that the necessary technology and sufficient leadtime are available. The issue of available technology is clearly presented under "Technological Feasibility" and has been demonstrated as feasible. However, providing manufacturers with sufficient leadtime to comply with the rulemaking is critical in establishing the model year implementation date.

The EPA staff recommends retaining the 1983 model year implementation date providing that the rulemaking is promulgated by June 1, 1980. Recognizing that the promulgation of the rulemaking after June 1, 1980 would place an increasing pressure on the manufacturer to comply with the rulemaking, the EPA staff recommends a 1984 model year implementation if the rulemaking is promulgated after December 1, 1980.

References

1/ Comments of General Motors Corporation, October 11, 1979, pg. 89.

2/ Comments of International Harvester, October 9, 1979, pg. G-3.

3/ Comments of International Harvester, October 9, 1979, pg. G-4.

4/ Comments of Ford Motor Company, October 11, 1979, Attachment III to Section IV.

5/ Comments of American Motors, October 10, 1979, pg. 11.

6/ Memorandum of Comment of the Department of Commerce, pg. 17.

7/ Comments of Motor Vehicle Manufacturers' Association, October 11, 1979, pg. 68

8/ Memorandum of Comment of the Department of Commerce, pg. 14.

9/ 123 Cong. Rec. H 11957 (daily ed. November 1, 1977).

10/ "Average Lifetime Periods for Light-Duty Trucks and Heavy-Duty Vehicles", EPA Report #SDSB 79-24, Glenn W. Passavant, November 1979.

11/ Comments of American Motors, October 10, 1979, Appendix B.

F. Issue: Economic Impact

1. Summary of the Issue

The U.S. EPA has proposed a comprehensive control strategy for 1983 and later model year light-duty trucks.

This strategy includes more stringent HC and CO emission standards, a new useful life definition, a revised durability testing program, revised allowable maintenance provisions, and an idle test with idle emission standards for HC and CO.

In addition, the control strategy includes a diesel crankcase emission standard for light-duty trucks powered by diesel engines and a reduction in the Selective Enforcement Auditing acceptable quality level from 40 percent to 10 percent.

In the proposal the EPA technical staff estimated an average per engine first cost increase of $62 (1978 dollars) with an expected operating cost increase of about $60 (discounted to January 1, 1983) associated with inspection/maintenance programs. The rulemaking strategy as a whole was expected to cost approximately $1.97 billion dollars for the 20.4 million light-duty trucks sales projected for the first five years of this regulation.

2. Summary of the Comments

The comments received on the economic impact of these proposed regulations will be summarized according to the major components of the rulemaking strategy. The following cost areas will be addressed: development and emission control hardware, certification, allowable maintenance, useful life redefinition, diesel crankcase control, and the stricter 10 percent AQL.

A. Development and Emission Control Hardware

Several manufacturers commented on the specific costs associated with the emission control hardware and other developmental costs associated with an emission control system capable of meeting the emissions standards for the full useful life. These cost comments are listed below by manufacturer.

1. Gasoline-Fueled LDTs

International Harvester

Exhaust System and Related Changes	$64
Ignition System and Related Changes	26
Carburetion and Fuel System	59
Other	49
TOTAL	$198

Ford

Ford estimated costs at about $80 per vehicle, but this did not cover the effects of full useful life or the 10 percent AQL.

General Motors

General Motors estimated initial hardware costs of $362 per vehicle. This figure includes $300 for the replacement of the catalytic converter and exhaust pipe.

Chrysler

Chrysler estimated a customer cost of $50 per vehicle with a 50,000 mile useful life and tooling cost of about $500,000. In addition, Chrysler stated that the full useful life might force the use of three way catalysts and feedback carburetors. In this case, the tooling cost was estimated at $20 million with a customer costs of $315 per vehicle. Chrysler estimated emission control system development costs at four million dollars.

Of the other manufacturers none commented on the emission control hardware costs in sufficient detail for analysis.

2. Diesel LDTs

Of the three manufacturers which currently market diesel LDTs none commented on the costs of bringing these engines into compliance.

However, for the record, Chrysler provided costs for turbocharging light-duty trucks.

Turbocharger Unit	-	$ 243
Oil lines and other plumbing charges	-	27
Change in injection pump configuration	-	9
Manifold and turbocharger exhaust transition	-	46
TOTAL:	-	$ 325

B. Certification

No manufacturer commented in detail on the costs of recertification. However, International Harvester commented on the need for very complete testing due to the redefinition of useful life. American Motors commented that EPA's certification costs were too low because too many ideal assumptions were made. American Motors did not provide any revised cost estimates.

C. Allowable Maintenance Provisions

No specific comments were received on the costs of implementing the allowable maintenance provisions.

D. Useful Life Redefinition

The cost-related comments on the useful life redefinition can be divided into two groups. The first group is greater costs aimed at meeting the lower target levels associated with a longer useful life. The second group is cost related to warranty claims.

1. Lower Target Levels

Chrysler

Chrysler speculated that 3-way catalysts and feedback carburetors might be necessary to meet the lower target levels for HC and CO.

International Harvester

Although International Harvester did not comment explicitly on the lower target levels, they did state that the more sophisticated emission control systems used and the longer useful life period anticipated would substantially reduce the value of their current data on the durability of their emission control systems.

Ford

Ford Motor Company did not provide comment in sufficient detail to allow analysis. They stated the extended durability and revised durability testing procedures taken together would cost $420. When questioned, Ford declined to provide further detail. However, it appears that the bulk of the cost is tied up in further hardware such as: electronic engine controls, feedback systems, and additional light-off catalysts.

2. Warranty Costs

Several manufacturers provided comments on increased warranty costs which they expected as a result of the longer useful life. These would be costs related to Section 207 of the 1977 Clean Air Act Amendments.

International Harvester

International Harvester provided in-depth comments on their anticipated warranty related costs. Referring to the table found in Attachment 4 to their written comments, IH's costs can be summarized as shown below:

1. Probable Warranty Cost (Parts and Labor)	:	$ 97
2. Diagnostic Costs (116% failure rate) ($23/hr x 2hr/diagnosis x 1.16 failure/vehicle)	:	$ 53
3. Dealer overhead and profit	:	$ 65
4. Average Engine Rebuild Cost (100,000 - 130,000 miles)	:	$ 71
TOTAL	:	$286

American Motors

American Motors expressed serious concern over the warranty implications of the extended useful life. They stated that the full useful life would force each new truck customer to incur a warranty related cost of $260 - $300 to cover emission related warranty claims in the second half of the vehicle life.

Ford

No comments were received.

General Motors

No comments were received.

E. Diesel Crankcase Control

No comments related to the control of diesel crankcase emissions were received.

F. 10 Percent Acceptable Quality Level (AQL)

In general, few comments were received on the costs of implementing a 10 percent AQL. As a group, manufacturers felt that the 10 percent AQL, if feasible, would force lower target emission levels and perhaps cause a fuel economy penalty.

Chrysler commented that a 10 percent AQL would force them to incur additional testing costs. These costs would include a one time investment of $1.70 million dollars for testing facilities and equipment, and an additional $300,000 per year for employees.

Although comments were solicited on any increase in internal audit testing which might be required by the 10 percent AQL, no manufacturers responded with any information.

3. Analysis of the Comments

As can be seen from the preceding section, very little substantial comment was received from the manufacturers. Few commentors replied in the detail requested in the NPRM, and only minimal supporting cost breakdowns were given by those who provided specific cost-related comments.

The EPA technical staff's analysis of these cost-related issues will be presented on a subject by subject basis similar to the preceeding section. In some cases the methodology used in the recently finalized heavy-duty engine regulations will be utilized.

The costs which EPA will ultimately consider chargeable to these regulations are only those which are necessary to meet the requirements imposed by these rules and not necessarily the total which the manufacturers stated they may spend.

A. Development and Emission Control Hardware

When considering the development and emission control hardware costs related to the various aspects of this rulemaking package, it is important first to consider the magnitude of the task. Based upon the Technological Feasibility discussion in Issue G, costs will be incurred in the following areas.

i. Redesign and Development Testing

Although the technology which will be employed to meet the target emission levels is proven and well understood, development costs will be incurred in improving the durability and reliability of emission related components. This includes primarily the catalyst, air injection, and EGR. Other related components which may be affected to a lesser degree include emission-related carburetor changes, electronic engine controls, and hardware used to control evaporative emissions.

In addition, the EPA technical staff expects that some development and testing will be done by the manufacturers to optimize the engine/emission control system to achieve optimum engine performance and fuel economy and emissions compliance for the minimum cost.

On a per engine basis the costs of improving system reliability and durability as well as engine optimization should not exceed \$5-\$10 per engine.1/ The EPA technical staff expects most of this cost will be spent on improving the quality and durability of materials used in the catalyst and hoses related to the EGR and air injection.

In most cases optimization efforts by the manufacturer would yield it a net benefit in terms of material costs saved or marketability of the product. In any event, optimization costs would be far less than \$1.00 per engine, so this analysis will assume the optimization cost is included in the \$5-\$10 estimate cited earlier for redesign and development.

ii. Emission Control Hardware

As stated in the technological feasibility discussion (see Issue G), the EPA technical staff expects that most manufacturers will use oxidation catalyst/air injection/EGR systems to comply with the provisions of the proposed rulemaking. In addition, EPA expects manufacturers to use electronic engine controls (EEC).

In most cases, changes to bring the vehicles into compliance will be primarily the addition of electronic engine controls and changes to catalyst volumes and loadings. In some cases air injection will have to be added or the less effective pulse air system will have to be replaced by a mechanical air pump.

To determine more specifically the costs related to bringing the LDT fleet into compliance with the 1983 emission standards the EPA technical staff studied the emission levels and corresponding emission control hardware found in the 1980 LDT fleet.

As of February 1980, twelve light-duty truck manufacturers had certified 47 engine families. Of these 47 families, 16 were Federal families, 22 were Federal and California families and 9 were California only families.2/ Since engine families sold only in California are certified to California emission standards, these families will be eliminated from this analysis. When appropriate, certification results for California engine families will be used to indicate a possible emission control strategy which would bring the Federal family into compliance.

The next twenty pages discuss for each manufacturer on an engine family by engine family basis the steps which the manufacturer may need to achieve the approximate emission target levels (.49 HC, 5.5 CO, 1.4 NOx) estimated by EPA.3/ At the end of the discussion for each manufacturer is a table outlining certification data for each engine family.13/ Data used in this analysis is actual certification data for 1980 LDTs. Costs in the Regulatory Analysis will be based upon these strategies.

a. American Motors

BT9A1 - Engine family BT9A1 is a 151 CID engine employing EGR and a pelleted catalyst. The HC level is below the target level already, and the CO and NOx levels are within 0.1 g/mile of the target levels. This engine family can be brought into compliance with only minor engine calibration changes or electronic engine controls.

Compliance Strategy: Use engine calibration changes or electronic engine controls to decrease CO and NOx. Air injection does not appear necessary.

CT3A1 - Engine family CT3A1 is a 258 CID/6 cylinder with air injection/EGR/and a 160 cubic inch pelleted oxidation catalyst.

From the 4K emission levels CO appears to be the major problem. Changing the catalyst volume and loading would increase CO oxidation. In addition, a start catalyst may be a valid measure to reduce CO emissions, however the full life durability of a start catalyst is questionable.

Compliance Strategy: Increase the catalyst loading to 2.2 g and increase the catalyst volume from 160 cubic inches to 200 cubic inches. Add electronic engine controls to reduce cold start emissions.

CT3H1 - Engine family CT3H1 is very similar to family CT3A1 and uses air injection, EGR, and a pelleted oxidation catalyst. Some of the 4K emission levels are below the target levels. Increases in the catalyst volume and loading, together with the addition of electronic engine controls would decrease the emission levels to near the target levels.

Compliance Strategy: Increase the catalyst loading to 2.2 g and increase the catalyst volume to 200 cubic inches. Use electronic engine controls (EEC) to reduce cold start and NOx emissions.

HT3A1 - Engine family HT3A1 is a 304 cubic inch 8 cylinder engine with air injection, EGR, and a pelleted oxidation catalyst. None of the emission data vehicles met all of the target emission levels. Increasing the catalyst volume and loading would likely yield the desired emission reductions.

Compliance Strategy: Increase the catalyst loading to 2.515 grams and increase the catalyst volume to 260 cubic inches. Use EEC to control cold start emissions and NOx.

NT3A1 - Engine family NT3A1 is a 360 cubic inch/8 cylinder engine employing EGR, air injection, and a pelleted oxidation catalyst. Although none of the emission data vehicles met the target emission levels, compliance with the target levels appears easily achievable through increasing the catalyst volume and loading, and using the variable calibrations of EGR available with EEC to control NOx emissions. These catalyst volume increases also will be necessary to increase catalyst durability.

Compliance Strategy: Increase the catalyst volume to 260 cubic inches and increase the noble metal loading to 2.515 grams. More NOx control can be gained through using modulated EGR or engine calibrations. Use EEC to control cold start emissions.

b. Chrysler Corporation

OTA-225-1-BCP - Engine family 225BCP is a 225 CID/6 cylinder engine with air injection, EGR, and 2 small oxidation catalysts. None of the emission data vehicles met any of the target emission levels. This family will require increased catalyst loading and volume as well as modulated EGR flow rates or a change in timing.

Table F-1

AMERICAN MOTORS

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
BT9A1	151/4	-	X	P	160	1.555g	Pt/Pd	5:2	.42	5.6	1.5
CT3A1	258/6	X	X	P	160	1.555g	Pt/Pd	5:2	.48	11.3	1.4
									.51	9.9	1.4
									.35	7.8	2.0
CT3H1	258/6	X	X	P	160	1.555g	Pt/Pd	5:2	.43	7.4	1.7
									.40	4.4	2.0
									.28	3.9	1.9
HT3A1	304/8	X	X	P	160	1.555g	Pt/Pd	5:2	.94	9.3	1.6
									.73	4.9	1.7
									.87	6.9	1.5
									.94	7.3	1.9
NT3A1	360/8	X	X	P	160	1.555g	Pt/Pd	5:2	.72	15	1.4
									.59	6.7	2.0
									1.1	13	1.7
									.56	11	1.6

Compliance Strategy: Increase the catalyst volume to 150 CID and the catalyst loading should be increased to about 2.5 gram of Pt per catalyst. Use EEC to reduce cold start emissions of HC and CO, and permit the use of modulated EGR.

OTA-318-2-BCA - Engine family 318BCA is a 318 CID/8 cylinder with air injection, EGR, and 2 small oxidation catalysts. A compliance strategy similar to 225BCP should be adequate to lower emissions to near the target levels. Some of the emission data vehicles had 4,000 mile emission data values near or below the emission target levels estimated by EPA. Modulated EGR will be necessary to slightly lower the NOx emission level.

Compliance Strategy: Change the catalyst volume to 150 CID and increase the platinum loading to 2.5 grams. Add EEC to reduce cold-start emissions, and use modulated EGR to reduce NOx.

OTA-318-2-BEP - Engine family 318BEP is a 318 CID/8 cylinder engine with air injection, EGR, and an oxidation catalyst. None of the emission data vehicles met all of the target emission levels. Increasing the catalyst loading and volume would be an efficient means of reducing HC and CO emissions to near the target levels. Electronic engine controls could be used to control cold start emissions and would allow the use of modulated EGR to control NOx.

Compliance Strategy: Increase the catalyst loading to approximately 2.0 grams and increase the catalyst volume to 200 cubic inches. Add EEC to reduce cold start emissions and NOx.

OTA-318/360-4BCP - Engine family 318/360 BCP represents 318/360 8 cylinder engines. As emission control systems these engines employ air injection, EGR, and two small oxidation catalysts. None of the emission data vehicles met all of the target emission levels, although the HC and NOx values were fairly low. To decrease the HC and CO emissions a larger more heavily loaded catalyst should be used. Electronic engine controls could be used to control cold start emissions and allow the use of modulated EGR to control NOx.

Compliance Strategy: Increase the catalyst volume to 150 cubic inches and increase the platinum loading to 2.5 grams. Use EEC to control cold start emissions and reduce NOx.

OTA-318/360-4BFP - Engine family 318/360 BFP represents a 318/360 8 cylinder engine. For emission control it uses air injection, EGR, a start catalyst, and a regular underbody catalyst. Only CO emissions are above the current target levels. Increasing slightly the volume and noble metal loading in the underbody catalyst will yield the required reductions and increased durability.

Compliance Strategy: Increase the catalyst loading to about

Table F-2

CHRYSLER

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
225 BCP	225/6	X	X	M	2 @ 45	.615g	Pt	1	.97	14	1.6
									1.05	13	2.2
									.55	10	1.5
									.58	11	1.6
									.61	12	2.0
318 BCA	318/8	X	X	M	2 @ 45	.615g	Pt	1	.51	5.4	2.3
									.76	10.8	1.2
									.74	6.6	1.9
									.60	12.5	1.3
									.52	6.1	2.1
318 BEP	318/8	X	X	M	141	1.44g	Pt	1	1.0	9.0	1.5
									1.1	10.8	1.3
									.80	15.7	1.6
									.80	12.8	1.7
									.66	12.8	1.7
									.66	8.6	1.8
318/360 BCP	318 & 360/8	X	X	M	2 @ 45	.615g	Pt	1	.85	9.2	1.8
									.78	14.1	1.4
									.71	12.5	2.0
318/360 BFP	318 & 360/8	X	X	M	22/141	.9/2.88g	Pt	1	.40	8.8	1.2
									.46	8.1	.90
									.35	7.5	1.1

3.0 g and increase the volume to about 200 cubic inches. The required reductions could be achieved by engine modifications but this could be at the expense of fuel economy. Increasing the volume and loading would also increase the emission control system durability and diminish dependence on start catalysts. Use EEC to reduce cold start emissions. Remove the start catalyst.

c. Ford Motor Company

4.9 NA - Engine family 4.9NA represents a 300 CID/6 cylinder engine which uses air injection, EGR, and an oxidation catalyst. One of the emission data vehicles met all of the target emission levels with the current hardware, so it could be argued that no incremental hardware cost is required. However, EPA expects that Ford will minimize dependence on engine calibrations which may be causing a fuel economy penalty. Therefore, Ford will most likely use either EEC to reduce NOx and cold start HC and CO or heavier noble metal loading to increase catalyst efficiency and durability. We will conservatively assume that both are used.

Compliance Strategy: Increase noble metal loading to 2.5 g to allow increased control and durability. Use EEC to reduce cold start emissions.

5.0 NA - Engine family 5.0 NA represents a 302 CID/8 cylinder engine which uses air injection, EGR, and an oxidation catalyst to control emissions. Although none of the emission data vehicles met all of the target emission levels the HC and CO levels are fairly close already. Using a larger catalyst with heavier loadings would yield the required emissions reductions together with no fuel economy penalty related to HC and CO reductions. The use of electronic controls will allow variable calibrations to reduce HC, CO, and NOx emissions.

Compliance Strategy: Use the same catalyst as engine family 5.0 NB (150 CID/2.17 Pt and Pd in a 2:1 ratio). Use EEC to reduce cold start and NOx emissions.

5.0 NB - Engine family 5.0 NB is very similar to family 5.0 NA. It's emission data vehicles have HC and CO emission levels below the targets and the NOx levels are easily achievable with variable calibrations of the EGR available through EEC.

Compliance Strategy: Use EEC to reduce cold start and NOx emissions.

5.8 M/6.6 NA - Engine family 5.8M/6.6 NA represents 8 cylinder 351 and 400 CID engines. These engines use air injection, EGR and an oxidation catalyst. Although none of the emission levels from the emission data vehicles met all of the target levels, several met the HC and CO target levels. Using a slightly larger catalyst with heavier noble metal loading should bring the desired HC and CO reductions. NOx reductions should be achieved through modulated EGR.

Compliance Strategy: Use a 150 CID catalyst with 2.17 grams of platinum and palladium in a 2:1 ratio. This is the same catalyst as on family 5.8 WNG. Use EEC to reduce cold start emissions. EEC will also allow the use of modulated EGR which will decrease NOx.

5.8 WNG - Family 5.8 WNG represents a 351 CID/8 cylinder engine which use EGR, air injection, and an oxidation catalyst. It's HC and CO levels are already below the target emission levels. Further NOx control is available through EGR.

Compliance Strategy: To gain further NOx control use modulated EGR.

d. General Motors Corporation

08F2A - Engine family 08F2A is a 250 CID/6 cylinder engine which uses a pelleted oxidation catalyst, EGR, and a pulse air system. Although none of the emission data vehicles met all of the target emission levels, the HC and NOx levels are close to the target levels. The CO levels are considerably above the emission target level of 5.5g/mile. Three steps may be necessary to bring this engine family into compliance: 1) replace the pulse air system with a mechanical air pump 2) slightly increase the catalyst loading and 3) add EEC to implement modulated EGR thus reducing NOx. Adding more air will increase the HC and CO oxidation and adding modulated EGR will assure adequate NOx reductions.

Compliance Strategy: Replace the pulse air system with a mechanical air pump. Increase the catalyst loading to 2.515 grams of Pt and Pd in a 5:2 ratio. Add EEC to reduce cold start and NOx emissions.

08K4AA - Engine family 08K4AA represents 350 and 400 CID/8-cylinder engines with EGR, air injection, and a pelleted oxidation catalyst. Of the four emission data vehicles three met the target HC and CO levels but none met the target NOx standards.

Compliance Strategy: Increase the catalyst loading to 2.515g, and use EEC to implement modulated EGR and control spark timing. Use EEC to reduce cold start emissions thus assuring HC and CO compliance.

08K4G - Engine family 08K4G represents 350 and 400 CID/8-cylinder engines which use only EGR and a pelleted oxidation catalyst. None of the emission data vehicles met either the HC or CO target levels and only one met the NOx target. The lack of any air injection seems to be the cause of the shortfall in the HC and CO areas. The 0.2 to 0.3 g/mile further NOx decrease required can easily be achieved through modulated EGR.

Compliance Strategy: Add a mechanical air pump or at least pulse air. Achieve required NOx reductions through modulated

Table F-3

FORD

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
4.9 NA	300/6	X	X	M	150	2.17g	Pt/Pd	2:1	.57	5.0	1.1
									.87	8.8	1.9
									.95	10	1.4
									.72	8.1	1.3
									.49	4.2	1.6
									.44	5.2	1.3
5.0 NA	302/8	X	X	M	128	1.85g	Pt/Pd	2:1	.49	5.0	1.6
									.59	3.5	1.8
									.73	6.9	1.6
									.61	7.6	2.0
									.58	9.6	1.3
									.51	4.1	1.5
5.0 NB	302/8	X	X	M	150	2.17g	Pt/Pd	2:1	.41	2.3	1.5
									.59	4.8	1.6
5.8 M/6.6 NA	351 & 400/8	X	X	M	128	1.85g	Pt/Pd	2:1	.39	2.8	1.9
									.56	6.1	1.5
									.78	12.0	1.5
									.39	4.5	2.0
5.8 WNG	351/8	X	X	M	150	2.17g	Pt/Pd	2:1	.34	2.9	1.6
									.33	3.9	2.0
									.49	3.7	2.0

EGR. Add EEC to aid reductions of HC and CO during cold start.

08Y2A - Engine family 08Y2A is an 8 cylinder/305 CID engine with a pelleted oxidation catalyst and an EGR system. None of the emission data vehicles met the NOx target levels but two met the HC level and one met the CO. From the emission data available it appears likely that the required HC and CO reductions are attainable by the addition of some form of air injection and variable timing. The required NOx reductions can be achieved through modulated EGR.

Compliance Strategy: Add a mechanical air pump. Add EEC to reduce cold start HC and CO emissions and allow implementation of modulated EGR.

e. International Harvester Company

4-196 - Engine family 4-196 is a 196 CID/4 cylinder engine which use air injection, EGR, and a pelleted oxidation catalyst. Certification data for this family shows the HC level is near compliance, but the CO and NOx levels will require additional reductions.

Compliance Strategy: Use EEC to reduce cold start HC and CO emissions. Increase catalyst loading to 2.2 g. Gain NOx control through modulated EGR.

V-304 - Engine family V-304 is a 304 CID/8 cylinder engine using air injection, EGR, and a pelleted oxidation catalyst. The emission data vehicles both had CO levels below the emission targets. The HC levels are near the target levels and the NOx levels are somewhat close. To reduce HC emissions a heavier loading is necessary in the catalyst. To reduce NOx emissions modulated EGR is necessary.

Compliance Strategy: Increase catalyst loading to 2.515 grams of Pt and Pd in a 5:2 ratio. Add EEC to reduce cold start HC and CO emissions. EEC will also allow the use of modulated EGR.

V-345 - Engine family V-345 is a 345 CID/8 cylinder engine with air injection, EGR, and a pelleted oxidation catalyst. The CO emission levels from both emission data vehicles achieved the target levels and the HC level from one vehicle is below the target level. This engine will require a heavier loading in the oxidation catalyst to lower HC emissions and will require modulated EGR to reduce NOx without a fuel economy penalty.

Compliance Strategy: Increase the catalyst loading from 1.555 to 2.515 grams of platinum and palladium in a 5:2 ratio. Add EEC to control HC and CO cold start emissions and allow the use of modulated EGR to reduce NOx.

Table F-4

GM

Engine Family	CID/ Cylinders	Emission Control System AIR	EGR	CAT	Catalyst Data Volume	Loading	Metals	Ratio	4K Emission Levels HC	CO	NOx
08F2A	250/6	PLS	X	P	260	1.555g	Pt/Pd	5:2	.56	15.0	1.2
									.43	12.0	1.1
									.53	9.7	1.8
									.70	16.0	1.9
08K4AA	350/8	X	X	P	260	1.555g	Pt/Pd	5:2	.59	8.0	1.9
									.41	4.5	2.0
									.36	4.1	2.0
	400/8	X	X	P					.41	5.2	1.5
08K4G	350/8	–	X	P	260	2.515g	Pt/Pd	5:2	.55	12.8	1.7
									.43	7.5	1.6
									.62	11.3	1.6
									.57	10.2	1.5
	400/8	–	X	P					.54	13.0	1.3
08Y2A	305/8	–	X	P	260	1.555g	Pt/Pd	5:2	.42	6.2	1.6
									.53	10.2	1.8
									.49	5.5	2.0
									.57	8.6	1.8

Table F-5

INTERNATIONAL HARVESTER COMPANY

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
4-196	196/4	X	X	P	160	1.555	Pt/Pd	5:2	.5	6.8	2.0
V304	304/8	X	X	P	260	1.555	Pt/Pd	5:2	.57	4.7	1.55
									.61	4.7	1.75
V345	345/8	X	X	P	260	1.555	Pt/Pd	5:2	.44	2.8	1.8
									.57	5.5	1.5

f. Isuzu Motors

A1TB - Engine family A1TB represents a 111 CID/4 cylinder engine with air injection and EGR. None of its current emissions levels are below the target levels. If this engine were sold in its California configuration nationwide all emissions would be in compliance.

Compliance Strategy: Add an oxidation catalyst similar to that used on the California version (160 CID, 1.555 g of Pt and Pd in a 5:2 ratio). Add EEC to reduce cold start emissions of HC and CO, and reduce NOx emissions through modulated EGR.

g. Mitsubishi Motors Corporation

G52T-F - Engine family G52T-F represents a 122 CID/4 cylinder engine which uses EGR and a monolithic oxidation catalyst. None of the emission data vehicles met all of the target emission levels but one did meet the HC and CO targets. The California version of this engine has emissions below the target levels for all three pollutants. The major differences are the addition of a pulse air system and engine calibrations.

Compliance Strategy: Add a pulse air system to reduce HC and CO emissions. Add EEC to reduce cold start HC and CO emissions. EEC will also allow the use of modulated EGR to reduce NOx.

G54T-F - Engine family G54T-F is a 156 CID/4 cylinder engine which is sold only in the Federal version. It uses a pulse air system, EGR, and a monolithic oxidation catalyst to control emissions. Of the three emission data vehicles, one met all of the target levels, two met the target HC levels, and two met the target CO levels. Based on the data from the emission data vehicles, this engine family can meet the new target levels with only engine or emission control system calibration changes or the use of electronic engine controls. However, it is possible that a mechanical air pump may be necessary to replace the pulse air system to assure increased oxidation of the HC and CO which may be created by the engine or emission control system calibration changes. This step is only necessary as an added assurance that compliance will be achieved.

Compliance Strategy: Use EEC to control cold start emissions of HC and CO. Use of EEC will also allow NOx reduction through modulated EGR.

h. Nissan Motors

TL20F - Engine family TL20F represents a 119 CID/4 cylinder engine which uses EGR, pulse air and a small monolithic oxidation catalyst. None of the emission data vehicles met all of the target emission levels. Only one met target NOx level and none met the HC or CO targets. The California version of this family uses a

Table F-6

ISUZU MOTORS

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
A1TB	111/4	X	X	-	-	-	-	-	1.3	11.0	1.6
									1.5	13.0	2.0
									1.4	14.0	1.6
									1.4	12.0	2.0
A1TC	111/4	X	X	P	160	1.555g	Pt/Pd	5:2	.23	2.7	1.3
									.26	4.7	1.3

Table F-7

MITSUBISHI

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
G52T-F	122/4	-	X	M	61	2.5g	Pd	1	.57	7.6	1.7
									.75	7.2	1.8
									.28	4.0	1.7
G54T-F	156/4	PLS	X	M	61	2.5g	Pd	1	.16	3.3	1.2
									.75	7.2	1.8
									.28	4.0	1.7

mechanical air pump and a larger, more heavily loaded catalyst. The California version of this family met all of the emission targets by a comfortable margin.

Compliance Strategy: Sell the California version nationwide. This would entail the replacement of the pulse air system with a mechanical air pump, the use of an 80 cubic inch catalyst (as opposed to 30) and an increase in the noble metal loading from .44 to 1.86 grams of platinum and palladium in a ratio of two to one. Use the variable calibration capabilities of EEC to reduce HC, CO, and NOx as needed.

i. Suzuki

LJ80 - Engine family LJ80 is a 49 cubic inch/4 cylinder engine which is used in small land rover type vehicles. Its only emission control system is EGR. The EGR system allows this engine to meet the target NOx level. Although the HC and CO levels are well above the target levels, the addition of a pulse air system or, at worst, a mechanical air pump should provide adequate air for increased oxidation of HC and CO.

Compliance Strategy: Add a pulse air system or air pump to reduce HC or CO emissions. If any additional reductions are necessary these should be gained through the variable calibration capabilities of EEC. The staff does not expect that an oxidation catalyst will be necessary to pass the emission standards, but it may be necessary due to the idle standard.

j. Toyo Kogyo

OMAT - Engine family OMAT represents a 120 CID/4 cylinder engine with a pulse air system, EGR, and an oxidation catalyst. The emission data vehicle for this family met the HC target and barely exceeded the NOx target. The CO level exceeded the target by 0.7 g/mile. The California version of this family easily met the target emission levels using only calibration differences from the system being used Federally.

Compliance Strategy: Use the same control hardware as is presently used, but use calibrations similar to those on the California version or preferably the variable calibration capabilities of EEC. Replace the pulse air system with a mechanical air pump.

OWBT - Engine family OWBT represents a 140 CID/4 cylinder engine which uses a pulse air system, EGR and a pelleted oxidation catalyst. Of the three emission data vehicles used for Federal certification, all met the HC target but only one met all three emission targets. The one emission data vehicle which met all three targets was sold in all 50 states. This engine family should be able to meet all of the target levels with the hardware currently in use.

Table F-8

NISSAN MOTORS

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
TL20F	119/4	PLS	X	M	30	.44g	Pt/Pd	2:1	.73	9.0	1.6
									.83	12.0	1.4
									.51	6.5	1.7
									.62	9.5	1.5

Table F-9

SUZUKI

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
LJ80	49/4	-	X	-	-	-	-	-	1.0	12	1.4

Compliance Strategy: Use the current hardware, but use EEC to gain the reductions required to reduce emissions without a fuel economy penalty. Replace the pulse air system with a mechanical air pump.

k. Toyota

2F(F) - Engine family 2F(F) is a 258 CID/6 cylinder with air injection, EGR, and a pelleted oxidation catalyst. Both of the emission data vehicles met the HC target level but neither met the CO or NOx target levels. The California version of this family has emissions well below all target levels and uses a heavier loaded catalyst of the same volume. The NOx control is gained through minor calibration changes.

Compliance Strategy: Increase the catalyst loading to that which is used in the California version. Use modulated EGR to reduce NOx emissions.

20R(TC) - Engine family 20R(TC) is a 134 CID/4 cylinder engine which was certified for sale in all fifty states in at least one configuration. The emission data vehicle met all of the target levels so this family can be considered in compliance.

Compliance Strategy: No action required to reduce emissions. EEC could be added to reduce dependence on fuel consuming engine calibrations which were used to reduce emissions for California sales.

20R(TF) - Engine family 20R(TF) is the Federal only version of the 20R(TC) family. This engine family uses air injection, EGR, but no oxidation catalyst. None of the emission data vehicles met any of the emission target levels. To bring this family into compliance an oxidation catalyst will be necessary. This catalyst should be similar if not identical to the catalyst used on family 20R(TC). In reality the likely outcome is the combination of families 20R(TC) and 20R(TF).

Compliance Strategy: Add an oxidation catalyst similar to that on family 20R(TC) 130 cubic inches, 4.27 grams of platinum and palladium in a 3:1 ratio. Add EEC to reduce cold start and NOx emissions and dependence on engine calibrations which may reduce fuel economy.

l. Volkswagen

37PF - Engine family 37PF is the Federal version of Volkswagen's 97 CID/4 cylinder engine. This engine uses fuel injection and EGR to control emissions. None of the emission data vehicles from family 37PF met the target emission levels. The California version of this family (37PC) uses a three-way type catalyst with feedback fuel injection and EGR. All of the emission data vehicles for family 37PC easily met all of the target emission levels. If

Table F-10

TOYO KOGYO (MAZDA)

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
OMAT	120/4	PLS	X	P	166	1.82g	Pt/Pd	.84:.16	.40	6.2	1.5
OWBT	140/4	PLS	X	P	200	2.31g	Pt/Pd	.83:.17	.25	2.8	1.1
									.37	7.3	1.6
									.28	6.5	1.6

Table F-11

TOYOTA

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
2 F (F)	258/6	X	X	P	244	3.0g	Pd/Pt	2:1	.44	8.7	1.8
									.49	9.5	1.7
20R (TC)	134/4	X	X	P	130	4.27g	Pd/Pt	3:1	.16	5.0	1.2
20R (TF)	134/4	X	X	-	-	-	-	-	.97	13.0	1.7
									.65	10.0	1.6
									.87	12.0	1.8
									1.20	14.0	2.0

family 37PC were sold nationwide this engine type would come into compliance.

Compliance Strategy: Sell family 37PC nationwide. A possible option is the addition of EGR and a small air pump and catalyst, but this methodology could be less fuel efficient.

Light-Duty Diesel Trucks (LDDT)

Currently three manufacturers GM, IH, and VW are certifying light-duty diesel trucks for sale in the U.S. (see Table F-13).

Of the three families certified, two, those from IH and VW already pass the target emission levels and will require no additional reductions.

The third, GM's 350, easily passes the CO target level, but does not pass the HC or NOx levels. This engine is basically the same as that sold in GM's light-duty diesel passenger cars. The passenger car version must meet 50,000 mile emission standards which are more stringent than the LDDT target levels. The EPA technical staff expects that the compliance strategy used to bring the LDD passenger car into compliance will also be used on the LDDT. This basically involves the addition of EGR and the redesign of injectors and other minor engine modifications estimated to cost $30 per engine.4/

iii. Other Control Strategies

Although the previous discussion has dealt almost exclusively with oxidation catalyst/air injection systems there is another control system available to the manufacturers. There is no doubt that a three-way catalyst system could also be used to meet the target emission levels. This three-way system would use a three-way catalyst, electronic engine controls, and a feedback carburetor. An approximate cost for this system on a 300-cubic inch engine is shown in the attached table (see Table F-14).

iv. Summary

The strategies discussed for each light-duty truck family will be used as a basic input for the economic impact chapter of the regulatory analysis. The actual per vehicle cost for each of these strategies will be estimated using the data and methodology found in a report prepared under contract for EPA.12/ The estimates in the report have been adjusted for inflation, increased real costs of material, and a more realistic overhead and profit margin. The profit and overhead margin used was derived in the 1984 heavy-duty engine regulations summary and analysis of comments.

B. Certification

As a result of these new emission regulations, EPA expects

Table F-12

VOLKSWAGEN

Engine Family	CID/ Cylinders	Emission Control System			Catalyst Data				4K Emission Levels		
		AIR	EGR	CAT	Volume	Loading	Metals	Ratio	HC	CO	NOx
37PF *	97/4	-	X	-	-	-	-	-	1.2	6.1	1.8
									1.4	6.5	1.8
									1.3	5.7	1.5

* Fuel Injection

Table F-13

LIGHT-DUTY DIESEL TRUCK EMISSION DATA

Manufacturer	LDT Family	Percent of LDDT Sales	Crankcase Control	Emission Control System			4K Emission Level		
				Turbo	EGR	FI	HC	CO	NOx
GM	09J9Z	76.16	Yes	-	-	X	.84	2.0	2.0
							.82	2.0	1.9
IH	SD-33T	3.62	No	X	X	X	.45	2.2	1.6
							.39	1.6	1.4
VW	DP	20.23	Yes	-	X	X	.32	.90	1.1

Table F-14

Three-Way Control Strategy 1/

	Three-way Catalyst	$181 2/
	Feedback Carburetor Mods	7
	Electronic Engine Controls	140
		$328
less	Oxidation Catalyst	$117 3/
	Air Pump	27
		$184 4/

1/ Incremental cost over a 1980 system.

2/ A catalyst volume of 330 cubic inches with a noble metal loading of 4.30g of Pt and .477g of Rh.

3/ A catalyst volume of 240 cubic inches with a noble metal loading of 2.31 g Pt and 1.16 g Pd was used.

4/ 1980 dollars, includes profit at all levels.

that most, if not all, LDT engine families will have to be recertified. This certification is expected to be a two step process: preliminary deterioration factor assessment and testing of emission data vehicles.

Preliminary deterioration factor assessment would most likely entail the testing of 1-2 durability vehicles per family in an over the road or test track usage. The cost of this testing will vary by manufacturer depending on the type of vehicle used, the number of durability vehicles per family and the useful life figure determined.

In the economic impact analysis, EPA will use costs in 3 major areas:

(1) Prototype vehicle,

(2) Mileage accumulation to 100,000 miles,

(3) Emission testing (28).

In most cases a 1975 EPA memo will be used to estimate these costs.5/ However the effects of inflation will be accounted for by increasing the 1975 costs by 38.2 percent to yield 1980 dollars.6/ Based on this memo and the inflation factor the costs of preliminary deterioration factor should be approximately as shown below:

1.	Prototype vehicle:	$ 35K	
2.	Mileage and maintenance to 100,000 miles:	263K	3/
3.	Testing (28)	12K	4/
		$310K	per durability vehicle

EPA expects that on the average each manufacturer will run 1-2 durability vehicles per family.2/ This durability vehicle program will be conducted as part of the development program described previously.

Emission data vehicles are much less expensive to develop and run to 4,000 miles. Using the methodology and memo used above these costs become:

1.	Prototype vehicle	$13,800	
2.	Mileage and maintenance to 4,000 miles	8,800	
3.	Testing (2)	800	
		$23,400	per emission data vehicle

EPA expects that on the average each manufacturer will run two durability vehicles and four emission data vehicles per family.

These costs are higher than those previously incurred during certification primarily due to the unknown deterioration characteristics of emission control systems past 50,000 miles.

C. Allowable Maintenance Provisions

Although no manufacturer commented on the costs of the new allowable maintenance provisions, some costs will be incurred. These costs are primarily related to research and development and improved materials. Of all the items for which allowable maintenance provisions were proposed, only two drew any real comment: spark plugs and catalysts.

The analysis of the spark plug interval question (in Issue C - Allowable Maintenance) indicates that the proposed interval is within the range of current technology. Therefore, the staff expects that the spark plug interval is obtainable at no extra cost.

The catalytic converter interval of 100,000 miles drew the most general comment and is where the greatest research effort will be necessary. The $5-$10 which was estimated earlier as an R&D cost should go toward assuring the durability of catalyst systems for at least 100,000 miles. This $5-$10 does not include any changes to catalyst loading which might be necessary to meet the increased catalyst durability requirements. The costs for increased loading were inherently addressed in the compliance strategy discussion.

D. Useful Life Redefinition

1. Lower Target Levels

The change in the useful life definition will force the manufacturers to achieve lower target levels in their compliance efforts than they would have had the useful life remained at 50,000 miles/5 years. The table below compares the target levels for the 50,000 and 100,000 mile useful life periods. Both sets of targets assume a 10 percent AQL.

Emission Target Levels 3/

	50,000 mile useful life	100,000 mile useful life
HC	0.57 g/mile	0.49 g/mile
CO	6.20	5.50
NOx	1.45	1.40

Although the NOx target level is not meaningfully affected, the HC and CO target levels are substantially changed.

The cost of the lower target levels could be estimated by determining the effect of the lower HC and CO targets on the actual hardware used. Three main pieces of hardware are affected: air pumps, catalytic converters, and electronic engine controls (EEC).

Of the 8 families which would have to add or upgrade their present air injection systems, few, if any, would be able to achieve even the 50,000 mile target levels without these systems. This can be easily judged by comparing the HC and CO emission levels of engines with and without air injection. Air injection system changes and improvements will be caused primarily by the more stringent emission standards and not the redefined useful life.

Almost all families affected by these more stringent emission standards will have to increase their catalyst volume and/or loadings to meet the lower target levels. The actual amount of the cost of the increased volume or loading directly attributable to the increased useful life is difficult to estimate.

To estimate what amount of the catalyst related cost is attributable to the longer useful life, it might be helpful to study the HC and CO emission levels and targets. Although HC oxidation occurs directly in the catalyst, CO (one of the HC combustion products) is the limiting pollutant, so CO will be considered further. The required reductions in CO emissions can be viewed in two segments: current levels to the 50,000 mile target and further reductions from the 50,000 mile target to the 100,000 mile target. Using the concept of segmented reductions, the catalytic converter cost related to the useful life can be estimated. To estimate this cost the only additional piece of information required is the current CO levels of the emission data vehicles. Using the data gathered from EPA's Certification Division and averaged for each engine family, the average CO emission level is currently about 7.8 g/mile (see Table F-15).

Total 100,000 mile CO reduction: 7.8 - 5.5 = 2.3
First 50,000 mile CO reduction: 7.8 - 6.2 = 1.6

Segmented Reduction: $\frac{1.6}{2.3} = .70$:First 50,000 miles

$\frac{2.3-1.6}{2.3} = .30$:Second half of life

Using the methodology described above, the conclusion from this analysis is that about 30 percent of the catalyst related hardware costs could be attributable to the lower target standards and thus the useful life. When computing the cost effectiveness of the useful life, 30 percent of the catalyst cost computed in Chapter V of the regulatory analysis will be included.

The third piece of hardware directly related to emissions reductions are electronic engine controls (EEC). EEC are a relatively new technology for maintaining or improving fuel economy and engine performance while lowering emissions. EEC will contribute substantially to lower cold start emissions due to variable timing and lower NOx emissions in all driving modes as a result of

Table F-15

Sales-Weighted Federal CO Levels

Manufacturer	Family	Sales Weight	Avg 4K CO Levels
AMC	BT9A1	.0093	5.6
	CT3A1	.0241	9.7
	CT3H1	.0142	5.2
	HT3A1	.0060	7.1
	NT3A1	.0252	11.4
Chrysler	225 BCP	.0257	12.0
	318 BCA	.0396	8.3
	318 BEP	.0560	11.6
	318/360 BCP	.0096	11.9
	318/360 BFP	.0087	8.1
Ford	4.9 NA	.0787	6.9
	5.0 NA	.1284	6.1
	5.0 NB	.0057	3.6
	5.8/6.6 NA	.0944	6.4
	5.8 WNG	.0162	3.5
GM	08F2A	.0456	13.2
	08K4AA	.1053	5.5
	08K4G	.1253	11.0
	08Y2A	.0347	7.6
	09J9Z	.0120	2.2
IH	4-196	.0016	6.8
	V-304	.0047	4.7
	V-345	.0053	4.2
	SD33T	.0005	1.5
Isuzu	A1TB	.0175	12.5
	A1TC	.0003	3.7
Mitsubishi	G52T-F	.0059	6.3
	G54T-F	.0040	4.8
Nissan	TL20F	.0249	9.3
Suzuki	LJ80	.0006	12
Toyo Kogyo	OMAT	.0105	6.2
	OWBT	.0081	5.5
Toyota	2F (F)	.0026	9.1
	20R (TC)	.0032	5.0
	20R (TF)	.0197	12.3
VW	37 PF	.0026	6.1
	DP	.0024	1.0

Sales-Weighted Avg: 7.767 g/mile

variable calibrations of EGR. These EEC will probably prevent the need for the fuel consuming engine calibrations or start catalysts used on many of the California engine families.

Although it cannot be stated unequivocally, it appears that the manufacturers will choose the use of EEC to control cold start emissions and maintain fuel economy. The start catalyst would be a viable strategy for a 50,000 mile lifetime but its durability for a full lifetime would be questionable.

The incremental cost of EEC for the second half of the lifetime could be estimated by determining the cost difference between a start catalyst and a EEC system.

A start catalyst used by Ford on its California engine family 5.0 NG would cost the consumer about $47 7/ and an EEC system would cost from $44 to $60 depending on production volume.8/ From this analysis there appears to be no inherent additional cost increase related to the EEC. A start catalyst has no significant cost advantage and EEC will yield many other benefits to the manufacturer and owner for the full life. The EPA technical staff concludes that no significant portion of the EEC is caused by the lower target levels, so no EEC cost will be attributed to the useful life redefinition.

2. Certification Costs

Since certification will be required for the full useful life it is reasonable that manufacturers will run their durability vehicles for the full useful life. If the full useful life is 100,000 miles, then one half of the mileage accumulation, maintenance and testing costs for each engine family are attributable to the full lifetime. Using the certification costs described previously, this cost comes to $137,500 per test vehicle or about $275,000 per engine family.

3. Warranty

Although several manufacturers stated that per vehicle warranty claims may exceed $250, there is one unstated but basic point in their analyses which leaves their comment open to some question. In the past the manufacturers and vendors of emission related components have designed and built these components knowing that their responsibility ends at 50,000 miles. So these components have been designed and built such that at 50,000 miles a small percentage failure is acceptable. EPA expects that manufacturers will not accept the potential warranty claims associated with components designed for a 50,000 mile lifetime, but instead, will redesign and eventually develop emission related components designed for a full vehicle lifetime. Under this concept, the manufacturers' warranty claims for a full lifetime should not exceed that for the current 50,000 mile lifetime. This is true because the acceptable failure rate at the average useful life should be the same as that for the 50,000 mile useful life.

As described briefly earlier, EPA expects that an average of about $5-$10 per vehicle will be spent in this redesign and development effort. This cost will primarily affect the catalyst, air pump, EGR, and electronic engine control system, although some lesser amounts may be spent on some other minor emission related components. This $5-$10 estimate does not include the heavier catalyst loadings described previously.

In any case, the manufacturers' estimates of increased warranty claims should not occur because of the revision in the useful life definition from that which was proposed. With the changes to the proposed definition, manufacturers will no longer be liable for engine rebuilds beyond their own warranty period.

E. Diesel Crankcase Control

Of the three light-duty diesel truck families currently certified, the General Motors and Volkswagen families already have closed crankcases. The remaining family, that from IH (actually built by Mitsubishi), does not have a closed crankcase. This IH family is turbocharged which may be the the reason the crankcase has not been closed.

Mercedes Benz has closed the crankcase on both its naturally aspirated and turbocharged light-duty diesel engines using a cyclonic separator and a few hoses.2/ A local Mercedes dealer estimated the replacement cost for these parts at $6 per engine, which seems quite consistent when compared to the cost of other crankcase control systems. A closed crankcase on gasoline-powered light-duty vehicles costs about $2 per vehicle9/ and on heavy-duty diesel engines this cost is approximately $10 per engine.10/ The estimate of $6 per vehicle seems reasonable in comparison to the other control systems, and will be used as the cost to close the crankcase on the small number of IH diesels affected.

F. SEA Related Costs

The SEA related costs fall into three major areas: SEA testing costs, self audit testing costs, and 10 percent AQL compliance costs.

1. SEA Testing Costs

A decrease in formal SEA testing costs is expected as a result of the change in the AQL and sampling plan. This will result in a change in the average sample number per audit from 16 vehicles per audit to 13 vehicles per audit. The change includes going from the current batch sampling plan and a 40 percent non-compliance rate to a sequential sampling plan and a 10 percent non-compliance rate. On a per audit basis this amounts to about $1200. On a per manufacturer or per vehicle basis this savings is not substantial enough to receive any further consideration and will not be included in the final cost analysis.

2. Self Audit Testing Costs

Although all major manufacturers were queried as to what increases in self audit testing would be expected with a change in the sampling plan and AQL, only Chrysler indicated that they would require more testing. Chrysler estimated increased testing hardware costs of $1.7 million and personnel costs of $300K per year.

Manufacturers' California audit testing data available to EPA indicates that the manufacturers current compliance efforts at a 40 percent AQL are already yielding compliance levels near or surpassing that necessary for a 10 percent AQL. This data is discussed in the Technological Feasibility Issue (G). Based on this data the EPA technical staff can see no need for any substantial increases in self audit testing. However, because Chrysler responded in the affirmative in the area of further testing, their costs will be included in the final economic impact analysis.

3. 10 Percent AQL Compliance Costs

Due to the test to test variability of emissions data and the more stringent 10 percent AQL, manufacturers will probably try to achieve lower target emission levels than might be sought at a 40 percent AQL.

Using variability of 10 percent (HC), 20 percent (CO), and 25 percent (NOx) the EPA technical staff has estimated target levels for a 40 percent AQL and a 10 percent AQL assuming in each case a 100,000 mile useful life.

Emission Targets 3/

	40 Percent AQL	10 Percent AQL
HC	0.53 g/mile	0.49 g/mile
CO	6.4	5.5
NOx	1.7	1.4

To determine any hardware costs related to going from the 40 percent AQL to the 10 percent AQL it must be determined what if any hardware changes may result from the slightly lower target levels anticipated.

There are four basic pieces of hardware which must be considered: air injection, EGR, catalytic converters, and electronic engine controls.

Of the families which need to add or upgrade an air injection system, it does appear that perhaps one GM family (08Y2A) may be able to meet the target HC and CO levels with the use of a pulse air system instead of a mechanical air pump if the 40 percent AQL were retained. The actual cost differential between these two systems is ($27-$4)=$23.9/ The 08Y2A family represents about 4 percent of all LDT sales so on a per vehicle basis the cost is about $0.92 per engine.

Most of the NOx reductions required by the more stringent AQL could be gained through changes in EGR or engine calibrations. However, the EPA technical staff expects that the required reductions can be gained through the use of the EEC systems thus eliminating the need for fuel consuming engine or EGR calibrations. The diesel light-duty truck family produced by GM will require the addition of EGR to meet the NOx targets. This EGR system would be the same as that used on the light-duty diesel passenger cars and cost between $8 and $15 per vehicle. The EPA technical staff will be conservative and use the higher cost or about $15 per engine. On a per LDT basis this is only $.60 per engine.11/

The difference between the 40 and 10 percent AQL HC emission targets is so small that it would probably not cause any substantial change in catalytic converter volume or loading. The difference in the CO target levels is relatively larger, and it might be argued that some of the catalyst volume or loading cost could be saved with the 40 percent AQL. The EPA technical staff believes that the manufacturers would probably use a slightly lighter catalyst loading and not expend much effort in catalyst size reduction. The EPA technical staff knows of no formula or rules of thumb which relate noble metal loading and emissions reductions explicitly. It seems reasonable that, at most, only 0.1 to 0.2 grams of noble metal could be saved in the catalyst. If one assumes that this metal is Platinum , the cost of 0.1 grams would be about $1.88. Thus lacking any other input this cost will be used for the gasoline-powered light-duty trucks.

Electronic engine controls will probably be necessary to aid in the reduction of cold start emissions. The EPA technical staff has no doubt that EEC will be used regardless of the AQL because there are so many benefits related to the use of EEC that the manufacturers would probably implement these controls for the marketing and fuel economy benefits alone. One other side benefit of EEC is to allow the manufacturers to optimize catalyst volume and loadings to achieve the greatest emission reductions at the lowest cost.

4. Recommendations

The final cost figures used to compute the economic impact of these regulations should be reevaluated based on the manufacturers' comments.

References

1/ This $5-$10 estimate was taken from the R&D costs for similar component shown in EPA report 460/3-78-002, Cost Estimations for Emission Control Related Components/Systems and Cost Methodology Description, Leroy H. Lindgren, Rath and Strong, Inc., March 1978.

2/ Based on data gathered from EPA's Certification Data.

3/ See Chapter VII of the Regulatory Analysis which supports this rulemaking.

4/ Regulatory Analysis, Light-Duty Diesel Particulate Regulations, OMSAPC, EPA, February 1980.

5/ EPA memo, Light-Duty Vehicle Certification Cost, Daniel Hardin to E.J. Brune, D.M. Kimball, and J.M. Marzen, March 1975.

6/ Based on CPI data received from the Bureau of Labor Statistic: 1976 - 4.8 percent, 1977 - 6.8 percent, 1978 - 9.0 percent, 1979 - 13.3 percent. Use of these percentages is very conservative.

7/ This catalyst is 52 cubic inches and is loaded with 1.2 g of Pt and Pd in an 11:1 ratio.

8/ Sames reference as footnote one. The values on page 301 were adjusted by an inflation rate of 26 percent over the three-year period, the overhead/profit rate used was 29 percent and costs were estimated at production volumes of 8 and 16 million. Thus, ECUs are estimated to cost between $34-$47 and sensors between $10 and $13 yielding a range of $44-$60 for the simple system planned.

9/ Same reference as footnote one.

10/ Based on Caterpillar Tractor Company's comment to the 1983 and Later Model Year Heavy-Duty Engine Gaseous Emission Regulations.

11/ Assumes this engine family, or one similar, comprises one-third of the light-duty diesel trucks sold, or 4 percent of all LDT sales.

12/ Cost Estimations for Emission Control Related Components/ Systems and Cost Methodology Description, Leroy H. Lindgren, Rath & Strong, Inc, March 1978.

13/ Abbreviations used in this analysis: PLS - pulse air injection; M - monolithic oxidation catalyst; P - pelleted oxidation catalyst.

G. Issue: Technological Feasibility

1. Summary of the Issue

EPA's proposed HC and CO standards represent a reduction of 90 percent in the emission levels of uncontrolled baseline light-duty trucks. This chapter explores whether these standards are technologically achievable within the context of revised certification and auditing requirements and existing NOx and particulate control requirements.

2. Summary of the Comments

Nearly all of the commenters agreed on the following point: The proposed HC and CO emission levels are achievable provided that the existing certification provisions and the current 40 percent SEA Acceptable Quality Level (AQL) are left unchanged. Most commenters argued, on the other hand, that in the presence of the new useful life provisions and an AQL of 10 percent, meeting the standards will be difficult or even impossible.

Several manufacturers provided estimates of how they expect the revised useful life and/or 10 percent AQL requirements to affect their ability to meet the standards. These estimates were presented in two different ways. The first approach was to "adjust" the standards upward to a level which allegedly takes the revised useful life and the 10 percent AQL into account. In the second approach, the anticipated design targets were shifted downward in such a way as to accommodate the new provisions. The following paragraphs present the industry estimates.

General Motors (GM), International (IHC), and Volkswagen (VW) all offered increased standards which incorporate the effects of the 10 percent AQL (IHC presented the numbers upon request by EPA, but opposes the 10 percent AQL and any such adjustment of the standard). The estimated levels follow:

	HC g/mi	CO g/mi
AMC	1.6	20.0
GM	1.4	20.0
IHC	1.1	17.1
VW	1.0	15.0
(Standards)	(0.8)	(10)

Toyota, GM, and IHC presented estimated design target levels which would result from a 10 percent AQL. (GM's targets need to be divided by the deterioration factors in order to be exactly comparable to the others.) Additionally, Toyota estimated the combined effect of a full-life useful life (they used 100,000 miles) along with a 10 percent AQL. In some cases, the targets corresponding to the current NOx standard (2.3 g/mile) are included. All of the estimates appear below:

		HC (g/mi)	CO (g/mi)	NOx (g/mi)
Toyota	(10% AQL, 50,000-mile U.L.)	.405	4.19	1.50
	(40% AQL, 50,000-mile U.L.)	.462	4.86	1.65
	(10% AQL, 100,000-mile U.L.)	.314	2.92	1.36
GM	(10% AQL, 50,000-mile U.L.)	.482/DF	5.50/DF	--
	(40% AQL, 50,000-mile U.L.)	.712/DF	8.84/DF	--
IHC	(40% AQL, 50,000-mile U.L.)	.53	7.69	--
	(40% AQL, 130,000-mile U.L.)	.34	5.49	--
	(10% AQL, 130,000-mile U.L.)	.26	3.2	--
AMC	(10% AQL, 50,000-(mile U.L.)	.021	2.5	0.9
	(40% AQL, 50,000-(mile U.L.)	0.42	5.0	1.8

Chrysler expected an 18.5 percent increase in the stringency of the standards to accompany a 10 percent AQL, although no quantitative support was provided. Similarly, AMC stated that the target emission levels under a 10 percent AQL constraint would approach those of 1983 light-duty vehicles, which, they add, is "clearly not the intent of Congress."

The interaction of the existing LDT NOx and particulate standards with the standards proposed in this rulemaking was the subject of comment, particularly from current and prospective diesel manufacturers. During the comment period for this proposed rule, a 0.2 g/mile particulate standard had been proposed for light-duty trucks in a separate rulemaking. Since then, a final standard of 0.26 g/mile has been promulgated. Thus, it was with respect to the lower, proposed standard that the comments were made. The current NOx standard is 2.3 g/mi.

AMC claimed that if a 10 percent AQL is instituted, the 2.3 g/mi NOx standard would probably need to be relaxed if they are to avoid a shift to three-way catalyst systems. With respect to diesel-powered light-duty trucks, Cummins stressed the interdependency between NOx and particulate control (e.g., increased EGR for NOx reduction can increase particulate emissions). And several manufacturers producing or considering producing light-duty diesel trucks expressed strong concern that the proposed particulate standard will be impossible to achieve with known technology.

Chrysler, GM, and AMC all claimed that a 0.2 g/mi particulate requirement would probably present an insurmountable obstacle.

Some of the commenters offered their assessment of what approach they would pursue in trying to meet the proposed standards. General Motors presented the most complete scenario. The following hardware changes and improvements are described as GM's "best effort," based on their California experience. (The proposed standards are equivalent, they say, to California's 1980 50,000-mile standards.)

GM expects to have to add air injection to their 5.0-, 5.7-, and 6.6-liter engines; the pulse-air system on the 4.1-liter engine will be replaced with an air pump. Regarding the catalyst, a heavier noble metal loading, special converter shell, and structural improvements will be required at a minimum for the sake of increased durability. Finally, GM anticipates that engine modifications to reduce oil consumption will be necessary. Three-way closed-loop systems are not being contemplated.

Chrysler, however, does expect that they would use three-way systems to achieve the design target emission levels. However, they state that in the absence of a full-life useful life they would use a small $22 in^3$ start catalyst with a $40 g/ft^3$ platinum loading in addition to their main catalyst. AMC as well suspects that three-way catalyst systems will be required for them to meet the current NOx standard if the proposed HC and CO standards plus a 10 percent AQL are implemented. Volkswagen also believes that a 10 percent AQL would require them to use three-way systems. In the presence of a 40 percent AQL, however, they would expect to use only an oxidation catalyst and EGR. VW would like to avoid the use of an air pump because intermittent NOx reduction, they say, can occur in a catalyst during portions of the driving cycle. If additional air injection is required to meet the HC and CO standards, this NOx reduction will be lost and the current NOx standard will be difficult to achieve.

IHC states that emission levels as low as their estimated design targets have been seen, but they doubt that they could consistently reach such levels in certification. This company claims their ability to comply with the regulations is dependent to a large degree on the performance of outside vendors, which supply much of IHC's hardware. By having to depend on other companies for technological improvements in their hardware and systems--and perhaps for some engines as well--IHC feels they have a reduced ability to define their technological feasibility.

3. <u>Analysis of the Comments</u>

The general approach of this section will be twofold. First, we will compare the 1980 California certification emission levels of current light-duty trucks with EPA estimated target levels. Our targets are based on those offered by the industry in conjunction with our own analysis. Second, we will investigate the achievability of these target levels by 1980 engine families and what control strategies we would expect to be necessary. By following this approach we will be able to treat the comments in a general way rather than engage in a comment-by-comment rebuttal.

The detailed EPA staff analysis which resulted in the projected emission target levels is presented in Chapter VII of the Regulatory Analysis document titled, "Cost Effectiveness." Industry data about emission variability were combined with anticipated deterioration factors to arrive at projected target levels which reflect full-life useful life requirements in the context of a 10 percent AQL. The reader is encouraged to consult this analysis, which in effect constitutes much of our response to the comments which concerned emission variability and effects of a full-life useful life and an AQL of 10 percent on low-mileage emission target levels.

a. Gasoline-Powered Light-Duty Trucks

Our analysis of current emission performance will center around engine families certified for California (or 50-state) sales. Since California's 1980 LDT emission standards are considerably tighter than the 1980 Federal standards and are in the same range as the 1983 standards proposed here,* one would expect that California-certified engines would offer some insight into the emission control strategies required to meet EPA's proposed standards.

There is one reason for caution when one makes comparisons to California vehicles. Manufacturers have warned that in complying with California standards they have seen a loss in the fuel economy of their vehicles. However, as we discuss in Issue L of this document, "Fuel Economy," the California control approaches amounted in most cases to "quick fix" modifications of Federal vehicles--modifications that have stressed easy compliance over fuel-economy considerations. Thus, from control technology standard standpoint, an analysis using 1980 California trucks is compromised by the fact that manufacturers will most likely begin to emphasize control systems which minimize fuel economy for future systems.

Despite this drawback we believe that a look at the California control systems and emission levels will be helpful. Emission rates for California vehicles indicate what is readily attainable using current catalyst systems. By placing side-by-side the California numbers and the anticipated Federal targets, we will be able to clarify at least generally where the feasibility problems lie and how compelling they seem to be.

* 1980 California LDT standards range from .41-.9 g/mi for HC, 9-17 g/mi for CO, and 1.0-2.3 g/mi for NOx, depending on vehicle weight and (for NOx) type of certification. Federal 1980 standards for LDTs are 1.7, 18, and 2.3 g/mi for HC, CO, and NOx.

The 4,000-mile emission levels for the 1980 LDT engine families that were certified either for California only or for all 50 states are presented in Table G-1. These values are "undeteriorated," that is, they have not been multiplied by deterioration factors, the process which would yield the certification emission levels. As they are, the numbers represent the actual low-mileage emission test results for the certification fleet (California plus 50-State).

But the question arises as to whether this sample, consisting solely of California engines, is representative of the entire LDT fleet. To a large degree it is representative, because only a few 1980 federal-only trucks have engines which were not sold in California trucks. These are not exceptional polluters, so conclusions about emissions feasibility drawn from the California data can be reasonably extrapolated to the LDT fleet as a whole.

The numbers which we will compare with those of Table G-1 are the staff's projected 1983 emission target levels, assuming that the proposed regulations are adopted:

HC: .49 g/mi
CO: 5.5 g/mi
NOx: 1.4 g/mi

It is worthwhile to stress again that these target levels (from Chapter VII of the Regulatory Analysis) are computed on the basis of actual LDT emission variability and under the assumptions of a full-life useful life and a 10 percent AQL.

As one studies the data of Table G-1, a demarcation quickly appears between the emission levels of the smaller, generally 4-cylinder imported vehicles and the levels of the domestic trucks. The foreign vehicles show considerably better emission performance; in fact, none of the 29 test vehicles exceeded the estimated HC target, only two exceeded the CO target and 5 met or exceeded the NOx target (just one of these actually exceeded it). Because the domestic and imported trucks demonstrate such marked differences in emission performance, we will treat them separately in our discussion. It seems reasonable to concentrate on the American manufacturers as presenting the most difficult feasiblity problems.

It is clear from Table G-1 that GM, Chrysler, IHC, AMC, and Ford will have to do development work above and beyond what was necessary for 1980 California certification in order to reach EPA's estimated targets. Effort will need to be focused primarily on improvements in CO and NOx. Hydrocarbon control is much less of a problem, and control of CO will generally improve HC simultaneously. Nine of the 44 domestic test vehicles (20 percent) are above the HC target, but only 3 exceed the target by more than 0.1 g/mi.

Carbon monoxide levels as recorded in Table G-1 are higher than the targets in 19 American test vehicles, and most of those

Table G-1

1980 California Certification Results

Manufacturer	Engine Family (Displacement, CID)	4K-Mile Emissions (g/mi) HC	CO	NOx
AMC	HT-3V1	.38	2.9	0.92
	(304)	.28	2.8	1.5
	NT-3A1	.59	9.9	2.0
	(360)	.57	9.1	1.8
	CT-4W1	.43	7.3	1.0
	(258)	.40	4.4	1.4
		.28	3.8	1.5
	BT-6C1	.18	2.5	1.3
	(151)	.18	1.9	1.2
Chrysler	OTA-225-1-BXP	.30	3.7	1.7
	(225)	.45	5.2	1.4
		.22	1.8	1.3
	OTA-318/360-4BCP	.22	7.0	1.2
	(318/360)	.44	8.3	1.4
		.33	5.6	1.8
	OTA-318/360-4BFP	.40	7.0	1.9
	(318/360)	.37	8.8	1.7
		.27	5.8	1.7
Ford	4.9 NA 1/	.49	4.2	1.6
	(300)	.44	5.2	1.3
	4.9 ND	.23	2.1	1.9
	(300)	.17	5.7	1.7
		.24	6.2	1.6
	5.0 NB	.36	2.4	1.5
	(302)	.41	2.3	1.5 1/
		.59	4.8	1.6 1/
		.42	4.2	1.4
		.70	9.5	1.5
		.40	6.7	1.1
	5.0 NG	.31	1.6	1.4
	(302)	.35	2.1	1.4
		.35	2.0	1.4

Table G-1 (Cont'd)

1980 California Certification Results

Manufacturer	Engine Family (Displacement, CID)	4K-Mile Emissions (g/mi) HC	CO	NOx
	5.8M/6.6NA	.39	2.8	1.9 1/
	(351/400)	.56	6.1	1.5 1/
		.20	2.4	1.3
		.34	4.5	2.0 1/
	5.8 WNG	.33	13.8	.98
	(351)	.39	9.2	1.5
GM	08F2A (250)	.43	8.7	1.4
	08K4AA	.30	7.3	1.0
	(350)	.41	5.2	1.5
IHC	V-304 (304)	.64	5.0	1.3
	V-345 (345)	.77	6.7	2.0
	4-196 (196)	.55	8.9	1.7
Isuzu	A1TC	.26	4.7	1.3 1/
	(111)	.23	2.0	1.0
		.23	2.7	1.3
		.23	2.7	1.3 1/
		.22	4.3	.98
Nissan	TL20C	.26	3.0	1.0
	(119)	.24	2.2	1.0
		.18	2.6	1.1
		.14	2.6	1.4
Mitsubishi	GT5-C	.26	3.8	1.2
	(121.8)	.19	2.5	1.1
		.26	3.5	1.1
		.20	3.2	1.2
Toyo Kogyo	OMAT (120)	.24	2.4	1.1

Table G-1 (Cont'd)

1980 California Certification Results

Manufacturer	Engine Family (Displacement, CID)	4K-Mile Emissions (g/mi) HC	CO	NOx
	OWBT	.24	2.5	1.2
	(140)	.23	2.6	1.2
		.25	2.8	1.1 1/
Toyota	2F(C)	.18	3.3	1.2
	(257)	.20	3.0	1.5
	20R(TC)	.15	1.9	1.4
	(133.6)	.12	2.3	.90
		.20	2.2	1.0
		.16	1.9	1.1
		.16	4.9	1.2 1/
VW	37PC	.16	2.0	1.4
	(97)			
	37PF	.16	2.0	1.4
	(97)			
	11	.19	3.8	.70
		.28	7.6	1.1
	12	.28	7.6	1.1

1/ 50-state certification.

miss the target significantly (their average emission level is some 40 percent over the target). The 19 vehicles represent eleven engine families.

Completing the picture of current emission control performance, we find that NOx seems to present the most difficult obstacle to compliance with the proposed regulations. Fully 32 of the 44 American vehicles in Table G-1, representing all but two California and 50-state engine families, meet or exceed the NOx target (24 vehicles actually exceed it). The average emission level is 12 percent above the target; 5 vehicles are 29 percent or more above.

It is plain that the level of effort which the American manufacturers applied to meeting the 1980 California standards will not be sufficient to comply with these 1983 regulations. We cannot agree, however, with the comments which argue that the task EPA places before the manufacturers with this rulemaking will only be accomplished with new technology, high cost, and major compromises in fuel economy, if it can be accomplished at all. On the contrary, we find abundant reason to believe that--even in the context of a full-life useful life and a 10 percent AQL--the proposed standards are achievable by all LDT manufacturers, for the most part with current control systems. The next paragraphs support this conclusion.

In order to reduce the HC and CO emissions of their federal vehicles to California levels the manufacturers have for the most part relied on improved catalyst efficiency and/or additional auxiliary air injection. Some have also introduced small "start" catalysts or calibration changes to improve cold-start emission performance. The cold start controls present special problems which we will cover shortly. In general, though, we believe that manufacturers will again pursue, to a large extent, catalyst improvements and increased air for their 1983 trucks, just as they did for California trucks in 1980. Light-duty truck catalysts are an especially fertile area for emission improvements, as the next paragraphs demonstrate.

Increasing the internal volume and/or the noble metal loading of catalysts can serve two crucial functions. The first of these is the improvement of catalyst efficiency, as defined as the percent reduction in mass exhaust emissions available through use of the catalyst. Increased catalyst volume implies that a greater surface area of substrate material is exposed to the exhaust flow, improving the opportunities for pollutant molecules to react. Independent of but related to converter sizing is the quantity of noble metals which are applied to the substrate surface. An atom or a group of atoms forms an active catalyst site, and the amount of reaction that can take place is dependent on the number of these sites that are exposed to the exhaust flow. Although there is obviously a limit, a general rule is that the greater the catalyst loading, the greater can be the HC and CO emission reductions.

In addition to improving the conversion efficiency, increased converter volume and noble metal loading make the catalyst and its operation more durable. This is an obvious advantage in light of the proposed extension of light-duty truck useful life. The durability of the converter structure--i.e., the physical integrity of the substrate--is improved because the greater mass and volume make it less likely that critical temperatures will ever be reached (1700°F for gamma alumina substrates). The progressive loss of surface area associated with occasional high-temperature excursions, and hence the loss of active sites and efficiency, is thus minimized. An additional advantage is gained by increased noble metal loading in that more active sites are initially available. Thus, even if a number of sites are rendered inactive through the life of the vehicle by lead or phosphorous poisoning, loss of substrate surface area, or agglomeration (catalyst atoms migrating toward each other, effectively reducing the number of sites), a significant number will remain available. In these ways converter sizing and loading can act to extend the functional lifetime of the catalyst. While both of these approaches are clearly available to the manufacturers, we expect increased loading to be the prevalent choice since manufacturers will probably wish to limit the number of catalyst canister sizes that they make.

Putting aside for the moment the improvements in catalyst durability, we believe that the additional HC and CO control available through more heavily loaded (or larger) catalysts will easily be sufficient to meet the proposed HC and CO standards. As is often the case, EPA is not able to quantitatively support this statement because actual data from LDT's equipped with prototype 1983 catalysts are obviously not yet available. However, one finds that current catalysts--even on California trucks--are for the most part much more lightly loaded than what we would expect to be required to comply with these regulations. Economic pressures have clearly encouraged the use of the least expensive systems necessary to meet the California standards. Coupling this observation with the Agency's accumulated knowledge of catalyst technology, we conclude that a considerable margin for improvement in catalyst efficiency exists in most cases.

In some instances, such catalyst improvements will require additional air injection. Most current families of light-duty trucks are equipped with air pumps, which add air to the exhaust stream in order to assure the presence of sufficient oxygen to maximize oxidation in the catalyst. A few truck families use a modulated "pulse-air" system, and a few more have no auxiliary air. We expect that most trucks will have to incorporate additional air injection in order to make full use of the improved catalysts, particularly American-made vehicles with larger engines; if there is presently none, an air pump may need to be added. The implications which increased use of air injection hold for LDT fuel economy are addressed under Issue L, "Fuel Economy."

GM will perhaps be most affected by a need for additional air injection. We agree that their 4.1-liter engines, which currently use the "pulse-air" system, will need air pumps. While a large-selling 50-state family using a 5.7-liter engine (08K4AA) already uses air injection in California applications, GM is probably correct in predicting that auxiliary air will be necessary for the remainder of the 5.7L engines as well as for the 5.0L engine family.

While we have been able to project that catalyst improvements and increased air injection can themselves bring many current trucks into compliance with the 1983 HC and CO requirements, the actual picture will be somewhat different. This is because we are anticipating a major shift by 1983 to the use of electronic engine controls (EECs) as a part of LDT emission control packages. The introduction of EECs, already popular in passenger cars, should occur at least partially as a result of inherent conflicts between cold-start emission control and fuel economy. Both conventional ways of reducing HC and CO prior to catalyst light-off suffer from drawbacks. Small, rapid light-off catalysts are subject to quick deterioration due to their proximity to the engine. The alternative approach, adjusting the timing to speed up the heating of the catalyst, causes a fuel economy penalty all during the vehicle's operation (these calibration changes are the cause of much of the loss in fuel economy experienced in the 1980 California fleet compared to the Federal fleet). EECs offer a way of varying the timing, returning the engine to a more fuel-efficient calibration after the catalyst begins to work. Thus, while working to reduce th heavily-weighted cold-start portion of a vehicle's emissions, EECs can simultaneously avoid a loss in fuel economy (Issue L, "Fuel Economy" explores this issue further).

Although meeting the existing NOx standard of 2.3 g/mi will become more difficult with the implementation of the proposed rule, compliance is within the reach of all domestic (and foreign) manufacturers using current technology NOx control. That current technology is exhaust gas recirculation (EGR), a system found today on nearly all light-duty trucks. An increased flow of recycled gas will probably be required for most U.S.-made trucks, though this increase should not go far beyond what has been required for California compliance. Table G-1 demonstrates that while California systems often fall short of the EPA target, few of the levels are grossly above that target. Our conclusion is that minor increases in EGR rates or none at all will be sufficient for most engine families to remain within the existing 2.3 g/mi standard. A small number of engine families, concentrated primarily in the larger CID range, may require a significant amount of EGR. This expectation is tempered by the fact that a shift away from the heavier engines will probably occur in the next few years, a topic that is taken up in detail in Chapter V of the Regulatory Analysis. As a final note, EGR has negative implications for fuel economy, but modulation with an EEC helps to minimize this. We address this issue in section L of this document, "Fuel Economy" and conclude that on a fleet-wide basis, the net fuel economy loss due to NOx control will be minimal.

Manufacturers may opt in some of these latter cases to apply three-way catalyst/feedback carburetor technology, but this should be a rare occurence; we doubt strongly that these regulations will require a move to three-way technology for any manufacturer. This doubt is based on two facts. First, NOx control efforts on California trucks have been aimed at meeting relatively high standards (in most cases, 2.0 or 2.3 g/mi, depending on whether deterioration is calculated on the basis of 50,000 or 100,000 miles). This makes it unlikely that many of these engines have reached the limits of NOx reduction through EGR. Second, it is generally in the small number of engine families which exceed 340 CID in size that the more difficult NOx problems seem to be concentrated. Again we point to the anticipated downward shift in engine size, which will act to reduce the number of engine families with higher NOx emissions. Our conclusion is that the degree of NOx control necessary to meet these regulations, barring possible exceptional cases, is available to all manufacturers through increased EGR.

We have primarily directed the foregoing discussions of HC, CO, and NOx feasibility at American-manufactured engines. The basic strategies for meeting the proposed standards, i.e., catalyst improvements, more air injection, additional EGR, and EECs, apply as well to the manufacturers of imported LDTs. However, the already lower emissions of the imports demonstrate that the necessary degree of improvement in the existing control systems is small; in many instances no improvement over California technology appears to be necessary at all to achieve EPA's estimated targets. Slight improvements in catalyst conversion efficiency (as discussed earlier) may be desired for lower CO for some families, but this approach is probably not necessary. Thus, the need for air injection (or additional air injection) will not be widespread. (This would mean that VW will probably not have to sacrifice the NOx control they get in the absence of an air pump). Regarding NOx, again very little is required, but a slight increase in EGR above that seen in California certification may be necessary in some cases. In any event, compliance with the regulations by all of the foreign manufacturers seems assured with California-type control systems, perhaps upgraded with electronic controls.

There was a great deal of comment that indicated that the effect of a 10 percent AQL and a full-life useful life would be greater than what we have concluded in this analysis. As a check on the reasonableness of our feasibility analysis, we have performed a separate analysis which uses actual 1980 California LDT production audit data. (This work has been placed in the public docket and is titled "Analysis of California 2% Audit Data.") We have applied the estimated full-life deterioration factors* to the audit emission data and calculated the rate at which these vehicles fail to meet the proposed Federal standards. The analysis used emission data from 7 tests on IH vehicles, 81 on Chryslers, and 262 on Fords, and 263 on GMs, totaling 613 tests. The re-

* 1.4 for HC, 1.3 for CO, and 1.04 for NOx.

sulting failure of the proposed standards occurred at a rate of 5.4 percent for HC, 7.8 percent for CO, and 8.8 percent for NOx. Further, if one exceptionally failure-prone Ford engine family is removed from the calculations, the failure rates drop to 5.0, 7.1, and 4.4 percent for HC, CO, and NOx. We can conclude that with absolutely no effort toward meeting the proposed regulations, a significant number of American made California LDTs already do and they would quite easily pass a 10 percent AQL audit. It would seem that our original analysis based on the target levels results in a conservative view of LDT feasibility. This look at actual production performance is strongly supportive of our conclusions that compliance with these regulations is achievable.

A final issue relating to feasibility deserves discussion. While we factored into our analysis the effects of a full-life useful life from the standpoint of initial zero-mile emission requirements, we have not yet discussed the feasibility of designing emission control systems which actually function for the 120,000-odd-mile lifetime of an LDT. Since durability is not a major problem for air pumps and EGR systems, the discussion should focus on the longevity of catalysts in LDT applications.

In developing a separate argument, AMC presented data for 4 catalyst-equipped light-duty vehicles. The data consist of periodic emission results extending out to 100,000 miles. (The data has been plotted in Figures G-1 through G-4). While the data points are somewhat scattered, there is in three vehicles a clear pattern of linear deterioration of HC, CO, and NOx emission deterioration (or improvement in the case of NOx). This is what we would expect to occur in a normally functioning catalyst; i.e., a gradual loss of efficiency with no evidence of severe damage. (One vehicle seems to have suffered engine problems late in its life -- HC and CO emissions skyrocketed yet NOx went down.) On those three vehicles, the catalyst was still functioning well--that is, there had been no abrupt failure--even after 100,000 miles of use. It is even more telling that these long catalyst lives are seen on 1975-76 vehicles equipped with early technology automotive catalyst systems.

Further evidence of catalyst durability comes from a recent EPA program in which 8 catalyst-equipped cars with an average accumulated mileage of 104,480 miles were emission tested (as reported in "Evaluation of Restorative Maintenance and Catalyst Replacement on Exhaust Emissions from Eight Very High Mileage Passenger Cars in St. Louis," available from the public docket associated with this rulemaking). The vehicles were tested in 5 configurations: in an as-received condition, after correction of maladjustments, after complete tune-up, with the catalyst removed, and with a new catalyst. An upward jump in HC and CO emissions when the catalysts were removed demonstrates that the catalysts were clearly still functioning even at these high mileages. Further, after maladjustments and disablements were corrected and a tune-up performed, half of the vehicles were able to meet the

FIGURE G-1

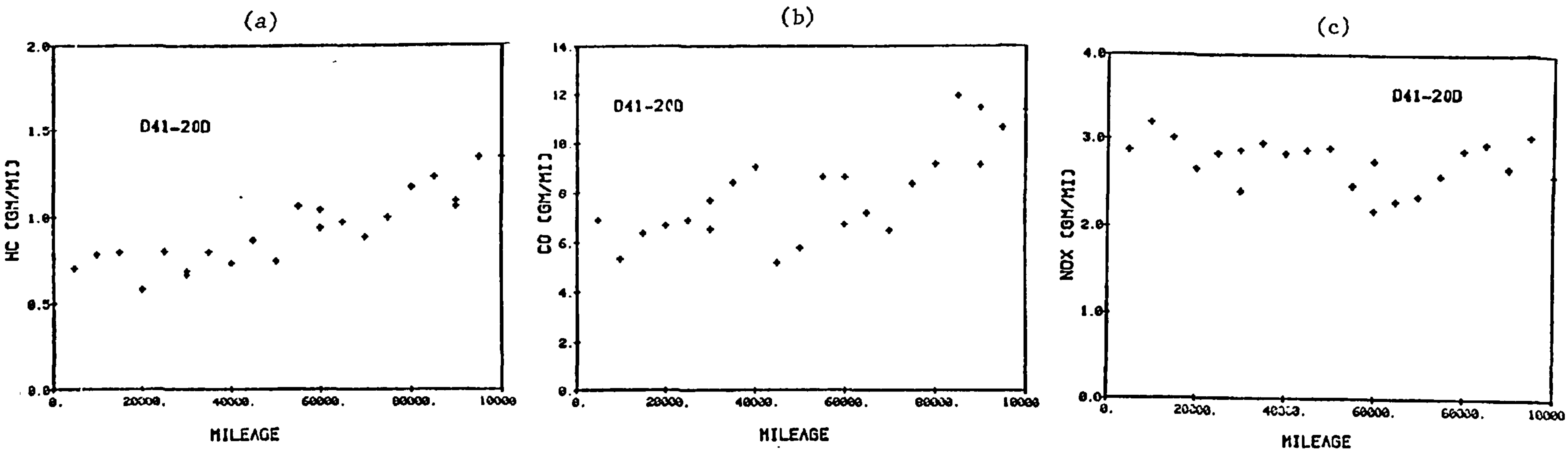


FIGURE G-2

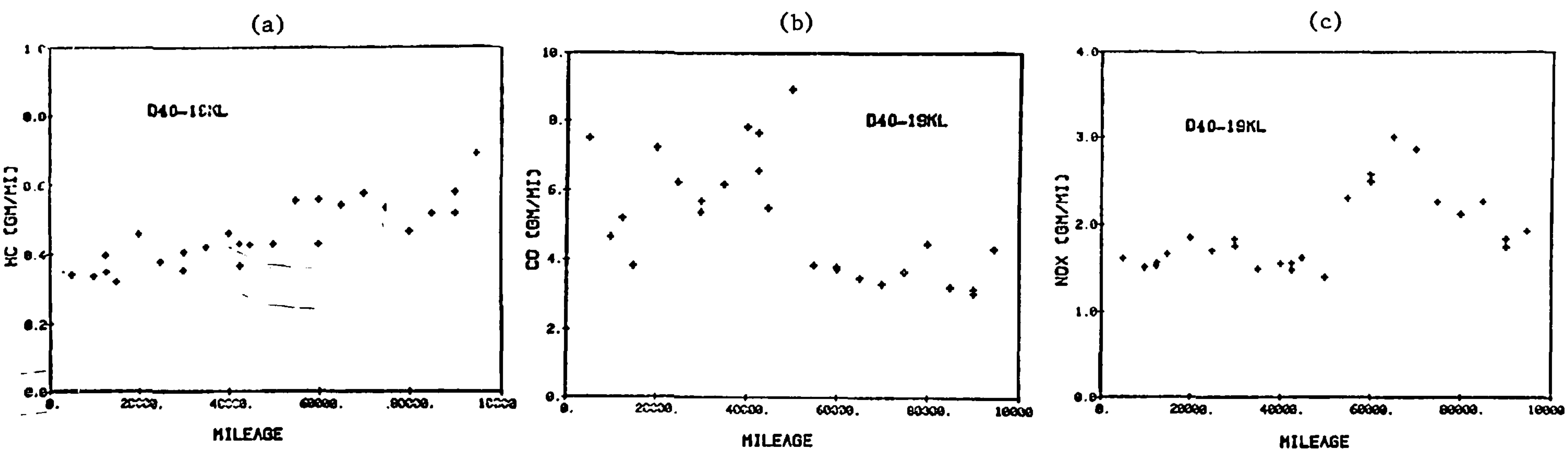


FIGURE G-3

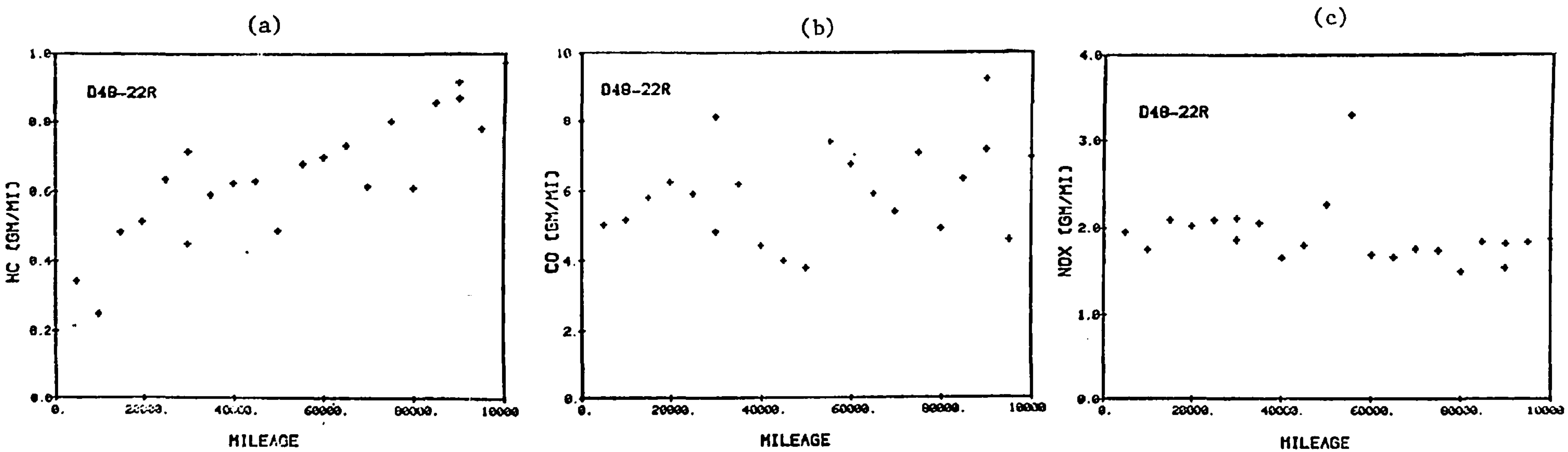
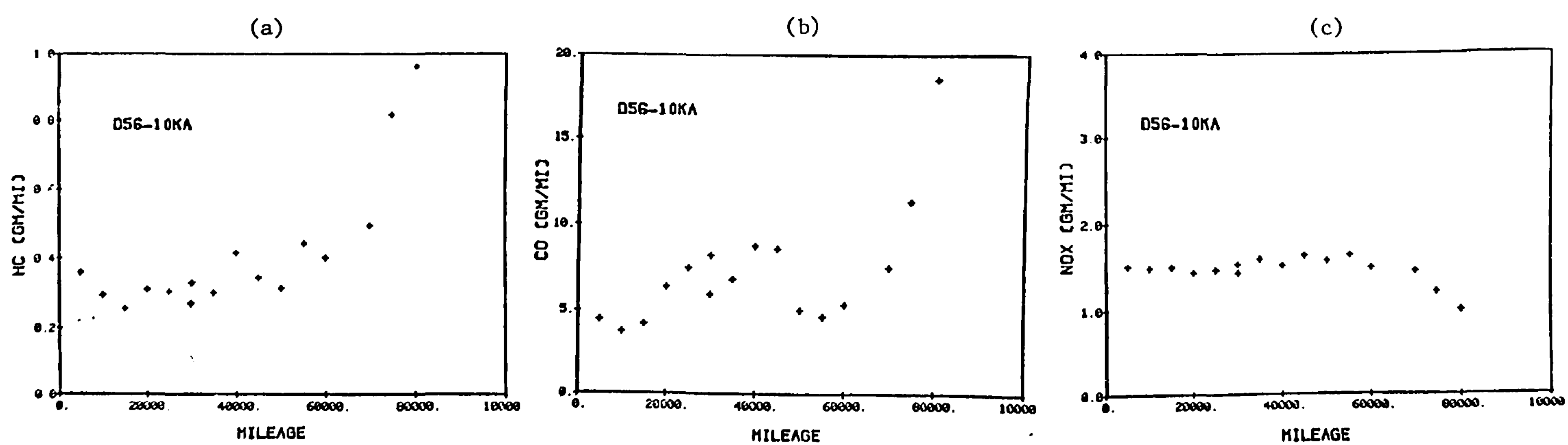


FIGURE G-4



federal emission standards with their original catalyst -- roughly the fraction that would be expected to have met the standards as they came off the production line under the production practices existing at the time (designing for the average vehicle to meet the standard).

Thus, evidence clearly exists that passenger car catalysts, while designed to operate only 50,000 miles, commonly last twice that long. The light-duty truck catalysts that we expect to be used to comply with these regulations will be, as discussed earlier, inherently more durable due to sizing and loading improvements. It is a reasonable conclusion, then, that long-lived catalyst technology will be available for 1983 light-duty trucks.

b. Diesel-Powered Light-Duty Trucks

The issue of feasibility is very different for diesels. They generally show low HC and CO emissions; but because of the higher combustion temperatures (as compared to gasoline engines) NOx values tend to be higher. In addition, one must be concerned with particulate emissions, standards for which have recently been published (Particulate Regulation for Diesel-Fueled Light-Duty Vehicles and Light-Duty Trucks, 45 FR 14496, March 5, 1980).

As a basis for comparison, we will use the same estimated low-mileage targets that we used for gasoline LDT's. This is because emission variability and deterioration information is very sparse for diesel LDTs. Since the HC and CO deterioration factors will on the average be smaller for diesels, the gasoline truck targets will be conservative and will provide an additional "margin of safety" in the following feasibility analysis. NOx deterioration, on the other hand, may be more rapid in diesels, and it might appear that the diesel NOx target should be lower to compensate for this. But the 1.4 target is already a conservative estimate because of the very high NOx variability that was used. We feel justified in using the gasoline target for diesels as well. For convenience we repeat the targets (g/mi): HC - 0.49, CO - 5.5, NOx - 1.4.

We have collected the 1980 certification data for light-duty diesel trucks and for GM's diesel-equipped Oldsmobile passenger car in Table G-2. The passenger car is included since it uses an upgraded version of the same basic engine that the GM trucks do and was tested at relatively high inertia weights (4,000, 4,500, and 4,750 lbs). Its emission performance should reasonably represent that of a LDT equipped with that engine configuration.

Carbon monoxide values are all well below the target. HC falls below the HC target in all but one case. The exception, the GM diesel truck, uses an engine configuration different than that used in the Oldsmobile,* probably the 1979 configuration. The

* GM used different injectors and introduced EGR on the Oldsmobile.

Table G-2

1980 Light-Duty Diesel Certification Emission Data
(Undeteriorated Gaseous Emissions, g/mile)

Manufacturer	Engine Family (Displacement, CID)	4K-Mile Emission (g/mi) HC	CO	NOx
GM LDT	09J9Z (350)	0.84	2.0	2.0
		0.61	1.9	2.0
		0.82	2.0	1.9
GM LDV (Oldsmobile)	03J9ZG (350)	0.28	1.2	1.8
		0.30	1.1	1.6
		0.34	1.1	1.4
		0.17	1.2	1.7
IHC LDT	SD-33T (198)	0.45	2.2	1.6
		0.39	1.6	1.4
VW LDT	DP (90)	0.32	0.90	1.1

passenger car has had to meet a tight 0.41 g/mi standard in 1980 for the first time, and its performance clearly indicates that the truck's HC could greatly be reduced by using the new engine configuration. It appears, then, that there is nothing inherent in current diesel LDT engines that will prevent their meeting EPA's HC and CO targets.

With respect to NOx on the other hand, additional development work will be required of the manufacturers in some cases in order to achieve the estimated 1.4 g/mi target. This does not seem to be a large problem. One finds in Table G-2 that, if we exclude the GM truck, all current certification vehicles lie in the 1.2-1.8 range (in fact, the VW engine falls well below the targets on all three pollutants). We again make an exception for the GM LDT, assuming that the cleaner Oldsmobile LDV engine will be used in the truck applications. Focusing, then, on the IH truck and the Oldsmobile, an increased rate of EGR should provide the degree of NOx control necessary for the vehicles to reach the vicinity of 1.4 g/mi. This is a reasonable conclusion on the basis of EPA's observation of diesel passenger cars, which indicates relatively low rates of EGR are currently used and hence, a range of control remains available to manufacturers.

The final item pertaining to diesel light-duty trucks is the question of particulates. The adoption of full-life useful life and a 10 percent AQL affects the difficulty of meeting particulate standards as well as HC, CO, and NOx. However, the staff finds that this increased difficulty is overcome by the relatively less stringent NOx standard applicable to light-duty trucks in comparison to light-duty vehicles.

The particulate standard of 0.6 g/mile which will be applicable for 1983 and 1984 was derived so as to be achievable in the context of a 1.0 to 1.5 g/mi light-duty vehicle NOx standard (the actual amount depending on the outcome of NOx waiver requests). By comparison, the light-duty truck requirement of 2.3 g/mile is quite generous. Where EGR is being used to control NOx, there is a direct relationship between NOx and particulates such that as NOx goes up, particulates go down. The following analysis shows that the less stringent 2.3 g/mi NOx standard allows sufficient flexibility to meet the 0.6 g/mi particulate standard for light-duty trucks at a 10 percent AQL and full-life useful life.

The Regulatory Analysis for the light-duty diesel particulate regulations included some data which had been supplied by General Motors in their May 1979 application for waiver from the 1981-1984 NOx emission standards for light-duty diesel engines.1/ This data illustrates the relationship between changing particulate and NOx emissions for 3 GM test vehicles, all in the 4,500 lb. inertia weight class. This data will be used to characterize the relative amount of particulate/NOx tradeoff which could occur, all other things being the same.

In analyzing the feasibility of meeting the 0.6 g/mi particulate standard, the staff found that GM would have the most difficulty with the standard.2/ Therefore, although the amount of tradeoff may vary between manufacturers, we believe that if the available flexibility is sufficient for GM it will also be sufficient for other manufacturers.

The tradeoff flexibilities in going from a NOx level of 2.3 g/mi (the light-duty truck standard) to 1.5 g/mi (the maximum light-duty vehicle standard) amounts to 36 percent for car "A," 54 percent for car "B," and 52 percent for car "C." That is, all other things being equal, going from 2.3 g/mile NOx to 1.5 g/mile NOx causes the particulate emissions of these three engines to increase by the given percentages. Since, for the case at hand, all other things are not equal, some or all of this available "cushion" will get used up. Our desire is to determine if indeed this available "cushion" is sufficient for light-duty trucks to meet the same standard as light-duty vehicles.

There are three areas where "cushion" is needed. First is the increase in emissions associated with increased road load horsepower and inertia weight of light-duty trucks. The staff analysis for the light-duty particulate package concluded that these increases amount to approximately 20 percent.3/ Second, a "cushion" to cover the added full life useful life requirements is needed. Using a maximum deterioration rate of 1.1 for 50,000 miles4/, this adds another 10 percent (to go from 50,000 miles to 100,000 miles). Lastly is the amount of "cushion" needed to go from a 40 percent AQL to a 10 percent AQL. This can be estimated using the methodology of Chapter VII of our Regulatory Analysis for this rulemaking, once an estimate of production variability is known. The staff analysis for the light-duty particulate package determined that particulate variability should be quite low.5/ Using the relatively low variability characteristic of hydrocarbons as an estimate, the data in Chapter VII of the regulatory analysis indicates an 8 percent "cushion" associated with changing the AQL. The total "cushion" needed is then 20 + 10 + 8 = 38 percent.

The required "cushion" compares very favorably to that available from the three test vehicles. Two of those vehicles (cars "B" and "C") exceed this requirement by a wide margin. The third, car "A", also has an adequate "cushion." In calculating the 36 percent available, no allowance was made for the fact that the actual NOx levels would be somewhat below, rather than at the standard. It is in the nature of the NOx/particulate relationship that at smaller NOx levels, the amount of tradeoff increases. Also, from the point of view of the needed amount of 'cushion', the 38 percent is an estimate of what should be the maximum need. For example, the 20 percent change associated with inertia and and road load differences between light-duty vehicles and light-duty trucks was a conservative estimate from data showing an average change of 16-18 percent. Therefore, the staff concludes that the feasibility analysis associated with the light-duty particulate regulations remains valid, even in the context of a 10 percent AQL and a full life useful life.

In 1985, we expect that new NOx control requirements will become effective for LDT's and heavy-duty engines. Although it is not necessary to discuss the effect of such a standard on LDT diesels (that is a topic for the NOx rulemaking itself), it is germane to look at how the current 2.3 g/mi NOx standard will affect light-duty diesel trucks if it is retained after 1985. Again, the light-duty diesel particulate final rulemaking considered NOx in the establishing of the second-stage (1985) particulate standards, 0.20 g/mi for LDVs and 0.26 g/mi for LDTs. The 30 percent higher standard for trucks is the result of an analysis which assumed that a stricter NOx standard* would indeed be implemented in 1985, removing the "safety margin" which the trucks would have previously enjoyed (as per the preceding paragraphs). The adjustment in the particulate standard was made to address just such a situation. In the absence of a 1985 NOx reduction, there should remain something of the 1983-84 margin. Thus, for the post-1985 time frame, we see no inconsistency between a 2.3 g/mi NOx standard and a 0.26 g/mi particulate standard.

c. General Responses

IHC made a comment which relates to feasibility yet is not technical in nature--that vendor dependency constrains their ability to change technology. We recognize the special problems associated with relying on outside suppliers. However, in this particular case, we do not agree that the resulting problems need be severe. For example, the required technological improvements are relatively minor and should not in themselves cause undue delays in vendor deliveries. Also, since this is an industry-wide action, the vendors, too, should be well aware of the changes at a very early stage.

A general overview of the comments and our response in the area of feasibility reveals significant disagreement between EPA and the commenters regarding the effect that a 10 percent AQL will have on emission targets. No commenter performed an analysis approaching EPA's in thoroughness. We are confident that our conclusions are based on sounder grounds than those of the commenters. For example, AMC was noted earlier as claiming that the target emission levels under a 10 percent AQL would approach those of light-duty vehicles. However, this position was based on nothing more than an "assumption" that the 10 percent AQL would lead to target levels that were one-half of those for the current

* They assumed that an LDT NOx standard comparable in stringency to the 1.0 g/mi LDV standard (1.0 g/mi presumes no further NOx waivers beyond 1985) would be enacted. This is a "worst case" scenario, since the 1985 NOx standard is not likely to be so stringent.

40 percent AQL. Our analysis shows that this is not true. The HC and CO targets for a 10 percent AQL are 92 percent and 86 percent of those for a 40 percent AQL, respectively. Targets used by individual manufacturers may vary somewhat from those we have estimated, but not by the amount claimed by AMC.

It should also be recognized that the delaying of in-use durability requirements has removed one of the complicating factors and has thus improved the situation of the manufacturers.

4. Recommendation

The staff concludes that no technological barriers exist to prevent compliance with these regulations by all light-duty truck manufacturers. We recommend that the proposed standards be retained.

References

1/ Regulatory Analysis of the Light-Duty Diesel Particulate Regulations for 1982 and Later Model Year Light-Duty Diesel Vehicles. Figure IV-1.

2/ Ibid, pg. 42.

3/ Ibid, pg. 57.

4/ Ibid, pg. 36.

5/ Ibid, pg. 34.

H. Issue: Selective Enforcement Auditing

In the July 12, 1979 NPRM, EPA proposed to revise the current Selective Enforcement Auditing (SEA) program for light-duty trucks (LDTs). The proposed SEA replaces the 40 percent Acceptable Quality Level (AQL) currently in effect with a 10 percent AQL and substitutes a sequential sampling plan for the batch sampling plan that is presently in Subpart G. There were also several other proposed changes to the current LDT SEA program.

The major portion of the LDT manufacturers' comments on the proposed LDT SEA concerned the 10 percent AQL; therefore, a large part of this summary and analysis is dedicated to that issue. Comments on other aspects of the SEA proposal are addressed following the discussion of the 10 percent AQL.

Acceptable Quality Level

1. Summary of the Issue

In brief, this issue can be stated as follows: What Acceptable Quality Level (AQL) should be promulgated in the final rule? The AQL represents the percentage of light-duty trucks (LDT) within a given population which will be allowed to exceed the emission requirements. The Clean Air Act does not specify the precise AQL to be applied to an assembly-line testing program like SEA.

A 10 percent AQL reflects EPA's view that the statute requires every vehicle to be warranted to meet the emission standards while allowing a 10 percent failure rate to account for measurement error and inevitable quality aberrations.

EPA promulgated an initial 40 percent AQL for its current SEA program because at the time the SEA regulation went into effect (1976), the industry was building vehicles and trucks to meet previously established standards on the average. A 40 percent AQL assures that, for a vehicle population assumed to have a skewed-normal distribution, vehicles within this population will comply with standards on the average. In order to have brought the light-duty engine families into compliance with a 10 percent AQL, manufacturers at that time would have had to add additional emission control equipment to retain their certificates of conformity. EPA's intent in promulgating an initial 40 percent AQL for its current SEA program was to provide light-duty vehicle and truck manufacturers the time and flexibility to bring all their motor vehicles into conformance with the standards on a reasonable schedule. This schedule is to parallel efforts to improve fuel economy.

In the LDT Notice of Proposed Rulemaking (NPRM), the Agency proposed a 10 percent AQL as part of the total compliance strategy outlined in the proposal. EPA indicated that the 10 percent AQL could be met with costs not unreasonably burdensome to the manufacturers. Comments on cost associated with meeting a 10 percent AQL were requested in the proposal.

2. Summary of the Comments

All the manufacturers and organizations that responded to the NPRM opposed the implementation of a 10 percent AQL for SEA. Most of the comments concerned the legal, technological and economic reasons why a 10 percent AQL should not be promulgated. Very little data were provided relating to the actual technological and economic considerations associated with meeting a 10 percent AQL.

All commenters made one or more of the following major points: the 10 percent AQL is inconsistent with the intent of Congress and the Clean Air Act; the 10 percent AQL would have the effect of lowering the standards to a point where the emission reductions are greater than the reduction mandated by Congress; the 10 percent AQL is inconsistent with the 40 percent AQL used in the light-duty vehicle (LDV) Selective Enforcement Auditing program; and the 10 percent AQL is not feasible due to testing and production variability. In addition, commenters gave various other reasons why a 10 percent AQL should not be put into effect: it is inconsistent with certification requirements which imply "averaging"; it will cause penalties in fuel economy; the air quality benefit of a 10 percent AQL has not been calculated; and no cost estimates have been made concerning the increased costs, in the areas of production testing, emissions hardware, and fuel consumption, involved with implementing a 10 percent AQL.

Most manufacturers stated that due to the above reasons the AQL should be revised to 40 percent in the final rule. Some gave examples of a 40 percent AQL sampling plan that EPA could adopt for the final rule.

a. Light-Duty Truck Manufacturers

General Motors (GM)

GM stated that it is opposed to a 10 percent AQL sampling plan for SEA. GM believes that Congress intended, in the 1977 Clean Air Act Amendments, that production vehicles meet the emission standards on the average.

In its SEA discussion, GM directed most of its arguments towards supporting the concept of averaging for production line testing. These arguments included statutory language; the Draft Regulatory Analysis discussion which GM claims to be based on averaging; ambient air quality considerations; various past Congressional Committee reports and statements of EPA Administrators; consistency with certification requirements; and the analysis of the baseline testing program.

GM also stated the emission design targets necessitated by the 10 percent AQL would be below those justified in the environmental and economic impact analysis. GM provided an analysis based on its 1979 production varability. GM estimated the design targets as .482/DF g/mile for HC and 5.50/DF g/mile for CO. GM also submitted an alternative sampling plan which determines compliance based on the mean emissions of a population. GM advocates the use of this sampling plan because it incorporates the averaging concept which GM believes is consistent with the intent of Congress.

Ford Motor Company (Ford)

Ford stated that it opposed a 10 percent AQL sampling plan for SEA. Ford believes that, as a matter of law and good engineering practice, a 10 percent AQL is inappropriate for production-line auditing.

Ford argued that it is not technically feasible to meet a 10 percent AQL and an averaging concept is necessary for production line testing. Ford submitted an analysis of the design target as a function of the ratio of the standard deviation to the Low Mileage Target. The Low Mileage Target equals the emission standard divided by the deterioration factor. On the basis of this analysis, Ford claims that it would not be technologically feasible for it to comply with the 10 percent AQL.

Ford also stated that the 10 percent AQL is inconsistent with the certification process and the intent of Congress. Ford developed an AQL sampling plan similar to the one proposed by EPA. Ford's plan incorporated a 40 percent AQL. It suggested that this plan be adopted in the final rule because a 40 percent AQL is consistent with the requirements of the Clean Air Act and the current SEA program.

Chrylser Corporation (Chrysler)

Chrysler commented that the 10 percent AQL represents a "considerable increase in stringency" over the 40 percent AQL and would result in a greater than 90 percent reduction from baseline. Chrysler estimated that the 10 percent AQL would cause it to lower its design targets by approximately 18 percent. The estimate is based on an analysis in which Chrysler assumed a lognormal distribution and stated the coefficient of variation is .2. This manufacturer stated that the Clean Air Act does not require every vehicle to meet the emission standards throughout its useful life. Rather, Chrysler believed the Act "compels" averaging because of the Section 202(a)(3)(A)(ii) statement requiring reductions ". . .from the average of the actually measured emissions. . ." It stated that a 40 percent AQL was instituted for the current SEA program "to avoid an unreasonable economic impact on the industry." Chrysler stated that the several SEA program were evidence that the industry is not advanced enough in its production practices to contend with a 10 percent AQL and that the 10 percent AQL was therefore unwarranted and unsubstantiated. Chrysler also stated that in the Regulatory Analysis EPA recognized the similarity between light-duty vehicles and light-duty trucks; therefore, "It would make little sense to attempt to extract different quality levels from essentially identical types of vehicles."

Chrysler advocated adopting a 40 percent AQL because of economic and technological considerations and because it would satisfy the Congressional intent of averaging.

American Motors Corporation (AMC)

AMC stated that it opposed a 10 percent AQL sampling plan for SEA because it "would increase the stringency of the proposed numerical standard greatly in excess of the 90 percent reduction mandated by Congress and is inconsistent with the Congressional intent of averaging".

AMC believes that the functional reliability of exhaust emission components necessary to meet a 10 percent AQL is not "practical and affordable" in volume production of vehicles. AMC stated that the design targets necessary for it to reach the 1983 LDT standards with a 10 percent AQL sampling plan are .21 g/mile for HC and 2.5 g/mile for CO. AMC estimated that the design targets necessary to comply with a 10 percent AQL were 50 percent lower than the design targets necessary to meet a 40 percent AQL. However, an explaination of how this figure was derived was not provided with the analysis. AMC stated that a 10 percnet AQL would have the effect of increasing the stringency of the NOx standard to a point that would require more sophisticated emissions control technology (e.g. three-way catalyst). AMC estimated that it would cost it and its vendors several million dollars to assure a 10 percent AQL.

International Harvester Company (IHC)

IHC opposes the 10 percent AQL sampling plan for SEA because it is claimed to be beyond the statutory authority provided to EPA and because it would allegedly cause an adverse economic burden on the manufacturers. IHC believed that Congress did not intend a 10 percent AQL be promulgated because that AQL imposes emission standards more stringent than those required by certification. IHC stated that the legislative history of the Clean Air Act indicates that vehicles need only meet standards on the average. In addition, IHC felt that the imposition of a 10 percent AQL would have an adverse economic impact on the light-duty truck industry, so it should be relaxed as it was in the light-duty vehicle SEA regulations. IHC provided an analysis in which the design targets necessary to meet a 10 percent AQL for SEA were estimated to be .26 g/mile for HC and 3.2 g/mile for CO.

IHC recommended that EPA retain the present 40 percent AQL to avoid imposing a much more stringent emission standard than Congress intended.

Cummins Engine Company, Inc. (Cummins)

Cummins believes that the potential impact of a 10 percent AQL must be carefully studied. Cummins stated that due to moderate test-to-test variability and vehicle design tolerances, manufacturers would need to design their products to meet an emission level which is significantly lower than the legislated requirement.

Volkswagen (VW)

VW stated that to comply with a 10 percent AQL for the proposed emission standards it would be necessary to use the closed loop controlled three-way catalyst concept. VW estimates that a 10 percent AQL would require the average emission level to be about 20 to 30 percent below the engineering goals currently used by VW. This reduction is solely because of the measuring uncertainties. VW did not provide an analysis to support its estimate of the percent reduction necessary to meet a 10 percent AQL.

VW recommended that "until government together with industry can minimize these uncertainties, the AQL should remain at 40 percent."

Toyota Motor Co. Ltd. (Toyota)

Toyota does not agree with EPA's proposing a 10 percent AQL instead of a 40 percent AQL because this manufacturer believes that a 10 percent AQL is not consistent with the intent of the Clean Air Act.

b. Other Commenters

Motor Vehicle Manufacturers Association (MVMA)

MVMA's main comment was that the 10 percent AQL is not consistent with an averaging concept for determining compliance with standards. Its arguments were based on the legislative history of the Clean Air Act, statements of past EPA Administrators, the averaging concept embodied in certification regulations, ambient air quality studies based on averages, the statutory language in Sections 202(a) and 202(b), and the inclusion of averaging concepts in the Regulatory Analysis for the NPRM.

U.S. Department of Commerce (DOC)

The DOC commented that there is no rationale in the NPRM for a 10 percent AQL. DOC stated if a 10 percent AQL is established engines and emission control systems must be designed to emit levels of pollutants considerably below the levels permitted by certification. DOC believes that a 10 percent AQL will increase component costs significantly, may require more sophisticated and expensive emission control hardware and would involve a fuel economy penalty. DOC did not supply an analysis supporting these statements. DOC recommended the retention of the 40 percent AQL for LDT.

U.S. Council on Wage and Price Stability (COWPS)

COWPS stated that the compliance cost estimates contained in the EPA Regulatory Analysis make no allowance for any increased manufacturing costs associated with the 10 percent AQL.

COWPS also suggested that the 10 percent AQL may go beyond the statutory mandate because it will require either a very low variance in the test results for production vehicles or an average level of emissions which is low relative to the standard. For these reasons COWPS recommended a cost-benefit analysis be performed before a 10 percent AQL is established.

3. Analysis of the Comments

Since many of the manufacturers and organizations responding made similar comments on the AQL issue, each of the major comments will be discussed under a separate heading in this section for purposes of clarity. For further information relating to the 10 percent AQL issue, reference is also made to the economic impact and the cost-effectiveness studies in Chapter V and Chapter VII of the Regulatory Analysis and to the discussion of the technological feasibility of the emission standards in the Summary and Analysis of Comments.

a. The 10 Percent AQL is Consistent with Congressional Intent

When reviewing the comments to the NPRM on SEA for light-duty vehicles in 1976, the EPA Office of General Counsel (OGC) reached a finding that "...Congress intended that, eventually, every car coming off the assembly line should meet the emission standards established under Section 202." A copy of the memorandum containing this finding (General Counsel Opinion No. 76-4) is available in the Public Docket for this Rulemaking. OGC acknowledged that a phasing in of this requirement was appropriate to avoid implementing SEA in an unreasonably burdensome manner, so long as the ultimate goal of full compliance is not abandoned. As explained in the LDV SEA preamble (41 FR 31474, July 28, 1976), auto manufacturers argued that implementation of a 10 percent AQL would have a disastrous economic impact on the industry, since it would result in a loss of certification for a majority of engine families. A 40 percent AQL was therefore established to implement SEA in a manner not unreasonably burdensome to the affected manufacturers. This initial approach was designed to "provide manufacturers the time and flexibility to bring all their vehicles into conformance with the standards on a reasonable schedule" (41 FR 31475).

Section 206(b) of the Clean Air Act provides for SEA testing of light-duty trucks. EPA maintains the position that there is a specific legal basis for requiring every LDT coming off the assembly line to meet emission standards. The full text of the EPA General Counsel memorandum, mentioned above, explains that the language of the Clean Air Act and the relevant legislative history support an "every car" approach to compliance with emission standards.

The ultimate goal of every vehicle and engine complying with emission standards is also supported by the U.S. General Accounting Office(GAO). The GAO did not take issue with EPA's legal interpretation of the Clean Air Act on this matter and recommended that the current LDV SEA program be revised to "...require a Federal emission standard compliance rate more indicative of the current rate for car configurations tested, which is well in excess of the 60 percent passing rate required." (GAO Report CED 78-180, p. 28).

b. The Relationship Between the Standards and a 10 Percent AQL

Section 202(a)(3)(A)(ii) of the CAA states, in pertinent part, ". . . regulations . . . applicable to emissions from vehicles or engines manufactured during and after model year 1983, in the case of HC and CO, shall contain standards which require a reduction of at least 90 percent . . . from the average of the actually measured emissions...during the baseline model year." Pursuant to this requirement, EPA conducted a test program on 1969 model year light-duty trucks (the last model year before imposition of HC/CO standards for light-duty trucks). Using the sales-weighted average emission levels obtained during this program, the standards were then set by multiplying these levels by 10 percent, i.e., a 90 percent reduction. These numbers, once identified, then became the required standards. The 10 percent AQL does not change the values of the standards; it merely reflects EPA's view that every production vehicle must comply with the established standards. This is consistent with EPA's finding, as discussed in Section 3(a), that every production vehicle must comply with standards established under Section 202 of the Clean Air Act. Also, as explained in the legislative history of Section 202(a)(3)(A)(ii), Congress intended that production line testing of heavy-duty vehicles ensure that "each production vehicle will comply in actual use." H.R. Rep. No. 95-294, 95th Cong., 1st Sess. 276 (1977). See also H.R. Rep. No. 95-564, 95th Cong., 1st Sess. 171 (1977). This language conclusively answers manufacturers arguments that by use of the term "average" in Section 202(a)(3)(A)(ii), Congress meant to reject the "every vehicle" concept.

EPA has performed an analysis which indicates that a 10 percent AQL can cause a manufacturer to design to lower target emission levels than those required by a 40 percent AQL. However, the magnitude of the difference between the target levels depends on several factors, some of which are within the manufacturer's control. One of the most important of these factors is the variability of identical production engines (the "width" of emissions distribution) at each design level. By increasing quality control and minimizing other variations in the manufacturing and assembly process, the manufacturer may reduce variability and raise the target emission levels which it needs to meet. In practice, the Agency believes that each manufacturer will trade off to one degree or another lower design targets versus stepped-up quality control to obtain the most cost-effective approach towards the 10 percent AQL goal.

c. <u>The Consistency of the 10 Percent AQL with the 40 Percent AQL in Effect for the Current Light-Duty SEA Program</u>

The 40 percent AQL was established for the current LDV SEA program to implement the program in a manner not unreasonably burdensome to the affected manufacturers. At the time the current LDV SEA was proposed, several auto manufacturers stated that they built the average production vehicle to meet the standards. It is important to note that the situation at the time the 10 percent AQL was proposed for the current LDV SEA program is different from the situation today. As discussed in the Preamble to the current LDV SEA regulations:

"The approach taken here, then, of not setting the AQL at 10% will provide manufacturers the time and flexibility to bring all their vehicles into conformance with the standards on a reasonable schedule. Such a schedule can be compatible with their parallel efforts to improve fuel economy and which does not expose them unduly to the risk of loss of certification while they are learning to bring their production vehicles into compliance with the law." (41 FR 31475, July 28, 1976).

The circumstances under which the proposed LDT SEA program is being promulgated are significantly different than those under which the current LDV SEA program was promulgated. When the LDV SEA program was promulgated the emission standards were already established for then-current and future model years and manufacturers were building vehicles to meet the standards on the average. The short notice that manufacturers were given before the proposed implementation of a 10 percent AQL for the LDV SEA program would not have provided sufficient time to make the necessary design and production changes, thus causing a severe economic impact on them. The proposed LDT SEA program will not be in effect until 2 1/2 years in the future; EPA has determined that this is this is sufficient leadtime to comply in a cost-effective manner with all of the 1983 regulatory requirements, which include the 10 percent AQL. (See Section E of the Summary and Analysis of

Comments for a discussion of "leadtime.") The LDT industry was put on notice in 1976 that EPA intended all motor vehicles to comply with the standards when the Agency made the above statement in the Preamble to the current LDV SEA regulations. When the proposed LDT regulations go into effect in 1983, the industry will have had seven years to develop the quality control procedures and institute the design changes necessary to meet a 10 percent AQL.

EPA's approach in the current LDV SEA program, the HDE SEA program and the proposed LDT SEA program is a consistent one: The Agency has endeavored to implement an SEA program consistent with its legal interpretation that every vehicle or engine must meet standards and in a practical manner that does not place an unfair or unreasonable economic or technological burden on the affected industry. In the LDT case, the Agency has determined that the final standards, in combination with a 10 percent AQL, are technologically attainable and can be implemented in a cost-effective manner (see Chapter VII of the Regulatory Analysis).

d. Relationship of a 10 Percent AQL Program to Certification Requirements

Several commenters indicated that they felt the present certification program embodied an averaging concept which conflicted with the concept of a 10 percent AQL. They argued that consistency required use of a 40 percent AQL so that essentially the average engine emission level would meet the standards.

The staff does not agree with this contention. Section 206 of the Clean Air Act authorizes a certification program (206(a)) and an assembly line testing program (206(b)). If a new motor vehicle or engine design demonstrates compliance with Section 202 standards throughout its useful life, a certificate of conformity will be issued under 206(a) regulations. The certificate is issued with respect to Section 202 regulations, i.e., regulations establishing emission standards. Since the function of the assembly line testing program is "to determine whether new motor vehicles or engines being manufactured do in fact conform with regulations with respect to which the certificate of conformity was issued," the program will determine compliance with emission standards.

The EPA certification and SEA programs attempt to accomplish different but related objectives. Because of the differences, the programs need not necessarily employ the same approaches towards compliance. Through certification, a manufacturer demonstrates that it has the capability to design a vehicle or engine that will comply with emission standards promulgated under §202(a) throughout its useful life under conditions simulating actual use. Once these prototype vehicles or engines demonstrate compliance, EPA issues the manufacturer a certificate of conformity allowing it to actually manufacture vehicles or engines similar to the prototypes for distribution into commerce. Then SEA requires the manufacturer to demonstrate that newly manufactured vehicles or engines will also comply with standards throughout their useful lives. As discussed in section a, EPA has determined that every production vehicle or engine must be in compliance.

e. Cost Impact of the 10 Percent AQL on Light-Duty Truck Manufacturers

There is a cost component attributable to the 10 percent AQL, as there is to all other compliance options in the regulatory package. A light-duty truck manufacturer will actually incur a "10 percent AQL" cost in those cases where it experiences difficulty in attaining the target emission levels, i.e., when the manufacturer must spend more money in going to the 10 percent AQL target level from some other (higher) level, or where it decides to step up its in-house quality control programs in response to a 10 percent AQL.

A cost-effectiveness analysis has been performed in conjunction with the evaluation of this regulation. One option examined was the cost of the proposed SEA program at a 40 percent AQL versus its cost at a 10 percent AQL. The analysis indicated that the 10 percent AQL SEA program is the more expensive option, but that the cost of moving to the 10 percent AQL is small relative to a 40 percent AQL.

f. Air Quality Impact of a 10 Percent AQL

EPA has performed an analysis of the reduction in emissions to be obtained in going from a 40 percent AQL to a 10 percent AQL in the SEA program. This analysis appears in Chapter VII of the Regulatory Analysis. The findings of this analysis indicate that by implementing a 10 percent AQL LDT HC emissions will be reduced an average of .006 tons per vehicle over the vehicle's lifetime, LDT CO emissions will be reduced 0.2 tons, and LDT NOx emissions will be reduced 0.04 tons.

As shown on Table VII-A in the Regulatory Analysis, these reductions represent a positive reduction in HC, CO and NOx for LDTs which EPA analyses have shown can be achieved in a cost-effective manner. On the basis of dollars spent per ton of emissions removed, the 10 percent AQL compares favorably with other emission control strategies.

g. The Effect of the 10 Percent AQL on Fuel Economy

In order to go from meeting the proposed 1983 LDT standards at a 40 percent AQL to meeting these standards at a 10 percent AQL it will be necessary to : 1) upgrade the air injection system of one LDT, 2) add EGR to a diesel LDT configuration, 3) recalibrate the EGR on some gasoline LDTs, 4) change the engine calibration for some LDTs and 5) increase the average catalyst loading slightly. (See the discussion of the 10 Percent AQL Compliance Costs in the will involve a small fuel economy penalty. When estimating the fuel economy impact of this package, EPA determined that if the manufacturers ignored fuel economy considerations in design and introduced no new technologies, the overall fleet fuel economy potential will be reduced less than 4 percent. The 10 percent AQL would account for a negligible part of the fuel economy penalty under this scenario. EPA believes that LDT manufacturers can avoid a fuel economy penalty entirely by using electronic engine controls. (See the discussion on Fuel Economy in the Summary and Analysis of Comments.) Electronic engine controls are already being used in 1980 passenger cars, and EPA believes that in 1985 most LDT manufacturers will use them to meet the tighter NOx and fuel economy standards.

4. Staff Recommendations

It is recommended that a 10 percent AQL be promulgated in the Final Rule. An SEA program with a 10 percent AQL is consistent with EPA's legal interpretation of the Clean Air Act, does not place unreasonable cost burdens on light-duty truck manufacturers, results in a positive reduction in emissions, has no significant impact on fuel economy, and is technologically feasible, given the emission standards to be promulgated.

Other Selective Enforcement Auditing Issues

1. Definition of "Configuration" (§86.1002(b)).

EPA proposed that a light-duty truck (LDT) configuration be "...described on the basis of... other parameters which may be designated by the Administrator." GM contested this definition as being unreasonably broad and vague and wanted protection against arbitrary selection of parameters by EPA.

This provision about "other parameters" is similar to a provision contained in the present light-duty vehicle (LDV) SEA definition of "configuration". A LDV configuration has never been defined beyond the specific parameters contained in that definition. Present LDT configurations can be described using the specific parameters in the LDT definition. However, EPA needs some flexibility in specifying configurations, because new emission control technologies developed in response to 1983 and later LDT standards may result in emission control parameters not presently identified. EPA does not intend to use this flexibility in an arbitrary manner but has retained the proposed definition in the final rule.

2. Low volume LDT families are not exempt from SEA test orders (§86.1003).

This exemption was not included in the proposal. MVMA recommended that if the "projected sales volume for a given code is less than 2,000 trucks for the current model year the manufacturer should be permitted, upon receiving a test order, to petition the Administrator for an exemption from Selective Enforcement Auditing of that engine code." Section 206(b) of the CAA does not exclude any particular class or category of production vehicles or production engines from its provisions. Therefore, from a legal standpoint, all production LDTs are potentially subject to testing to determine compliance with applicable emission standards. From a practical standpoint, to the extent that test orders for low volume configurations are issued, EPA believes that its newly developed sequential sampling plans allow these configurations to be tested as expeditiously as possible because, with these plans, as few as 7 LDTs are required to pass an audit, and the LDTs to be tested may even be selected over several days. Therefore, the impact on customer delivery schedules should be minimized. Because the sequential plans allow the flexibility to deal with low-volume configurations, no change has been made in the final rule.

3. Statement about "...instructions in the test order" is not redundant and unnecessary (§86.1003(b)).

GM stated that this phrase, in the last sentence of paragraph (b), should be eliminated because the CAA mandates compliance with test orders issued under regulations. EPA prefers not to delete the phrase because it alerts the manufacturer of its obligations directly in the regulations under Subpart K.

4. Vehicle selection procedures in the test order (§86.1003-83(c)(1)).

The proposal stated that "the test order will specify... the procedure by which LDTs of the specified configuration must be selected." GM stated that this statement was vague and ambiguous. Both GM and MVMA said that this allowed too much flexibility and could impede the expeditiousness of the audit and that by not including these procedures in the regulations EPA was denying the LDT manufacturers the right to comment on them.

EPA has made no changes in its proposed statement for the final rule. Commenters stated that if procedures can be standardized, they should be placed in the regulation. However, it is not possible to standardize the selection process because of the different production procedures encountered at the assembly plants. Neither GM nor MVMA offered any useful suggestions as to how to standardize selection techniques. In addition, EPA's experience with selection, during the current SEA program, indicates that it is necessary to have flexibility in the selection process to account for the unique situations encountered during vehicle selection at different assembly plants. EPA intends to use the flexibility to expedite vehicle selection and therefore does not believe that this will impede the progress of audits. It should be emphasized that paragraph §86.1007-83(a) allows for manufacturer input into the determination of the selection procedure.

5. Other standardized test order instructions (§86.1003-83 (c)(2)).

EPA proposed that "In addition, the test order may include other directions or information essential to the administration of the required testing." GM stated that this statement was vague and ambiguous: "Any procedures which can be standardized should be placed in the regulations and information deemed to be "essential" should also be included so that the manufacturers are not effectively precluded from commenting on such information or procedures."

EPA has determined that some of the specific instructions presently incorporated in LDV SEA test orders are applicable to LDT SEA testing and has included them in the final rule as new paragraph §86.1003-83(c)(2). As the need for new instructions which can be standardized becomes apparent in the future we intend to amend the regulations to incorporate them. However, the provision to include "other directions or information" essential to administer SEA testing has been retained to allow some flexibility in SEA operating procedures. This flexibility can be in the interest of the manufacturers and EPA, as it will allow audits to be conducted in the most expeditious manner practical, given circumstances unique to a particular manufacturer.

The latitude built into the test order and sample selection sections of the SEA regulations is intended to accomodate procedural variations, especially in the area of LDT selection. Specific instructions may be made to minimize the impact on each manufacturer's normal production activities while still assuring the generation of accurate, representative test results.

6. Selection at non-preferred plants (§86.1003(d)).

EPA proposed that, even though a manufacturer has submitted a list of assembly plants preferred for LDT selection, "the Administrator may order testing at other than a preferred plant." GM and MVMA believed that manufacturers should be able to designate from which plant a specific configuration will be selected. GM stated that it was necessary for the manufacturers to designate those plants in order to ensure that vehicle selection does not disrupt normal production practices at some plants and to allow the manufacturers to have an input into the selection process.

The sequential sampling plans contained in this regulation were designed to allow flexibility in sample selection to prevent, to the greatest extent possible, disrupting a manufacturer's normal production and delivery schedules. EPA intends to select the sample of LDTs at preferred locations, but requires the flexibility of selecting at non-preferred plants when that would allow the audit to be performed more expeditiously or permit the auditing, based upon available evidence, of specific cases of noncompliance. To retain this flexibility, EPA made no change to the final rule.

7. Clarification of the projected annual sales used in determining the annual limit on test orders. (§§86.1003 (f)(1)(i) and 86.1003(f)(1)(ii).

EPA proposed that the annual limit of SEA test orders be calculated using the projected "sales for that year." Although no comments were received on this issue these paragraphs have been revised to specify that the annual limit is calculated using the projected "sales bound for the United States market for that year" in order to clarify the intent of these paragraphs and to make them consistent with the previously promulgated heavy-duty engine regulations (44 FR 9488, February 13, 1979).

8. Test orders that will count against the annual limit (§86.1003-83(f)(2), (3)).

EPA proposed that test orders will not count against the annual limit under the following circumstances:

(1) The configuration being tested fails according to the sampling plan decision criteria;

(2) Testing is not completed;

(3) The test order is issued on the basis of any evidence indicating noncompliance with the AQL; and

(4) Follow-up audit testing is conducted on a configuration which previously had its certificate of conformity suspended or revoked.

GM, Chrysler and MVMA stated that failed test orders which pass a follow-up audit and test orders issued on the basis of evidence of noncompliance should count. They said if these test orders did not count, there would not be an upper limit and manufacturers could not plan the extent to which facilities must be allocated to meet this requirement.

Because of its responsibility to investigate those LDT configurations for which it has evidence of noncompliance, EPA will not establish an absolute limit on the number of test orders it will issue. However, EPA is sensitive to the manufacturers' concerns that they may be subjected to an indefinite number of test orders. Therefore, the proposal has been amended to provide that, when based on evidence of noncompliance, a test order issued within the annual limit will count toward the annual limit, if the configuration passes the audit. If the limit has been reached, additional test orders can be issued only on the basis of evidence of noncompliance. In addition, the provision requiring a statement of the reason for issuance of a test order beyond the annual limit will be retained.

Follow-up audits do not count toward the annual limit because they fall under the "umbrella" of the original test order, which resulted in a fail decision; see paragraph §§86.1012-83(j)(2) and (k)(2). The only exception to this provision is when a configuration, having had its certificate of conformity suspended or revoked by EPA, is then "replaced" by another configuration that was previously certified.

9. Selection of test vehicles by the Administrator (§86.1004(a)).

EPA proposed that when SEA testing will be performed by the Administrator, he will select LDTs "...in a manner designated by him..." GM suggests that this provision be revised so that LDTs are selected in accordance with §86.1007-83. EPA intends to select LDTs for its own testing in a manner consistent with the standardized selection procedures established in consultation with that manufacturer. The final rule therefore includes the statement that the Administrator will select his test LDTs "...in a manner consistent with the requirements of §86.1007-83..."

10. Discrepancies between EPA test results and manufacturer test results. (§86.1004(b), (c)).

EPA proposed that its test results comprise the official data for a test vehicle when there is a disagreement with the manufacturer's results. GM disagrees with the assumption that the manufacturer's test facility is deficient and that it bears the burden of proving that its own data is correct. However, the regulations provide two mechanisms for resolving differences between data: (1) paragraph §86.1004-83(c)(2) allows a manufacturer to demonstrate that EPA's data were erroneous and its own data was correct; and (2) if EPA invokes a suspension of the certificate of conformity based on the Administrator's test data, the manufacturer can request a hearing under paragraph §86.1012-83 (l) to determine whether the tests were conducted properly. Therefore, EPA is not changing this provision.

11. Retaining names of personnel (§86.1005-83(a)(2)(iii), (iv)).

EPA proposed that the manufacturers be required to retain the names of all personnel involved in the conduct of the test and in the supervising and performance of a repair. GM objected to these requirements, stating that the information "is unnecessary and irrelevant for EPA's needs and goes beyond that required by current LDV and LDT regulations."

EPA believes that the names of manufacturer personnel involved in SEA audits should be available if an investigation of the conduct of an audit is necessary. However, EPA does agree with GM that it is unnecessary to include this information in the audit suggested by GM, but paragraph §86.1005-83(a)(2)(ii) in the final rule requires the manufacturer to retain the names of all personnel involved in the audit for future reference.

12. Requirement for submitting manufacturer's test results (§86.1005(c)).

Several manufacturers were critical of the proposed provision requiring them to submit their own production LDT test data. GM, Ford, Chrysler, Toyota and MVMA considered this requirement unreasonable and an unjustifiable burden. GM stated that these data do not necessarily reflect overall production emissions performance throughout the model year. GM and Toyota objected to EPA's use of this data for enforcement purposes and along with Chrysler believed that this is a deterrent for manufacturers to continue in-house auditing. Chrysler believes that this requirement is not in conformance with the Clean Air Act. Chrysler stated that "Congress intended that the Administrator be only entitled to access to the data he needs to determine compliance on a specific basis". (Chrysler's emphasis) Ford and MVMA also believed that data submitted to EPA should be limited. MVMA suggested that only data from complete emission tests of production vehicles need be submitted. Ford proposed that the manufacturers only be required to report the results of regularly scheduled tests.

Subpart K does not impose any requirement that a manufacturer conduct an internal quality audit program, but if it does conduct this type of program, Section 208(a) authorizes the Administrator to require the submission of this data because the data can help determine compliance of LDTs with applicable emission standards. This requirement has been proven workable in the LDV SEA program and does not appear to be unreasonably burdensome to manufacturers. EPA believes that the reporting requirements it proposed for the LDT manufacturers are reasonable because these requirements are similar in scope to those currently being met by LDV manufacturers. However, EPA has made two changes in response to comments received: (1) The manufacturer is required to describe the emission test used to obtain the data submitted; see §86.1005-83(c)(1). This change will help EPA determine the degree of correlation between a "short test" result, if the manufacturer uses this kind of test, and full FTP data. (2) The manufacturer need only submit data on ADP storage devices if these devices are compatible with EPA equipment. EPA will furnish the necessary ADP storage devices upon a manufacturer request.

13. Entry and access (§86.1006).

Ford contends that the provision allowing EPA inspectors to "inspect and monitor any aspect of engine or vehicle test procedures or activities" is beyond EPA's authority in the CAA because it would allow EPA to have access to those areas of manufacturing facilities which have no connection at all to a legitimate EPA interest. Ford wants EPA to limit its inspections to those items specifically listed in Section 86.1006-83(b)(2).

Section 206(c) of the CAA allows EPA ". . . (1) to enter, at reasonable times, any plant or other establishment of such manufacturer, for the purpose of conducting tests of vehicles . . . or (2) to inspect, at reasonable times, records, files, papers, processes, controls, and facilities used by such manufacturer in conducting tests under regulations of the Administrator." Ford did not explain how EPA was exceeding its authority in Section 206(c) or any other section of the CAA. EPA must be able to monitor and inspect any aspect of vehicle test procedures and activities necessary to assure that these vehicles are being prepared and tested according to applicable regulations and the prescribed Federal Test Procedure. In addition, EPA at this time cannot develop a specific comprehensive list of all test procedures or activities which could require inspection or monitoring during the course of an audit. If Ford believes that EPA is conducting an inspection in excess of its authority, it may not consent to the inspection. The Supreme Court decision in Marshall vs. Barlow's, Inc. has limited inspections without a search warrant to those which have the manufacturer's consent. If voluntary consent is refused, EPA will not attempt to enter any of a manufacturer's facilities, including emission testing facilities, without first obtaining a search warrant. GM suggests that only "emission related" parts be investigated in paragraph §86.1006(b)(4), but gave no reason for this comment. §86.1006(a) states that only matters related to Subpart K will be investigated. EPA has not revised §86.1006 in response to these comments.

14. Entry and access in foreign jurisdictions (§86.1006(g)).

EPA proposed that foreign testing and manufacturing facilities must be located so as to permit EPA entry and access. VW requested that this requirement be deleted because manufacturers have no control over a country's policy.

EPA has made no change in its proposed statement for the final rule. To allow a manufacturer to produce vehicles in a country which did not permit EPA to conduct inspections would inhibit EPA's ability to enforce air pollution regulations at that location. Further, it would give that manufacturer an unfair advantage over other manufacturers which are subject to EPA inspections. When a manufacturer decides to locate an assembly plant in a foreign country, one of the risks it is voluntarily accepting is that the country will continue to allow EPA inspectors to conduct assembly plant inspections within that country. EPA must be able to conduct inspections at these foreign assembly plants to accomplish the tasks mandated by Congress.

15. Authorization for personnel appearances and entry without 24 hours notice. (§86.1006(h)(4)).

GM recommended that proposed paragraph §86.1006-83(h)(4) be amended to require approval of the Assistant Administrator for Enforcement before manufacturer personnel could be questioned by EPA investigators. GM and VW also recommended adding a new paragraph §86.1006-83(h)(5) which would require the Assistant Administrator to sign test orders in which manufacturers are not given 24 hour notice before entry. EPA believes it is unnecessary to require the Assistant Administrator to authorize either appearances of personnel or entry without 24 hours notice because these authorizations can be performed by other responsible Agency officials. If a manufacturer refuses to consent to personnel appearances or entry without 24 hours notice, EPA is required to seek a search warrant before attempting to conduct these activities. Therefore, no changes relating to these issues have been made in the final rule.

16. Order of test results (§86.1007(e)).

EPA proposed that the test order will specify the order in which test results will be used in applying the sampling plan. This paragraph was also proposed in the rulemaking concerning gaseous emission regulations for heavy-duty engines (HDEs) (44 FR 9488, February 13, 1979). Based upon a comment received during that rulemaking, EPA changed the final version of that paragraph (45 FR 4173, January 21, 1980). The revised paragraph specifies that the order of sample selection determines the order of the decision sequence. Although no specific comments were received relating to this paragraph during the 1983 LDT rulemaking, EPA has revised this paragraph, to be consistent with the HDE regulations, for purposes of uniformity and clarification. This will provide a consistent basis for applying test results to the sequential decision criteria.

17. Retention and shipment of test vehicles (§86.1007(f)).

EPA proposed that all untested LDTs in the test sample be kept on hand until a pass or fail decision is reached. GM indicated this might involve the selection of the maximum number of test vehicles before testing began and their retention until the audit was completed. Under the sequential sampling plan, vehicles may be selected as required to assure expeditious testing. The maximum number of vehicles associated with a sampling plan need not be selected prior to initiating testing. Further, any LDT which has passed the required emission test during the SEA audit may be shipped. However, once a manufacturer ships any LDT from the test sample, as defined in §86.1002-83, it relinquishes its prerogative to conduct retests during that audit.

18. Allowance for a "dealer preparation" procedure (§86.1008 (b)(1)).

GM, Ford, MVMA, Chrysler and AMC believe EPA should allow the manufacturers to conduct a predelivery inspection on SEA vehicles. GM, Chrysler and Ford believe this inspection is necessary to assure that the results of SEA testing are representative of the emission levels of vehicles on the road. GM states that disallowing the dealer preparation increases the stringency of the emission standards because EPA would require the manufacturers to build cars which meet the deteriorated emission standards off the assembly line. GM also believes that this action is inconsistent with §85.2108 of the recent NPRM on 207(b) Warranty Regulations. AMC stated that disallowing the predelivery inspection would force them to institute extra inspections on the assembly line. These extra inspections would be redundant because they are performed by the dealers.

EPA believes that SEA test vehicles which have undergone dealer preparation procedures will represent "real world" conditions only to the extent that these procedures are actually and correctly performed by dealers. §86.1008(b)(1) of the proposed regulations does permit a dealer preparation procedure to be performed if it is approved in advance by the EPA Administrator. §85.2108 of the proposed Warranty Regulations requires dealers to furnish the purchaser of a new light-duty motor vehicle with a certificate which states that the vehicle meets emission standards To make this certification in good faith the dealer would have to perform all emission related preparation required by the manufacturer. The certificate in itself does not prove that the dealer preparation procedures are being performed properly in the "real world". EPA's experience with light-duty vehicles (LDVs) indicates that in several cases, dealer preparations are not performed, or are performed incorrectly. For these reasons, unless the manufacturer can demonstrate to the Administrator that these dealer preparation procedures are carried out routinely and correctly at the dealerships, the Administrator may require additional information, such as dealer survey data, which demonstrates that dealerships are performing the dealer preparation correctly before allowing a manufacturer to perform certain dealer preparation procedures during SEAs.

19. Time allowed to ship test vehicles (§86.1008(e)).

EPA proposed that the manufacturers be required to ship test vehicles to the testing location within 24 hours of selection, unless the Administrator approves a greater shipping time based on a request from the manufacturer. GM believes that the 24 hour shipping time is not applicable to low volume configurations and requests that a provision allowing a greater period of time to ship these vehicles be incorporated into the regulations.

EPA has made no change in the final rule because EPA may approve a different time period based on a satisfactory manufacturer request. If GM can adequately justify more time for the situation it mentions a time extension may be granted.

20. Option to retest (§86.1008(i)).

GM requested that EPA revise this proposed paragraph to allow retesting at any time during the audit (as opposed to only after a fail decision has been reached) and to delete the requirement for testing each LDT the same number of times. GM claims that these changes are necessary in order to minimize the possible logistic, storage, and economic impacts upon a manufacturer's operations.

Selective retesting of test vehicles could bias the test results from a statistical viewpoint, because vehicles not retested may produce different results, in terms of pass or fail, than they did in the first test. Therefore, EPA will require that each LDT be tested the same number of times. EPA realizes that there may be certain situations in which retesting prior to reaching an audit decision will require fewer emission tests to complete the audit. Therefore, EPA has revised §86.1008(i) to allow for retesting before an audit decision is reached, upon approval by EPA of a manufacturer's justified request to retest.

This provision is also being incorporated into the previously promulgated heavy-duty engine regulations for consistency with the LDT approach. Since EPA considers this a relaxation of the previously promulgated heavy-duty engine provision, no reproposal of this paragraph is being made.

21. Rounding of final test results (§86.1009(b)).

GM recommended that the final test results be rounded to 3 decimal places, instead of the proposed 2 decimal places, to provide for a more accurate computation. GM did not provide any analysis to support its recommendation. Upon review of this issue, EPA has revised the method of calculating the final deteriorated test results in SEA to make it compatible with the method used during certification, which is based on the number of significant figures instead of decimal places. To calculate the final deteriorated test results, the actual emission results are rounded to the same number of decimal places contained in the applicable standard expressed to 1 additional significant figure. This number is then multiplied by the DF and rounded to the same number of significant figures contained in the standard. This method will allow for a direct comparison between the final deteriorated test results and the standard. This change has also been incorporated into the previously promulgated heavy-duty engine regulations for purposes of generalizing the rounding procedure for all standards.

22. Calculation of final deteriorated test results (§86.1009 (c)(1) and (c)(2)).

GM believes that these proposed paragraphs should be revised to eliminate the inconsistency in proposed §86.1009 between paragraph (c) and (c)(2). These paragraphs have been amended to remove the inconsistency noted by GM and to clarify the use of DFs. In

GM's suggested revision of the proposed paragraphs no mention was made of adjustment of DFs according to certification conventions. Multiplicative DFs which were determined during certification to be less than one are set equal to one. Similarly, additive DFs which were less than zero during certification are set equal to zero. These DF conventions permit comparisons to be made between certification and SEA test results.

23. Reporting of Invalid Tests (§86.1009(d)(5)(iii)).

GM objects to the proposed provision that requires the manufacturers to report the test result of invalid tests and the reason for invalidation. GM states that this information is not required by the Administrator to determine whether a manufacturer is acting in compliance with the regulations.

EPA believes that this information is necessary for the Agency to determine if the decision to invalidate the test was in compliance with the regulations. The results of all emission tests performed during an SEA must be available in the event that the Agency subsequently declares valid an emission test the manufacturer had declared invalid. For these reasons no change has been made to the proposed provisions.

24. Use of test results following a pass or fail decision for a particular pollutant (§86.1010(c)).

GM suggests that this paragraph be modified by adding a sentence to indicate that once the test sample is accepted or rejected for a particular pollutant, additional test results for the pollutant will not be considered for auditing purposes.

EPA has added a clarification to the final rule in essentially the form proposed by GM, except to change the wording to read, "Once a pass or fail decision has been made for a particular pollutant..." to retain consistency with sequential sampling plan terminology.

25. Batch Sampling vs. Sequential Sampling for Vehicle Selection (§86.1007).

VW encouraged EPA to continue use of batch sampling plans, because VW believed an SEA decision under the sequential sampling plan could be made based on results from unrepresentative vehicles. The manufacturer stated that "the proposed sampling technique no longer ensures that sample vehicles are drawn all across the manufacturer's production output." VW contended that since an audit could consist of one single sample drawn at one time, a manufacturer could fail an audit on the basis of a quality control problem encountered on a single shift.

EPA is implementing sequential sampling plans instead of batch type sampling plans because the sequential plans often require fewer tests to reach an audit decision than the batch plans, fewer vehicles need be retained during the audit, and the simpler decision rules ease administration. When conducting an SEA of high volume configurations under the current batch sampling plan, several batches of vehicles may be selected over one shift. The decision rules for batch sampling allow for audit failure after two batches. Therefore, the risk of failing an SEA based on a single shift's production also exists under a batch sampling plan.

If a manufacturer believes it has failed an audit due to quality control problems, the regulations provide a mechanism for the manufacturer to prove its contention. §86.1012(j) allows the Administrator to reinstate the suspended certificate of conformity when the manufacturer: 1) submits a written report which identifies the reason for noncompliance and describes the proposed remedy and 2) demonstrates that the vehicle configuration now complies with the standards. Under this provision, if a manufacturer believed it failed an SEA because of a problem on the assembly line during a single shift, the manufacturer could have its certificate reinstated after it submitted a report describing this problem, demonstrated to the Administrator that steps had been taken to remedy the problem, and showed that the vehicles now comply with the standards through a reaudit.

26. <u>Complexity of the Sampling Plan (§86.1010(c))</u>.

Ford concurs with the proposed sequential sampling plan for SEA test purposes; however, "Ford is still dismayed at the unnecessary complexity of the plan, as proposed, with its various code letters, annual sales, and phases." Ford developed a single sampling plan with a 40 percent AQL which could be used for all engine families with yearly projected sales above 50.

Ford did not explain why the proposed sampling plans are unnecessarily complex. The decision as to which sampling plan to use for a particular configuration is dictated by the projected annual sales of that configuration. Manufacturers supply this information to EPA in their Application for Certification, and therefore the information is readily available to both EPA and the manufacturer. EPA does not believe its proposed sampling plans are overly complicated.

The sampling plan that Ford developed incorporates a 40% AQL. EPA plans to implement a 10% AQL for LDT. Further, Ford's sampling plan requires the manufacturers to do more testing than would be necessary using the sampling plans proposed by EPA. EPA believes that it is desirable to reduce the number of tests a manufacturer must perform during an SEA to a minimum. EPA has therefore not revised §86.1010(c) in response to this comment.

27. <u>Application of suspension decisions to all manufacturing plants (§86.1012(e))</u>.

EPA proposed that a suspension decision imposed on LDTs of a failed configuration produced at one plant could also be imposed on LDTs of the same configuration produced at all other plants. Chrysler, VW and MVMA stated that the proposed regulations did not allow for a partial suspension or revocation. Chrysler and MVMA requested that EPA allow the manufacturer a chance to demonstrate that a problem was plant specific before the certificate was suspended or revoked for that configuration.

Paragraph §86.1012-83(e) states,"...the Administrator <u>may</u> suspend the certificate... at all other plants" (emphasis added). The use of the word "may" indicates that this is a discretionary decision on EPA's part and that the suspension order will not automatically apply to all other plants. Any manufacturer has an opportunity, as provided in Subpart K, to demonstrate that the suspension order should not apply to other plants. §86.1012(l) allows a manufacturer to request a hearing for a suspension under §86.1012(e). §86.1014(a) states that hearings are applicable to requests under §86.1012(l). §86.1014(c)(2)(ii)(B) states, in pertinent part, that when a hearing is requested under §86.1012(l), the issues will be restricted to proper conduct of tests and proper application of sampling plans, specifically,"...whether there exists a basis for distinguishing LDTs produced at plants other than the one from which LDTs were selected for testing which would invalidate the Administrator's decision under §86.1012(e)". EPA has therefore made no change to this paragraph in the final rule.

28. <u>Failed vehicle report (§86.1012(i)(2))</u>.

EPA proposed that the report on corrective testing of those vehicles that failed emission testing during an SEA be submitted to EPA "...within 5 days after completion of testing...". GM proposed that the 5 day requirement be deleted in order to provide a reasonable period of time to the manufacturers and for comparability with the LDV SEA requirements. To clarify its intention, EPA has revised this paragraph for the final rule to read "...within five working days after successful completion of testing on the failed engine or vehicle...". While EPA needs to receive reports on the repair of noncomplying LDTs in a timely fashion, corrective action need not be taken immediately after a failure, so long as the manufacturer does not attempt to introduce a failed LDT into commerce.

29. <u>Qualifications of a Judicial Officer (§86.1014(b)(5)(iii))</u>.

GM proposed that this paragraph be amended to ensure that the Judicial Officer (J.O.) is a graduate of an accredited law school and a member of a bar association.

EPA does not take issue with GM's proposal and has incorporated it into the final rule.

I. Issue: Nonconformance Penalty

This issue concerns the system for production compliance auditing (PCA) and nonconformance penalties (NCP) proposed in the NPRM. Since the proposed emission standards were considered feasible for all manufacturers to meet, nonconformance penalties were not made available in the NPRM.

As described elsewhere in this Summary and Analysis of Comments (see G. "Technological Feasibility"), the EPA staff still believes that the standards are attainable by all manufacturers. However, EPA has decided not to finalize nonconformance penalties at this time. The possible need for making nonconformance penalties available and their role in the compliance process is still under review by the Agency. These matters will be the subject of separate rulemaking by EPA. Therefore, comments received on these aspects of the NPRM will not be dealt with at this time.

Delaying final action on PCA/NCP does not adversely affect the mnufacturers' ability to comply with the regulations finalized in this present rulemaking. With or without PCA/NCP, it is EPA's intent for all manufacturers to comply with the standards. NCPs are not to be viewed as a route to a less stringent emission standard via intentional design to a higher emission rate and payment of the associated NCP.

J. Issue: Diesel Crankcase Emissions Control

1. Summary of the Issue

The proposed regulations require that no crankcase emissions shall be discharged into the ambient atmosphere from 1983 model year (and later) light-duty truck diesel engines.

2. Summary of the Comments

The proposed crankcase controls for diesel LDTs drew considerable adverse reaction. Both EPA's justification and feasibility issues were addressed by most of the commenters.

Several comments pointed to the low hydrocarbon and carbon monoxide emissions from light-duty diesel crankcases as evidence of a lack of need for controls. Additionally, commenters felt that the information quoted in the NPRM is inconclusive in establishing the presence of nitrosamines in diesel blowby emissions.

The feasibility of controlling the crankcase emissions was challenged on the basis that some light-duty diesel engines will be equipped with turbochargers. The anticipated technical problems arise from the oily nature of the blowby emissions which in a simple system would be introduced into the inlet air supply. Although in a naturally-aspirated engine the slight negative pressure of the manifold can draw crankcase fumes into the combustion chamber, the manifold of a turbocharged engine is under greater pressure than the crankcase. Thus, unless it is pressurized, the blowby must enter the stream on the inlet side of the turbocharger, allowing the oily emissions to become deposited on the compressor wheel. It was indicated that this will result in a decrease in turbo-efficiency which can detrimentally affect performance, fuel consumption, and emissions.

Cummins Engine Company mentioned four means of crankcase control which may have potential. None are developed to the extent of assessing their feasibility. These four alternatives are:

1) Duct gases to turbo-inlet by way of a pressure regulator and oil separator.

2) Draw gases through the regulator and separator and a pump to the manifold downstream of the turbo (an expensive alternative which still requires much development work to ascertain whether it is satisfactory).

3) Aspirate and mix gases into the exhaust flow.

4) Pump the gas through the regulator and a separator into the exhaust stream.

3. Analysis of the Comments

All but a fraction of the light-duty diesel engines currently being produced (for both LDVs and LDTs) have crankcase controls; however, such control is not required by regulation. Regulation was proposed in order that crankcase control be maintained in the future and so that parity would exist between the diesel and gasoline engines. Although the number of diesel LDTs is small at this time, it is anticipated that the number will grow substantially with time.

The majority of commenters saw no major problems associated with the control of crankcase emissions in naturally-aspirated diesel engines. The turbocharged engine, however, was quite another matter. EPA received a number of comments essentially stating that there are technical problems associated with crankcase emission control of the turbocharged diesel, and that overcoming these problems could be relatively costly. A possible solution was recommended by Cummins (Suggestion #2 in Summary of Comments) and seems to be worthy of investigation. By allowing the turbocharger to be bypassed, the oil separator/pump/pressure regulator configurations would eliminate the excessive deterioration of the component efficiencies. The pump itself might be affected to some degree by the oily emissions; therefore, further analysis would have to be performed.

Some commenters suggested that ducting the gases to the turbo-inlet by way of a pressure regulator and oil separator (Cummins Suggestion #1) may be the easiest and least costly of the possible crankcase control methods. It was noted by the commenters that even though this method seems viable there are problems related to the oily emissions which can deposit and build up on the compressor wheel causing a reduction in turbo-efficiency, fuel economy, and durability.

Contrary to the conceptual arguments of the manufacturers, however, is a concrete example of crankcase control of a production turbocharged diesel engine. Mercedes-Benz, for some time now, has been producing a light-duty diesel vehicle that is equipped with a turbocharger and crankcase emission controls. In their design, the engine blowby gases and the crankcase vapors flow through a vapor line in the cylinder head to a cyclone separator located in the air filter. The gaseous content of the crankcase emissions is drawn off the separator by the intake manifold vacuum; the fluid content is routed back to the oil pan. In an effort to gain further information regarding their design (essentially Suggestion #1 by Cummins) the Staff at ECTD made telephone contact with Mercedes engineers. The staff learned during the conversation that Mercedes has had no problems to date with their deisgn and in addition did not foresee any further problems such as significant drops in turbocharger efficiencies. Obviously, such a method must be practical and not be overly burdensome since it is being done without imposing regulations. We realize that there may be differences between light-duty truck and light-duty vehicle diesel engines, but the staff believes these differences to be few and relatively minor. Therefore, the staff must conclude that the proposed diesel crankcase emission control standard is technically and economically feasible.

4. Staff Recommendation

The staff, after careful consideration, recommends that the proposed crankcase emission standard for diesel light-duty trucks remain unchanged.

K. Issue: Numerical Standards/Standards Derivation

1. Summary of the Issue

EPA has proposed new emission standards for light-duty trucks:

0.8 g/mile HC
10 g/mile CO

These standards are derived from emission tests of uncontrolled 1969 model year light-duty trucks. These emission tests data were used to calculate a baseline from which the proposed HC and CO standards were derived. The 1969 Light-Duty Truck Test Procedure (Title 40, CFR, Part 86, Subpart B) was used to obtain the emissions data.

EPA is proposing that the current NOx standard of 2.3 g/mile be retained for 1983 and later model years.

2. Summary of the Comments

The majority of the comments were directed at EPA's development of emission standards in Technical Report SDSB-79-23 entitled "1969 Light-Duty Truck Baseline Program and 1983 Emission Standards Development. Commenters contend that improper mathematical and engineering practices were employed to develop the LDT baseline and proposed emission standards. Specifically, criticism of the test program and standards derivation were:

a. Eighteen vehicles were too small a sample.

b. Vehicle stratification was inadequate. Only 1 Chevy 307 was tested, while 4 Chevy 350's were tested.

c. The vehicles were unrepresentative since all vehicles came from San Antonio, Texas area and had mileages much less than new proposed useful life and represented only 84 percent of the LDT market.

d. The pre-test vehicle maintenance was improper for establishing the baseline.

e. Deterioration factors should have been calculated and applied to the baseline and standards.

f. Sampling error should have been recognized in calculating the standards.

g. Standards are more stringent as a result of other elements of the NPRM such as allowable maintenance and durability.

3. Analysis of the Comments

This section is divided into two Subparts. First, EPA's discussion relating to the final 1969 LDT baseline emissions results is presented. Second, the comments on the issue are analyzed.

a. <u>Final 1969 LDT Baseline Emission Results</u>

This section updates and summarizes the final 1969 LDT baseline emission results. These results were obtained under EPA Contract No. 68-03-2683 with EG&G, Inc. The initial baseline results which appeared in SDSB Technical Report No. 79-23, "1969 Light-Duty Truck Baseline Program and 1983 Emissions Standards Development", July 1979, are shown in Table 1.

These baseline results were used to calculate the light-duty truck HC and CO standards, proposed on July 12, 1979, in FR, Vol. 44, No. 135. Subsequently, EG&G discovered that some of the vehicles were tested without having had all the carburetor maintenance performed (letter of 9/8/79, EG&G to Mr. Larry Ragsdale). As a result, all vehicles were rechecked and proper carburetor adjustments were made to the vehicles where necessary. Any vehicles that needed adjustment were retested.

Table 2 shows the final corrected emission test results for the 18 vehicles included in the baseline report cited above. Ten vehicles of the eighteen used to calculate the proposed 1983 light-duty truck HC and CO standards were retested. Additionally, Table 3 summarizes emission data for all 1969 light-duty trucks tested under EPA's baseline program. Included in this table are emission results from an additional three vehicles (#617, #621, #623) that were not part of the original sample used to determine 1969 light-duty truck baseline levels (refer to Table 1). These additional vehicles were tested after the 1969 baseline levels had been determined and included in the 1983 Light-Duty Truck NPRM.

Table 4 summarizes the sales-weighted emission results derived from the various test samples (Tables 1, 2, and 3). Table 5 presents the emission levels that represent a 90 percent reduction from the baseline levels in Table 4. Clearly, the retesting would have resulted in lower HC and CO proposed standards (representing the Clean Air Act's mandated 90 percent reduction). The inclusion of the three additional vehicles would have further reduced the HC standard.

The staff recommends retaining the standards (0.8 g/mile HC and 10 g/mile CO) proposed in the LDT NPRM even though they are higher than standards calculated from EPA's 21 vehicle sample. The proposed standards represent an 88 percent reduction in HC emissions and an 87 percent reduction in CO emissions as measured from the final 21 vehicle baseline. Since these values are close to the desired 90 percent reductions, the staff considers this action as a reasonable option to follow. To repropose the standards at lower levels would delay implementation of the rulemaking while making only small environmental gains.

Table 1

1969 L.D.T. BASELINE EMISSION RESULTS

02-07-80 09:27:05

INITIAL BASELINE DATA

	VEHICLE	CID	VEH#	% LDT SALES		CORR. %	HC NON-WID	HC SALE-WID	CO NON-WID	CO SALE-WID	NOX NON-WID	NOX SALE-WID
1	DODGE	225	428	2.20 / 2 =	1.100	1.32	7.651	0.101	70.070	0.928	5.488	0.073
2	DODGE	225	404	2.20 / 2 =	1.100	1.32	5.736	0.076	158.213	2.094	2.328	0.031
3	DODGE	318	418	3.30 / 2 =	1.650	1.99	7.856	0.156	85.976	1.707	4.354	0.086
4	DODGE	318	444	3.30 / 2 =	1.650	1.99	11.480	0.228	102.562	2.036	3.918	0.078
5	FORD	302	618	7.10 / 1 =	7.100	8.54	7.993	0.683	141.764	12.112	1.733	0.148
6	FORD	360	610	24.20 / 6 =	4.033	4.85	11.667	0.566	203.157	9.860	2.309	0.112
7	FORD	360	473	24.20 / 6 =	4.033	4.85	10.663	0.518	219.724	10.665	1.673	0.081
8	FORD	360	613	24.20 / 6 =	4.033	4.85	5.177	0.251	77.388	3.756	4.974	0.241
9	FORD	360	491	24.20 / 6 =	4.033	4.85	6.969	0.338	63.785	3.096	5.054	0.245
10	FORD	360	421	24.20 / 6 =	4.033	4.85	7.963	0.386	60.709	2.947	2.904	0.141
11	FORD	360	425	24.20 / 6 =	4.033	4.85	2.946	0.143	44.556	2.163	2.767	0.134
12	CHEV	250	441	9.40 / 1 =	9.400	11.31	4.374	0.495	57.264	6.478	4.546	0.514
13	CHEV	307	607	28.40 / 1 =	28.400	34.18	9.111	3.114	95.537	32.650	3.618	1.236
14	CHEV	350	450	7.80 / 4 =	1.950	2.35	13.844	0.325	90.393	2.121	3.389	0.080
15	CHEV	350	419	7.80 / 4 =	1.950	2.35	7.767	0.182	149.356	3.505	2.140	0.050
16	CHEV	350	427	7.80 / 4 =	1.950	2.35	7.188	0.169	100.387	2.356	2.818	0.066
17	GMC	350	602	7.80 / 4 =	1.950	2.35	8.623	0.202	106.630	2.502	3.155	0.074
18	IHC	345	601	0.70 / 1 =	0.700	0.84	14.742	0.124	155.920	1.313	1.958	0.016
					------	------		--------		--------		--------
					83.100	100.00		8.058		102.29		3.408

PROGRAM NAME: SGWK:7140C-LDT

Table 2

1969 L.D.T. BASELINE EMISSION RESULTS 02-07-80 09:38:22

WITH RETESTS

VEHICLE	CID	VEH#	% LDT SALES	CORR. %	HC NON-WTD	HC SALE-WTD	CO NON-WTD	CO SALE-WTD	NOX NON-WTD	NOX SALE-WTD
1 DODGE	225	404*	2.20 / 2 = 1.100	1.32	4.238	0.056	86.072	1.139	6.380	0.084
2 DODGE	225	428	2.20 / 2 = 1.100	1.32	7.651	0.101	70.070	0.928	5.488	0.073
3 DODGE	318	418	3.30 / 2 = 1.650	1.99	7.856	0.156	85.976	1.707	4.354	0.086
4 DODGE	318	444	3.30 / 2 = 1.650	1.99	11.480	0.228	102.562	2.036	3.918	0.078
5 FORD	302	618*	7.10 / 1 = 7.100	8.54	4.096	0.350	69.613	5.948	3.267	0.279
6 FORD	360	421	24.20 / 6 = 4.033	4.85	7.963	0.386	60.709	2.947	2.904	0.141
7 FORD	360	425	24.20 / 6 = 4.033	4.85	2.946	0.143	44.556	2.163	2.767	0.134
8 FORD	360	473*	24.20 / 6 = 4.033	4.85	4.547	0.221	65.038	3.157	4.862	0.236
9 FORD	360	491*	24.20 / 6 = 4.033	4.85	5.294	0.257	77.663	3.769	5.780	0.281
10 FORD	360	610*	24.20 / 6 = 4.033	4.85	6.925	0.336	118.007	5.728	5.382	0.261
11 FORD	360	613*	24.20 / 6 = 4.033	4.85	5.942	0.288	67.867	3.294	5.139	0.249
12 CHEV	250	441*	9.40 / 1 = 9.400	11.31	3.910	0.442	27.438	3.104	4.895	0.554
13 CHEV	307	607	28.40 / 1 = 28.400	34.18	9.111	3.114	95.537	32.650	3.618	1.236
14 CHEV	350	419	7.80 / 4 = 1.950	2.35	7.767	0.182	149.356	3.505	2.140	0.050
15 CHEV	350	427*	7.80 / 4 = 1.950	2.35	6.789	0.159	70.528	1.655	2.825	0.066
16 CHEV	350	450*	7.80 / 4 = 1.950	2.35	7.628	0.179	144.841	3.399	2.365	0.055
17 GMC	350	602	7.80 / 4 = 1.950	2.35	8.623	0.202	106.630	2.502	3.155	0.074
18 IHC	345	601*	0.70 / 1 = 0.700	0.84	7.612	0.064	108.287	0.912	2.272	0.019
			83.100	100.00		6.866		80.542		3.958

PROGRAM NAME: SGWK:7140C-LDT

* Vehicles were retested.

TABLE 3

1969 L.D.T. BASELINE EMISSION RESULTS 02-19-80 09:42:17

ALL VEHICLES

VEHICLE	CID	VEH#	% LDT SALES	CORR. %	HC NON-WTD	HC SALE-WTD	CO NON-WTD	CO SALE-WTD	NOX NON-WTD	NOX SALE-WTD
1 DODGE	225	404	2.20 / 2 = 1.100	1.30	4.238	0.055	86.072	1.118	6.380	0.083
2 DODGE	225	428	2.20 / 2 = 1.100	1.30	7.651	0.099	70.070	0.910	5.488	0.071
3 DODGE	318	418	3.30 / 2 = 1.650	1.95	7.856	0.153	85.976	1.675	4.354	0.085
4 DODGE	318	444	3.30 / 2 = 1.650	1.95	11.480	0.224	102.562	1.998	3.918	0.076
5 FORD	302	618	7.10 / 1 = 7.100	8.38	4.096	0.343	69.613	5.835	3.267	0.274
6 FORD	360	421	24.20 / 6 = 4.033	4.76	7.963	0.379	60.709	2.891	2.904	0.138
7 FORD	360	425	24.20 / 6 = 4.033	4.76	2.946	0.140	44.556	2.122	2.767	0.132
8 FORD	360	473	24.20 / 6 = 4.033	4.76	4.547	0.217	65.038	3.097	4.862	0.232
9 FORD	360	491	24.20 / 6 = 4.033	4.76	5.294	0.252	77.663	3.698	5.780	0.275
10 FORD	360	610	24.20 / 6 = 4.033	4.76	6.925	0.330	118.007	5.619	5.382	0.256
11 FORD	360	613	24.20 / 6 = 4.033	4.76	5.942	0.283	67.867	3.232	5.139	0.245
12 CHEV	250	441	9.40 / 2 = 4.700	5.55	3.910	0.217	27.438	1.523	4.895	0.272
13 CHEV	250	623	9.40 / 2 = 4.700	5.55	7.516	0.417	62.402	3.463	3.421	0.190
14 CHEV	292	617	1.60 / 1 = 1.600	1.89	10.345	0.195	83.903	1.585	3.717	0.070
15 CHEV	307	607	28.40 / 2 = 14.200	16.77	9.111	1.527	95.537	16.017	3.618	0.607
16 CHEV	307	621	28.40 / 2 = 14.200	16.77	5.128	0.860	56.641	9.496	3.231	0.542
17 CHEV	350	419	7.80 / 4 = 1.950	2.30	7.767	0.179	149.356	3.439	2.140	0.049
18 CHEV	350	427	7.80 / 4 = 1.950	2.30	6.789	0.156	70.528	1.624	2.825	0.065
19 CHEV	350	450	7.80 / 4 = 1.950	2.30	7.628	0.176	144.841	3.335	2.365	0.054
20 GMC	350	602	7.80 / 4 = 1.950	2.30	8.623	0.199	106.630	2.455	3.155	0.073
21 IHC	345	601	0.70 / 1 = 0.700	0.83	7.612	0.063	108.287	0.895	2.272	0.019
			84.700	100.00		6.464		76.025		3.807

PROGRAM NAME: SGWK:7140C-LDT

Table 4

Sales-Weighted Emission Results

Data	Sample Size	HC (g/mi)	CO (g/mi)	NOx (g/mi)
Initial Test Results (before retesting, Table 1	18	8.058	102.29	3.408
Initial Test Results (after retesting, Table 2	18	6.866	80.542	3.958
Final Test Results (includes all vehicles tested, Table 3)	21	6.464	76.025	3.807

Table 5

90 Percent Reduction from Baseline HC and CO Levels

Data	Sample Size	(HC g/mi)	CO (g/mi)
Initial Test Results (Table 1)	18	0.8*	10*
Initial Test Results after Retesting (Table 2)	18	0.7	8
Final Test Results (Table 3)	21	0.6	8

---

* These levels were proposed as 1983 emission standards for light-duty trucks in July, 1979 (FR, Vol. 44, No. 135).

b. Comments

Many of the issues concerning the LDT baseline program were previously raised in connection with the 1984 heavy-duty engine gaseous emissions rulemaking. These issues are analyzed in depth in the Summary and Analysis of Comments document accompanying the final heavy-duty rulemaking, and to the extent relevant, are incorporated herein by reference. Because of this, the issues will be treated breifly here, and the reader is referred to the heavy-duty document for further discussion.

MVMA and the manufacturers criticized the light-duty truck test program's sample size of 18 vehicles as being too small to formulate an accurate baseline. The staff disagrees. EPA's rationale for using 18 vehicles was based on two considerations. First, the sales-weighted emissions after 18 vehicles had been tested were leveling off at essentially constant values and EPA believed that further testing would not significantly change the baseline. Second, the emission results obtained from the 18 vehicles agreed favorably with the previous emission results obtained from other EPA test programs for 1969 light-duty trucks. This rationale is further discussed in the report "1969 Light-Duty Truck Baseline Program and 1983 Emission Standards Development" contained in the docket.

Tables 6 and 7 show that after testing only 8 vehicles, the emission results began to stabilize. (NOTE: these are plots of the 18 vehicles' emission results before retesting of 10 of the vehicles).

The baseline results after retesting are:

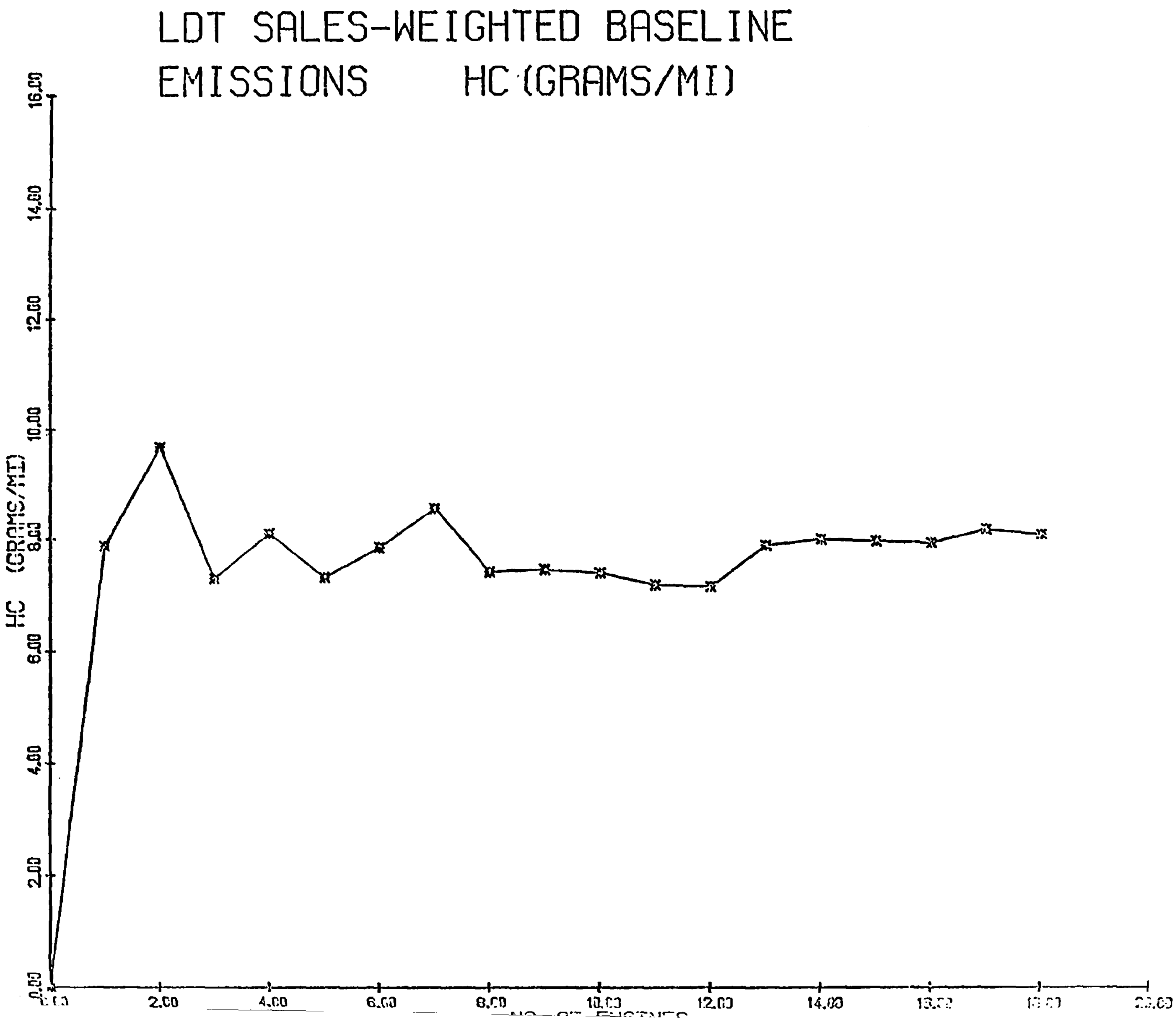
6.87 g/mile HC
80.54 g/mile CO

Three additional vehicles were tested after issuance of the NPRM. Inclusion of these three vehicles reduced the baseline by less than 6 percent (see Table 3). Thus, final baseline emissions for all 21 vehicles tested at EG & G are 6.464 g/mile HC and 76.025 g/mile CO. Inclusion of sales-weighted emission data from 11 LDTs from other EPA programs (see Table 8) yields baseline values of 6.53 g/mile HC and 74.55 g/mile CO for the 32-vehicle sample. The values for the 32-vehicle sample are 5 percent lower for HC and 7 percent lower for CO than the 18-vehicle sample.

The pertinence of constructing this 32-vehicle composite baseline is to show that the 18-vehicle baseline results are reasonably close to the 32-vehicle baseline results. Nearly doubling the sample size had minimal effects on the baseline results (i.e., 6.87 g/mile vs. 6.53 g/mile for HC).

The second consideration was the agreement between previous 1969 LDT emission test data and the baseline emissions data. The

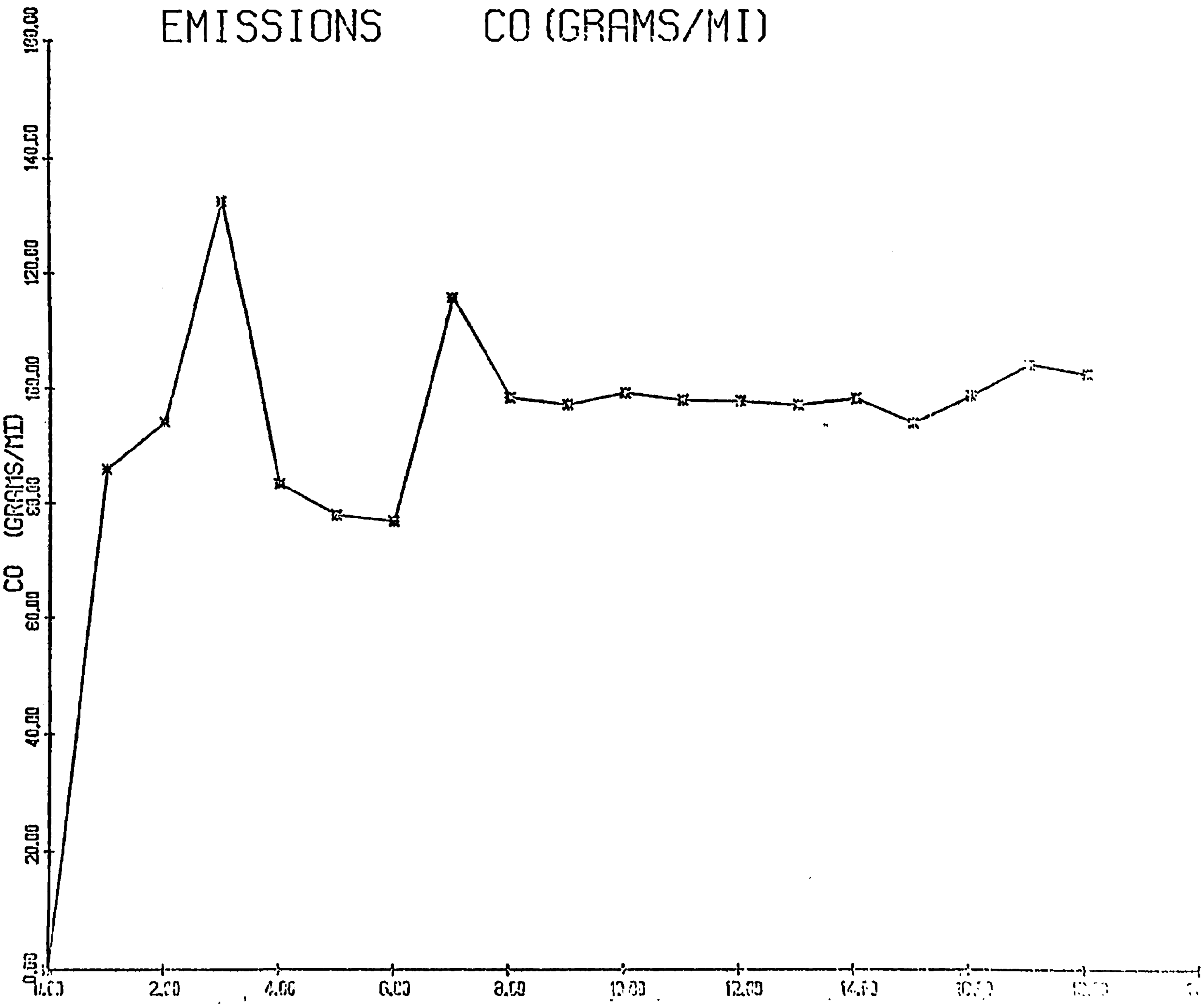
Table 6


LDT SALES-WEIGHTED BASELINE
EMISSIONS HC (GRAMS/MI)
HC (GRAMS/MI)
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00

127

Table 7

LDT SALES-WEIGHTED BASELINE EMISSIONS CO (GRAMS/MI)



129

Table 8

1969 L.D.T. BASELINE EMISSION RESULTS - COMPOSITE DATA   02-22-80 14:09:33

VEHICLE	CID	VEH#	% LDT SALES		CORR. %	HC NON-WTD	HC SALE-WTD	CO NON-WTD	CO SALE-WTD	NOX NON-WTD	NOX SALE-WTD
1 DODGE	225	404	2.20 / 2 =	1.100	1.16	4.238	0.049	86.072	0.998	6.380	0.074
2 DODGE	225	428	2.20 / 2 =	1.100	1.16	7.651	0.089	70.070	0.812	5.488	0.064
3 DODGE	318	418	3.30 / 2 =	1.650	1.74	7.856	0.137	85.976	1.495	4.354	0.076
4 DODGE	318	444	3.30 / 2 =	1.650	1.74	11.480	0.200	102.562	1.783	3.918	0.068
5 FORD	240	8	5.90 / 1 =	5.900	6.22	6.890	0.428	114.970	7.148	5.400	0.336
6 FORD	302	618	7.10 / 1 =	7.100	7.48	4.096	0.306	69.613	5.208	3.267	0.244
7 FORD	360	421	24.20 / 9 =	2.689	2.83	7.963	0.226	60.709	1.720	2.904	0.082
8 FORD	360	425	24.20 / 9 =	2.689	2.83	2.946	0.083	44.556	1.262	2.767	0.078
9 FORD	360	473	24.20 / 9 =	2.689	2.83	4.547	0.129	65.036	1.843	4.462	0.135
10 FORD	360	491	24.20 / 9 =	2.689	2.83	5.294	0.150	77.663	2.200	5.780	0.164
11 FORD	360	610	24.20 / 9 =	2.689	2.83	6.925	0.196	118.007	3.344	5.362	0.152
12 FORD	360	613	24.20 / 9 =	2.689	2.83	5.942	0.168	67.867	1.923	5.139	0.146
13 FORD	360	3	24.20 / 9 =	2.689	2.83	4.530	0.128	56.000	1.587	4.140	0.117
14 FORD	360	7	24.20 / 9 =	2.689	2.83	8.040	0.228	103.500	2.933	2.810	0.080
15 FORD	360	10	24.20 / 9 =	2.689	2.83	12.490	0.354	106.460	3.016	6.960	0.197
16 FORD	390	4	3.50 / 1 =	3.500	3.69	4.310	0.159	54.480	2.009	8.460	0.312
17 CHEV	250	441	9.40 / 2 =	4.700	4.95	3.910	0.194	27.438	1.359	4.895	0.242
18 CHEV	250	623	9.40 / 2 =	4.700	4.95	7.516	0.372	62.402	3.091	3.421	0.169
19 CHEV	292	617	1.60 / 2 =	0.800	0.84	10.345	0.087	83.903	0.707	3.717	0.031
20 GM	292	6	1.60 / 2 =	0.800	0.84	6.180	0.052	68.390	0.577	4.810	0.041
21 CHEV	307	607	28.40 / 3 =	9.467	9.98	9.111	0.909	95.537	9.530	3.618	0.361
22 CHEV	307	621	28.40 / 3 =	9.467	9.98	5.128	0.512	56.641	5.650	3.231	0.322
23 GM	307	12	28.40 / 3 =	9.467	9.98	6.220	0.620	31.490	3.141	7.240	0.722
24 CHEV	350	419	7.80 / 7 =	1.114	1.17	7.767	0.091	149.356	1.754	2.140	0.025
25 CHEV	350	427	7.80 / 7 =	1.114	1.17	6.789	0.080	70.528	0.828	2.825	0.033
26 CHEV	350	450	7.80 / 7 =	1.114	1.17	7.628	0.090	144.841	1.701	2.365	0.028
27 GMC	350	602	7.80 / 7 =	1.114	1.17	8.623	0.101	106.630	1.252	3.155	0.037
28 GMC	350	1	7.80 / 7 =	1.114	1.17	4.940	0.058	89.240	1.048	7.030	0.083
29 GMC	350	2	7.80 / 7 =	1.114	1.17	9.000	0.106	113.600	1.334	5.080	0.060
30 GMC	350	11	7.80 / 7 =	1.114	1.17	9.730	0.114	152.730	1.793	5.490	0.064
31 GMC	396	9	0.80 / 1 =	0.800	0.84	7.070	0.060	83.440	0.703	7.060	0.060
32 IHC	345	601	0.70 / 1 =	0.700	0.74	7.612	0.056	108.287	0.799	2.272	0.017
				94.900	100.00		6.532		74.548		4.623

PROGRAM NAME: SGWK:7140C-LDT

Table 9

Estimated 1969 Light Duty Truck Baseline

(6,000 - 8,500 GVWR)

No.	Manufacturer	Engine	Inertia	Road Load	Emissions g/mile HC	CO	NOx
1	General Motors	350 in^3	5000 lbs	17.9 hp	4.94	89.24	7.03
2	General Motors	350 in^3	5000 lbs	17.9 hp	9.00	113.60	5.08
3	Ford	360 in^3	4500 lbs	13.1 hp	4.53	56.00	4.14
4	Ford	390 in^3	5000 lbs	17.9 hp	4.31	54.48	8.46
5	Dodge	383 in^3	5000 lbs	17.9 hp	8.54	149.00	9.12
6	General Motors	292 in^3	5500 lbs	22.7 hp	6.18	68.39	4.81
7	Ford	360 in^3	5000 lbs	17.9 hp	8.04	103.50	2.81
8	Ford	240 in^3	4500 lbs	21.8 hp	6.89	114.97	5.40
9	General Motors	396 in^3	5000 lbs	21.1 hp	7.07	83.44	7.06
10	Ford	360 in^3	5000 lbs	21.1 hp	12.49	106.46	6.96
11	General Motors	350 in^3	5500 lbs	22.7 hp	9.73	152.73	5.49
12	General Motors	307 in^3	5000 lbs	17.9 hp	6.22	31.49	7.24
			Average	19.2	7.33	93.61	6.13
			Metric (g/km)		4.55	58.17	3.81

Sources: A Study of Baseline Emissions on 6,000-14,000 Pound Gross Vehicle Weight Trucks, June 1973, Automotive Environmental Systems, Inc., APTD-1572. (Vehicles 1 to 5)

Baseline Emissions on 6,000 to 14,000 Pounds Gross Vehicle Weight Trucks, June, 1973, Southwest Research Institute, APTD-1571 (Vehicles 6 and 7)

Medium Duty Baseline Tests, Environmental Protection Agency, Unpublished (Vehicles 8 to 12) sales-weighted baseline results for the initial tests of 18 vehicles (Table 1) are 8.06 g/mile HC and 102.29 g/mile CO. This is close to the average emissions (7.33 g/mile HC, 93.61 g/CO) for 12 vehicles tested previously in EPA programs (Table 9). The revised baseline results agree even more closely than did the original baseline data.

Commenters criticized the vehicle sampling plan for inadequate stratification. They cite that only 1 GM 307 (28.4 percent of LDT sales) was tested while 4 GM 350's (7.8 percent of LDT sales) were tested. EPA originally, because of the sales data available, set a target number of GM 350's to be tested at 2-3. Later this was revised to two GM 350's when more accurate sales data was provided by the manufacturers. Since 4 vehicles were already procured, they were included.

Regarding the GM 307, EPA's original target goal was seven engines, however only two were finally obtained. This was due to our inability to locate more engines. Only one of these engines was tested at the time the original baseline testing was completed for the NPRM. The second 307 was tested subsequently, and that data is included in Table 3.

In evaluating the adequacy of the samples tested for individual families it is important to bear in mind the sales-weighting process used by EPA to determine the baseline emission rate. In that process, the emission results from each engine are weighted to account for the fraction of sales which the subject engine family represents. Because of this, it is not in any way necessary for the number of engines tested in each family to also be sales-weighted. A baseline could just as well be computed from a sample containing equal numbers of engines from all families. The reason why EPA desired to sales-weight the sample of engines procured was to obtain the most accurate data for the most important (in terms of sales) families with the minimum overall number of engines. Failure to be completely successful at this goal does not invalidate the baseline process.

MVMA contends that the sample vehicles are unrepresentative since: 1) they were all procured from the San Antonio, Texas area; 2) the mileages were much less than the new proposed useful life; and 3) the 18-vehicle sample represented ony 84 percent of LDT sales.

The staff disagrees with this assertion. The vehicles selected for baseline testing were 1969 model year light-duty trucks which had received no major engine overhaul and which had original carburetors and distributors in most cases. In addition, the vehicle selected had to pass selection criteria aimed at obtaining vehicles in good mechanical condition. Pre-test maintenance assured that the vehicles were representative. Specifically, engines were tuned to manufacturers specifications in an effort to preclude uncharacteristic emissions caused by out of spec. engines. Defective components were replaced in some instances. Accordingly the pre-test maintenance normalized the vehicle sample. MVMA has presented no reasons why emissions from well maintained vehicles would have significant geographic variability.

Commenters were critical of the test vehicle mileages because they were less than the proposed useful life definition. EPA's goal in formulating a baseline has been thoroughly discussed in the Analysis of Comments to the heavy-duty 1983 gaseous emissions rulemaking (Issue M). In summary, all efforts were made to insure that only mechanically sound engines with original equipment were used in the baseline to accurately reflect 1969 engines. Practical limitations then resulted in low-mileage applications being preferentially selected. In-use deterioration of well-maintained vehicles is inherently low (see discussion below), so that no important mileage related effect will occur.

MVMA criticized the 18 vehicle sample even though it represented nearly 84 percent of light-duty truck sales. EPA believes that 84 percent is a reasonable figure for determining a baseline. The emission results for 21 vehicles tested at EG&G are 6.464 g/mile HC and 76.025 g/mile CO and represents 84.7 percent of the LDT sales (6001-8500 lb. GVWR). EPA's 32 vehicle sample results in emissions of 6.532 g/mile hc and 74.548 g/mile CO and represents 94.9 percent of the LDT sales. The difference in emissions between the two baselines is minimal.

Commenters contend that the pre-test vehicle maintenance was improper for establishing the baseline. Maintenance should have been limited to only maintenance specified in the certification procedure as defined in the new NPRM. The staff disagrees with this contention.

The maintenance performed on the test vehicles was necessary to assure that the test engines were as close to new engine configuration as possible without major overhaul. If a component was so worn that manufacturers specifications could not be met, then it was rebuilt or replaced. However, the most important consideration was to tune-up the engines to 1969 manufacturers specifications. In fact, several vehicles were rejected after having been procured because major engine maintenance was needed. The maintenance performed was not limited to certification specified maintenance. the staff believes the maintenance performed was reasonable, however, for 10 year old vehicles.

Manufacturers maintained that deterioration factors should have been calculated and applied to the baseline and standards. The staff disagrees. Baseline emissions were calculated to represent the average of the actually measured emissions from 1969 model year light-duty trucks. Since the engines were characterized as new engines (due to pre-test maintenance) a zero deterioration factor assumption was made. Furthermore, certification data for non-catalyst engines shows that these engines have inherently low deterioration factors, and support the zero d.f. assumption.

MVMA and the manufacturers asserted that sampling error should be recognized in calculating the standards and recommended using the upper 90 percent confidence limit of the mean. The staff does not believe that this procedure is required by the Clean Air Act. According to section 202 a(3)(A)(ii) of the Act, the standards are to be derived "from the average of the actually measured emissions."

MVMA contends that as a result of other elements of the NPRM, the standards are more stringent than a 90 percent straight reduction. The staff disagrees with this comment. EPA is directed to promulgate regulations which will cause at least a 90 percent reduction in HC and CO emissions as measured from 1969 model year LDT's. The other elements of the rulemaking do not directly affect the stringency of the numerical standards, which are unchanged. Rather, they work toward a fuller degree of compliance with the standards. Thus, they help assure that the desired minimum percentage reductions are attained.

4. Recommendation

Retain the new emission standards as proposed.

L. Issue: Fuel Economy

1. Summary of the Issue

If adopted as proposed, will the regulations and standards cause complying vehicles to experience a fuel economy penalty?

2. Summary of the Comments

In general, most commenters preferred to analyze fuel economy effects on the basis of 40 percent AQL and a 50,000-mile useful life, in spite of the proposed changes. Bearing this in mind, most manufacturers considered the current emission standards in California to be approximately equivalent in stringency to the proposed standards; the impact on future fuel economy was extrapolated from the fuel economy performance of the California fleet. No fuel economy impact on diesel vehicles was claimed.

General Motors claimed a one mpg (7 percent) fuel economy penalty in gasoline vehicles as a direct result of these standards. The addition of air injection and danger to spark retard, EGR, and carburetor calibrations to assist catalyst lightoff are all strategies currently used in California which GM argued would be adopted Federally to meet the proposed standard. No closed-loop systems are anticipated.

Ford claimed that use of oxidation catalyst, EGR and air injection would be necessary to meet the standards at a 40 percent AQL and 50,000-mile useful life. In addition, the higher inertia powertrains would require light-off catalysts of dubious durability. Overall fuel economy penalties of 3.4 percent and 7.2 percent for models with and without light-off catalysts respectively were anticipated. No projections were given under 10 percent AQL, full useful life conditions.

International Harvester claimed that EGR, additional air injection, and oxidation catalysts would be needed.

Volkswagen claimed that with a 40 percent AQL and 50,000-mile life, only EGR and oxidation catalysts would be necessary. (The lean burn techniques presently used permit the reduction of NOx in the exhaust with only oxidation catalysts.) No additional air injection would be necessary. With 10 percent AQL, however, Volkswagen's preferred strategy would be the use of three-way catalyst and feedback carburetor. In general, Volkswagen foresaw a 5 percent fuel economy penalty in its heavier vehicles, as opposed to some gains using three-way systems with lighter inertia weight vehicles.

American Motors predicted a fuel economy loss of .4 to .8 mpg (40 percent AQL, 50,000-miles). No hardware changes were predicted; changes to carburetor calibrations would allow compliance but result in the fuel economy penalty.

In public testimony, commenters disclosed under questioning that electronic engine control technology was being pursued, but refused to give further details for "proprietary" reasons.

3. Analysis of the Comments

Since most commenters preferred to analyze this issue on the basis of the California fleet, the staff's initial analysis of expected fuel economy impact will follow suit. From there, an analysis will be performed of the differences between California compliance strategies and those strategies which the staff anticipates to be used to comply with the 1983 standards. An estimate of the fleetwide fuel economy impact of these proposed regulations will conclude the analysis.

Table L-1 presents comparative emission and fuel economy data for California and Federal light-duty trucks tested at EPA's Motor Vehicle Laboratory. In all cases (except where noted), the comparative vehicles are identical with the exception of emission control equipment.* For ease of comparison, the control strategies adopted for California compliance and their impact on the California vehicle's fuel economy (or averaged over all similar-technology tests) are presented in Table L-2.

Tables L-3 and L-4 present data used in deriving the staff's projected fuel economy penalty for the national light-duty truck fleet presuming that no new technology is introduced in 1983. The analysis sales-weights the penalties derived from EPA certifiation data in Table L-1 with one exception,** and derives a fleet-wide fuel economy penalty based upon the projected market shares of four, six, and eight cylinder engines in 1983.

The results of the comparison support the industry's contention that an overall fuel economy penalty is likely if California-style technology is applied. The staff's analysis indicates that with no technological improvements, an average penalty of 5.2 percent per manufacturer was experienced in California. This agrees fairly well with the commenters' projections. The staff takes strong issue, however, with the claim that such a penalty is unavoidable for compliance with the 1983 standards.

---

* Same inertia weight, transmission, axle ratio, and dynamometer road load horsepower.

** Some eight cylinder engines tested at EPA's lab indicated no fuel economy penalty. However, vehicles in higher weight classes are certified to California standards which are roughly equivalent to the Federal standards, i.e., no reduction, no applied technology, no fuel economy loss. Based upon GM's comments alluding to the fact that air pumps would be needed on eight cylinder families, an overall penalty of 4 percent was attributed to the air pumps' parasitic horsepower requirements.

Table L-1

Emission and Fuel Economy Data for Light-Duty Trucks
Acquired From EPA's Emission Certification Tests for 1980 MY

Vehicle Model	ENGINE MFG	ENGINE Family	CID	Fed. or Calif.	Additional Technology in California	4K Certification Levels HC	CO	NOx	MPG	Percent Difference
Jeep CJ5	AMC	BT6C1	151	Both	3-way Catalyst	0.18	2.47	1.30	21.5	+0.5
Jeep CJ7	AMC	BT9A1	151	Fed.		0.42	5.62	1.50	21.4	
Jeep CJ7	AMC	CT4W1	258	Calif.	Light-off	0.43	7.39	1.00	15.1	-3.2
Jeep CJ7	AMC	CT3A1	258	Fed.	Catalyst	0.48	11.28	1.40	15.6	
Jeep CJ5	AMC	CT4W1	258	Calif.	Light-off	0.40	4.43	1.41	15.4	+1.3
Jeep CJ5	AMC	CT3H1	258	Fed.	Catalyst	0.67	6.35	2.00	15.2	
Eagle Wagon	AMC	CT4W1	258	Calif.	Light-off	0.28	3.88	1.50	15.0	-8.5
Eagle Wagon	AMC	CT3A1	258	Fed.	Catalyst	0.35	7.76	2.00	16.4	
Jeep CJ7	AMC	HT3V1	304	Calif.	Increased Cata-	0.38	3.90	0.92	12.1	-14.8
Jeep CJ7	AMC	HT3A1	304	Fed.	lyst Loading	0.94	9.27	1.60	14.2	
Jeep CJ5	AMC	HT3V1	304	Calif.	Increased Cata-	0.28	2.80	1.45	11.4	-11.6
Jeep CJ5	AMC	HT3A1	304	Fed.	lyst Loading	0.73	4.87	1.70	12.9	
Jeep J20	AMC	NT3A1	360	Calif.	Calibration	0.57	9.10	1.74	10.7	-2.7
Jeep J20	AMC	NT3A1	360	Fed.		0.56	11.00	1.65	11.0	
Cherokee	AMC	NT3A1	360	Calif.	Calibration,	0.56	9.90	1.94	11.5	-2.5
Wagoneer	AMC	NT3A1	360	Fed.	Axle ratio	0.72	15.00	1.36	11.8	
B1 Van (109" WB)	Chrysler	OTA-225 -1-BXP	225	Calif.	Catalyst Loading, Inertia Weight,	0.23	1.81	1.28	17.1	+11.0
B100 Van (109" WB)	Chrysler	OTA-225 -1-BCP	225	Fed.	Axle Ratio	0.58	11.00	1.60	15.4	
B2 Van (127" WB)	Chrysler	OTA-318/360 4 BCP	360	Calif.	Light-off Cata- lyst (Fed.), Cata-	0.22	6.99	1.20	11.6	+1.8
B2 Van (127" WB)	Chrysler	OTA-318/360 4 BFP	360	Fed.	lyst Loading, Iner- tia Weight, Axle	0.40	8.80	1.20	11.4	
B2 Van (127" WB)	Chrysler	OTA-318/360 4 BFP	360	Fed.	Ratio	0.46	8.10	0.94	13.1	-11.5
W150	Chrysler	OTA-318/360 4 BCP	360	Calif.	Transmission, Iner- tia, Axle Ratio,	0.37	8.80	1.70	11.8	+9.3
W150	Chrysler	OTA-318/360 4 BFP	360	Fed.	Light-off Catalyst, Catalyst Loading	0.78	14.14	1.40	10.8	
F-100 Reg. CAB LWB	Ford	4.9ND	300	Calif.	Light-off Catalyst, Axle Ratio	0.23	2.10	1.90	16.8	+3.7
F-100 Reg. CAB LWB	Ford	4.9NA	300	Fed.		0.57	5.00	1.08	16.2	
F-150 SC LWB	Ford	4.9ND	300	Calif	Light-off Catalyst,	0.24	6.20	1.60	16.0	-10.6
F-150 SC LWB	Ford	4.9NA	300	Fed.	Axle Ratio	0.87	8.80	1.86	17.9	
F-250, 4x4 LWB	Ford	5.0NB	302	Both	Larger Catalysts,	0.59	4.82	1.59	12.4	-3.1
F-250, 4x4 LWB	Ford	5.0NA	302	Fed.	Transmission, Inertia Weight	0.73	6.92	1.59	12.8	
F-150, 4x2 LWB	Ford	5.0NB	302	Calif.	Larger Catalyst,	0.42	3.96	1.42	14.4	-2.0
F-150, 4x2 SWB	Ford	5.0NA	302	Fed.	Inertia Weight	0.58	9.62	1.31	14.7	
F-150, 4x2 LWB	Ford	5.0NG	302	Calif.	Light-off Catalyst,	0.24	2.10	1.45	13.5	-8.2
F-150, 4x2 SWB	Ford	5.0NA	302	Fed.	Larger Catalyst	0.58	9.62	1.31	14.7	
E-250, LWB Clubwagon	Ford	5.0NB	302	Calif.	Larger Catalyst, Calibration	0.40	6.72	1.17	11.8	-5.6
E-250, LWB Clubwagon	Ford	5.0NA	302	Fed.		0.51	4.13	1.50	12.5	
F-100, 4x2 SWB RC	Ford	5.0NG	302	Calif.	Light-off Catalyst, Larger Catalyst,	0.22	1.60	1.45	13.2	-19.5
F-100, 4x2 SWB RC	Ford	5.0NA	302	Fed.	Axle Ratio	0.61	7.60	1.97	16.4	
F-100, 4x2 LWB RC	Ford	5.0NG	302	Calif.	Manual Transmis- sion, Axle Ratio,	0.24	2.00	1.45	13.0	-15.6
F-100, 4x2 LWB RC	Ford	5.0NA	302	Fed.	Light-off Catalyst, Larger Catalyst	0.59	3.46	1.78	15.4	

Table L-1 (cont'd)

Emission and Fuel Economy Data for Light-Duty Trucks
Acquired From EPA's Emission Certification Tests for 1980 MY

Vehicle Model	ENGINE MFG	Family	CID	Fed. or Calif.	Additional Technology in California	4K Certification Levels HC	CO	NOx	MPG	Percent Difference
	GM	08K4AA	400	Calif.	Lower Catalyst	0.41	5.18	1.50	11.8	--
-	GM	08K4G	400	Fed.	Loading, Air Pump	0.54	12.74	1.30	11.8	
Traveler 4x4	IHC	V304	304	Calif.	Calibration,	0.65	4.98	1.36	10.8	-6.1
Traveler 4x4	IHC	V304	304	Fed.	Manual Transmission	0.61	4.72	1.75	11.5	
Scout II, 4x4	IHC	V345	345	Calif.	Manual Transmis-	0.78	6.80	2.00	12.0	-2.4
Scout II, 4x4	IHC	V345	345	Fed.	sion, More Inertia	0.57	5.52	1.50	12.3	
					Weight High Axle					
					Ratio, Calibration					
Scout II, 4x4	IHC	4-196	196	Calif.	Extra Speed Trans-	0.55	8.90	1.70	14.9	-5.7
Scout II, 4x4	IHC	4-196	196	Fed.	mission, Axle	0.50	6.80	2.00	15.8	
					Ratio, Calibration					
Chevy LUV-1	Isuzu	AITC	111	Calif.	Oxidation Catalyst,	0.22	4.29	0.98	21.9	-6.0
Chevy LUV-1	Isuzu	AITB	111	Fed.	Calibration	1.40	14.00	1.60	23.3	
Chevy LUV-4	Isuzu	AITC	111	Calif.	Oxidation Catalyst,	0.23	2.73	1.30	21.7	--
Chevy LUV-4	Isuzu	AITB	111	Fed.		1.40	12.00	2.00	21.7	
Deluxe, 5 spd	Nissan	TL20C	119	Calif.	Greater Air,	0.26	2.97	1.00	21.9	
Pickup					Higher Catalyst					-10.6
Deluxe, 5 spd	NIssan	TL20F	119	Fed.	Volume and Loading	0.73	9.00	1.64	24.5	
Pickup										
Pickup, 5 spd	Nissan	TL20C	119	Calif.	Greater Air,	0.24	2.16	1.00	22.8	
King Cab					Higher Catalyst					-9.2
Pickup, 5 spd	Nissan	TL20F	119	Fed.	Volume and Loading	0.83	12.00	1.35	25.1	
King Cab										
Pickup King Cab	Nissan	TL20C	119	Calif.	Greater Air,	0.18	2.61	1.10	21.6	-10.4
Pickup King Cab	Nissan	T120F	119	Fed.	Higher Catalyst	0.51	6.50	1.74	24.1	
					Volume and Loading					
Pickup Cab	Nissan	TL20C	119	Calif.	Greater Air,	0.14	2.61	1.40	15.1	
and Chassis					Higher Catalyst					+2.1
Pickup Cab	Nissan	TL20F	119	Fed.	Volume and Loading	0.62	9.50	1.54	14.8	
and Chassis										
D50	Mitsubishi	G5T-C	121	Calif.	Pulse Air	0.26	3.83	1.20	22.0	-0.5
D50	Mitsubishi	G52T-F	121	Fed.		0.57	7.64	1.70	22.1	
D50	Mitsubishi	G5T-C	156	Calif.	Calibration	0.19	2.49	1.10	21.5	-4.4
D50	Mitsubishi	G52T-F	156	Fed.		0.75	7.17	1.80	22.5	
D50	Mitsubishi	G5T-C	156	Calif.	Calibration	0.26	3.54	1.10	21.7	--
D50	Mitsubishi	G54T-F	156	Fed.		0.17	3.42	1.20	21.7	
D50	Mitsubishi	G5T-C	156	Calif.	Calibration	0.20	3.16	1.20	21.4	-0.9
D50	Mitsubishi	G52T-F	156	Fed.		0.29	4.20	1.70	21.6	
Courier	Toyo Kogyo	CMAT	120	Calif.	Extra Speed Trans-	0.24	2.37	1.10	25.5	-5.6
Courier	Toyo Kogyo	CMAT	120	Fed.	mission, Calibration	0.40	6.23	1.49	17.0	
Courier	Toyo Kogyo	CWBT	140	Calif.	Calibration	0.24	2.50	1.20	20.0	-8.3
Courier	Toyo Kogyo	CWBT	140	Fed.		0.34	7.56	1.56	21.8	
Courier	Toyo Kogyo	CWBT	140	Calif.	Calibration	0.23	2.57	1.20	19.5	-4.4
Courier	Toyo Kogyo	CWBT	140	Fed.		0.26	6.72	1.56	20.4	
Land Cruiser	Toyota	2F(C)	258	Calif.	Calibration	0.22	3.40	1.18	11.8	
Hardtop										-4.1
Land Cruiser	Toyota	2F(F)	258	Fed.		0.44	8.73	1.80	12.3	
Hardtop										
Land Cruser	Toyota	2F(C)	258	Calif.	Calibration	0.24	3.10	1.42	11.5	
Sta. Sgn.										-0.9
Land Cruiser	Toyota	2F(F)	258	Fed.		0.49	9.49	1.70	11.6	
S/W										
4-WD Pickup SB	Toyota	20R(TC)	134	Calif.	Oxidation	0.15	1.89	1.40	18.0	+2.3
4-WD Pickup LB	Toyota	20R(TF)	134	Fed.	Catalyst	1.19	13.82	2.00	17.6	

Table L-1 (cont'd)

Emission and Fuel Economy Data for Light-Duty Trucks
Acquired From EPA's Emission Certification Tests for 1980 MY

Vehicle Model	ENGINE MFG	Family	CID	Fed. or Calif.	Additional Technology in California	4K Certification Levels HC	CO	NOx	MPG	Percent Difference
Long Bed Pickup	Toyota	20R(TC)	134	Calif.	Oxidation Catalyst	0.16	1.89	1.10	18.6	-6.5
Long Bed	Toyota	20R(TF)	134	Fed.		0.96	12.83	1.70	19.9	
Short Bed Pickup	Toyota	20R(TC)	134	Calif.	Manual Transmission, Oxidation Catalyst,	0.20	2.19	1.00	18.0	-18.9
Short Bed Pickup	Toyota	20R(TF)	134	Fed.	Calibration	0.64	9.87	1.60	22.2	
Bus	VW	11	120	Calif.	3-Way Catalyst,	0.19	3.80	0.70	16.5	-4.1
Bus	VW	11	120	Fed.	Closed Loop Carburetor, No EGR	0.91	13.00	2.00	17.2	
Camper	VW	12	120	Calif.	3-Way Catalyst,	0.28	7.60	1.10	15.7	-6.5
Camper	VW	12	120	Fed.	Closed Loop Carburetor, No EGR	0.79	10.00	1.50	16.8	
Truck	VW	37PC	97	Calif.	Oxidation	0.16	2.00	1.40	22.0	+1.9
Truck	VW	37PF	97	Fed.	Catalyst	1.30	5.73	1.50	21.6	
Truck	VW	37PC	97	Calif.	Oxidation	0.31	1.10	1.10	22.4	-1.8
Truck	VW	37PF	97	Fed.	Catalyst	1.20	6.06	1.80	22.8	
Truck	VW	37PC	97	Calif.	Oxidation	0.14	1.30	1.10	23.2	+1.8
Truck	VW	37PF	97	Fed.	Catalyst	1.40	6.47	1.80	22.8	

First of all, the technology applied in California was the "add-on" type and incorporated no technological improvements. The California strategies were designed to minimize production and tooling changes, i.e., manufacturers needed to change the large volume forty-nine state product to a "customized" product for the single state with stricter emission standards and not unreasonably chose the easiest method. Fuel economy was not as critical a design parameter as the economies of scale associated with the production of similar vehicles.

Secondly, as presented in Table L-6, the fleet-wide emission reductions required for California were significantly greater for HC and CO than those anticipated for 1983. Less than half of the California HC reduction and 12 percent less of a CO reduction are required. Only 5 percent more of a NOx reduction will be needed, and it can be reasonably argued that the 5 percent is not so much a reduction in emission levels but a reduction in emission variability.* Given the fact that less reductions are necessitated by the 1983 standards, it follows that the fuel economy impact will be similarly reduced. Experience tells us that HC control follows CO control (i.e. CO is the more difficult of the two to control in a catalyst system), hence a 12 percent less CO reduction should, at the least reduce the fuel economy loss by a similar amount, i.e., from -4.51 to -3.97 percent per manufacturer.

The staff's analysis indicates that in the <u>worst</u> case, i.e., where manufacturers ignore fuel economy considerations in engine design, and introduce no new technologies of the type already in production on 1981 passenger cars utilizing essentially the same power plants, then overall engine fuel economy will be reduced approximately 4 percent per manufacturer.

It is the staff's belief, however, that this worst case scenario is unlikely. New emission control technologies (in particular, electronic engine controls) are being marketed today which not only control emissions but also enhance fuel economy.

---

* No change in the statutory NOx standard has occurred, however, changes in the AQL level from 40 percent to 10 percent imply that either lower low mileage emission targets or lower variability will be required. The staff's projected 1983 low mileage NOx target of 1.4 g/mi is conservative and assumes high NOx variability on a test-to-test basis during SEA audits. This assumption is judged extremely conservative on the basis of audit data from the state of California).1/ This data indicates that in 534 tests of GM, Ford, IHC, and Chrysler LDTs, after application of EPA's estimated full life deterioration factors, 9.4 percent of the vehicles exceeded a NOx level of 2.35 g/mi; if a particularly variable Ford engine family is discounted (5.8M/6.6NA), then in 441 tests only 4.3 percent exceeded the 2.35 g/mi limit. In short, the industry is already meeting a 10 percent AQL level for NOx, no further reduction in design targets would be necessary, and therefore no fuel economy penalty associated with NOx control is expected.

Electronic engine controls are seeing widespread use in passenger cars in 1980, and in conjunction with three-way catalysts, will see even more use in 1981 as tighter NOx and fuel economy standards take effect. Two systems used today are General Motors' C-4 (Computer Controlled Catalystic Converter) system and Ford's EEC III system. Both systems control air/fuel ratio (for use with a three-way catalyst), ignition spark timing, air injection, EGR flow, and evaporative canister purge. In addition, the C-4 system controls idle speed and operation of the torque converter clutch; the EEC III also controls throttle kicker position. Each system allows highly accurate optimization of the combustion process over a wide variety of engine operating modes and conditions.

Matrix mappings of emission generation and fuel consumption are made for every possible combination of engine operating conditions.3/4/ Those conditions which are either determined by the driver (for design purposes, the "driver" is the Federal Certification Test Cycle), or which are environmental (engine temperature) are then optimized for fuel economy and emissions by generating the optimum combination of remaining engine parameters (e.g., spark advance, EGR rate, fuel/air ratio, etc.). Over the full range of operating conditions, these optimum parameters take the form of continuous mathematical functions, which are then programmed algorithmically into the control unit microprocessor.5/ The result is an engine whose calibration continuously varies in response to driver and environmental demands, and which is far superior to the static mechanical calibrations now present on all light-duty trucks.

It can be argued that engine calibrations significantly affect fuel economy and emissions, as illustrated in Table L-2. Several Federal engine families were merely recalibrated to meet the California standards, i.e., no hardware differences exist. Engine recalibration can lower the combustion temperature to reduce NOx (spark retard), and increase the rejection of thermal energy to speed catalyst light-off to reduce HC and CO; both effects reduce combustion efficiency, i.e., degrade fuel economy. Electronic controls can directly alleviate fuel economy penalties while also controlling emissions. For example, continuously variable spark timing allows cold start timing such that catalyst light-off is enhanced, and to a much greater degree than a single static timing position would allow. Once catalyst light-off has occurred (as determined by a temperature sensor), the control unit switches the timing to a more fuel efficient range. In short, both HC and CO cold start emissions are controlled and overall fuel economy is enhanced.

The magnitude of the fuel economy effect is dependent primarily upon engine size, vehicle inertia weight, and applied emission control technology. The National Highway Traffic Safety Administration (NHTSA) in its preliminary analysis of proposed 1983 fuel economy standards for light-duty trucks2/ concluded that even

Table L-2

Fuel Economy Effects of Several Emission Control Strategies in California Light-Duty Trucks**

Additional California Technology*	Number of Test Data Points on the Average	Average Fuel Economy Impact (%) $\Sigma(\frac{\text{Calif. mpg} - \text{Fed. mpg}}{\text{Fed. mpg}})/N$	Standard Deviation of the Average
3-way catalyst with feedback carburetors	3	-3.4	3.6
Calibration only	8	-3.2	2.7
Greater oxidation catalyst volume, loading, and additional AIR	8	-7.6	5.8
Light-off catalysts alone	3	-3.5	4.9
Light-off catalysts with all other changes	9	-5.7	9.3
Overall average without light-off catalysts	38	-3.9	5.5
Vehicle changes only	5	-4.5	4.5
Vehicle changes with all other changes	15	-4.4	9.07
Overall average	47	-4.3	6.3

* NOTE: Where no differences in emission control hardware are indicated between California and Federal vehicles (as evaluated from EPA Certification records), and significant emission level differences exist, this analysis assumes that a change in calibration (spark timing, distributor curve, carburetor setting) has occurred. It is understood that calibration changes can and may have occurred during the application of any other technology.

** This table makes no correction for 8-cylinder engine/higher inertia weight vehicles, (see Table L-3).

Table L-3

Projected Fuel Economy Impact of 1983 Regulations
(Using Current Engine Mix and No Technology Improvement)

Comparative Families (Fed./Calif.)	(# cylinders)	Fuel Economy* Impact (%)	Projected Sales Fraction**	Sales Weighted F.E. Impact
AMC BT9A1/BT6C1	(4)	+.5	.0093	+.0046
AMC CT3A1/CT4W1	(6)	-3.2,-8.5	.0241	-.1410
AMC CT3H1/CT4W1	(6)	+3.2	.0142	+.0184
AMC HT3A1/HT2V1	(8)***	-14.8,-11.6	.0060	-.0792
AMC NT3A1/NT3A1	(8)***	-4.0,-4.0	.0252	-.1008
Chrysler 225 BCP/BXP	(6)	+11	.0257	+.2825
Chrysler 318/360 BFP/BCP	(8)***	-4.0,-4.0,-11.5	.0391	-.2542
Ford 4.9 NA/ND	(6)	+3.7,-10.6	.0787	-.5430
Ford 5.0 NA/NB,NG	(8)***	-3.1,-2.0,-5.6 -8.2,-19.5 -15.6	.1341	-1.2717
GM 08K4G/08K4AA	(8)***	-4.0	.2277	-.9108
Nissan TL20F/TL20C	(4)	+2.1,-10.4,-9.2 -10.6	.0249	-.1749
Mitsubishi G527F/G57C	(4)	-.5,-4.4,0,-.9	.0099	-.0144
Toyo Kogyo OMAT/OMAT	(4)	-5.6	.0105	-.0589
Toyo Kogyo OWBT/OWBT	(4)	-8.3,-4.4	.0081	-.0529
Toyota 2F(F)/2F(C)	(6)	-.9,-4.1	.0026	-.0066
Toyota 20R TF/TC	(4)	+2.3,-6.9,-18.9	.0197	-.1520
VW 37PF/37PC	(4)	+1.9,-1.8,+1.8	.0026	+.0016
IHC V304/V304	(8)***	-6.1	.0047	-.0287
IHC V345/V345	(8)***	-4.0	.0053	-.0112
IHC 4-196/4-196	(4)	-5.7	.0016	-.0091
Isuzu AITAB/AITC	(4)	-6.0,0	.0178	-.0534
		Totals =	.6918	-3.57
Adjusted totals for sales not represented		=	1.0000	-5.15%

* From Table L-1.

** EPA certification records - manufacturer's projected sales for 1980.

*** It is assumed here that some 8-cylinder engines are used in vehicles whose inertia weight is high enough to result in certification to California standards comparably stringent to 1980 Federal standards (i.e., fuel economy comparisons are not indicative of the effects of the 1983 Federal standards). To compensate, a fuel economy penalty of 4 percent is assumed for all vehicles exhibiting less of a penalty. This 4 percent is based upon comments attributing a 4 percent loss on 8-cylinder engines due to air pump addition.

Table L-4

Impact of 1983 Regulations,
Using Projected Fleet Engine Mix
(Assuming No Technology Improvements)

	Adjusted Sales Fractions*		Adjusted Fuel Economy Penalty	
	1980***	1983	1980***	1983
4 cylinder	.151	.15	-.736	-.731
6 cylinder	.210	.40	-.563	-1.072
8 cylinder	.639	.45	-3.85	-2.711
Totals	.999*	1.00	-5.15	-4.51

* Some totals do not add up to 1.000 due to round-off error.

** For 1983 sales projections, see Chapter 5 of the Regulatory Analysis of this rulemaking.

*** From Table L-3.

Table L-5

Sales Weighted (by Current Federal Sales) Emission Contributions of 1980 Federal and California LDT Fleets

Comparative Families (Fed./Calif.)	4K Emissions (Fed./Calif.)			Sales-Weighted 4K Emissions (Fed./Calif.)		
	HC	CO	NOx	HC	CO	NOx
AMC BT9A1/BT6C1	.42/.18	5.62/2.47	1.50/1.30	.0039/.0017	.0523/.0230	.0140/.0121
AMC CT3A1/CT4W1	.42/.36	9.52/5.64	1.70/1.25	.0101/.0087	.2294/.1359	.0410/.0301
AMC CT3H1/CT4W1	.67/.40	6.35/4.43	2.00/1.41	.0095/.0057	.0902/.0629	.0284/.0162
AMC HT3A1/HT3V1	.84/.33	7.07/3.35	1.65/1.19	.0050/.0020	.0424/.0201	.0099/.0071
AMC NT3A1/NT3A1	.64/.37	13.00/9.50	1.51/1.84	.0161/.0144	.3276/.2394	.0381/.0464
Chrysler 225 BCP/BXP	.58/.23	11.00/1.81	1.60/1.28	.0149/.0059	.2827/.0465	.0411/.0329
Chrysler 318/360 BFP/BCP	.55/.30	10.35/7.90	1.18/1.45	.0215/.0117	.4047/.3089	.0461/.0567
Ford 4.9 NA/ND	.72/.24	6.90/4.15	1.46/1.75	.0567/.0189	.5430/.3266	.1149/.1377
Ford 5.0 NA/NB,NG	.60/.35	6.89/3.53	1.58/1.58	.0805/.0469	.9239/.4734	.2119/.2119
GM 08K4G/08K4AA	.54/.41	12.74/5.18	1.30/1.50	.1230/.0934	2.9010/1.180	.2960/.3416
Nissan TL20F/TL20C	.67/.21	9.25/2.59	1.57/1.13	.0167/.0052	.2302/.0645	.0391/.0281
Mitsubishi G52TF/G5TC	.45/.23	5.61/3.26	1.60/1.15	.0045/.0023	.0555/.0323	.0158/.0114
Toyo Kogyo OMAT/OMAT	.40/.24	6.23/2.37	1.49/1.10	.0042/.0025	.0654/.0249	.0156/.0116
Toyo Kogyo OWBT/OWBT	.30/.24	7.14/2.54	1.56/1.20	.0024/.0019	.0578/.0206	.0126/.0097
Toyota 2F(F)/2F(C)	.47/.23	9.11/3.25	1.75/1.30	.0012/.0006	.0237/.0085	.0046/.0034
Toyota 20R TF/TC	.93/.17	12.18/1.99	1.77/1.17	.0183/.0033	.2399/.0392	.0349/.0230
VW 37PF/37PC	1.30/.20	6.09/1.47	1.70/1.20	.0034/.0005	.0158/.0038	.0044/.0031
IHC V304/V304	.61/.65	4.72/4.98	1.75/1.36	.0029/.0031	.0222/.0234	.0082/.0064
IHC V345/V345	.57/.78	5.52/6.80	1.50/2.00	.0030/.0041	.0293/.0360	.0080/.0106
IHC 4-196/4-196	.50/.55	6.80/8.90	2.00/1.70	.0008/.0009	.0109/.0142	.0032/.0027
Isuzu AITB/AITC	1.40/.23	13.00/3.51	1.80/1.14	.0249/.0041	.2314/.0625	.0320/.0203
			Total =	.4235/.2378	6.779/3.1466	1.0198/1.0230
			Adjusted Totals* =			
			Federal:	.61	9.80	1.47
			California:	.34	4.55	1.48
			1983 Federal Targets:	.49	5.50	1.40

* Adjusted for sales not represented.

Table L-6

1980 California and Federal 4K Emission Levels
Sales-Weighted at 1983 Engine Mix (Fed./Calif.)

	1980*			1983*		
	HC	CO	NOx	HC	CO	NOx
4 cyl.	.1143/.0324	1.3867/.4120	.2480/.1764	.1135/.0322	1.3775/.4093	.2464/.1752
6 cyl.	.1336/.0575	1.6898/.8390	.3325/.3184	.2545/.1095	3.2187/1.5981	.6333/.6065
8 cyl.	.3643/.2538	6.7232/.3.326	.8936/.9850	.2565/.1878	4.7346/2.3423	.6293/.6930
1983 Federal Estimated Targets:				.49	5.5	1.4

	HC	CO	NOx
% Reduction from 1980 Federal to 1980 California:	-48%	-53%	-2.6%
% Reduction from 1980 Federal necessary for 1983 Federal:	-21%	-41%	-7.3%

* From Table L-5.
** Using adjusted sales fractions from Table L-4.

with a hypothetical 5 percent engine fuel economy penalty due to emission control in 1983, an overall increase in fleet fuel economy will occur due to vehicle improvements. Furthermore, it has been demonstrated that shifts in consumer buying habits toward more fuel efficient product lines in California have made the 1980 LDT California fleet more fuel efficient than the 1980 Federal fleet by 6.5 percent!7/8/ Shifts in market share do not directly offset the effects attributable to tighter emission standards, however, and it is viewing the engine as a separate entity with which the analysis will be primarily concerned.

NHTSA stated that it believed a 3 percent average fleet fuel economy improvement to be a reasonable estimate of the effect of electronic engine controls, presuming introduction of a variety of controls of varying levels of sophistication in 1982.6/ NHTSA also quoted a range of 3-5 percent improvement which they believed attributable to electronic engine controls.6/ The EPA Staff's analysis of electronic engine controls - in particular their availability and fuel economy potential - is presented in Reference 7. Based upon a review of the published literature, the Staff must conclude that electronic engine controls of moderate complexity (in particular electronic spark advance and EGR modulation) will be sufficient to offset the worst case 4 percent fuel economy impact of the 1983 emission standards on the average engine. (Note that there are HC and CO control strategies which do not degrade full economy, e.g., increasing oxidation catalyst volume and noble metal loading. In conjunction with electronic spark advance to handle transient warm-up/catalyst light-off conditions, the 1983 HC and CO standards will not be difficult to attain.) The EPA staff, however, takes issue with NHTSA's claim that the use of EEC's will become prevalent in 1982. This claim is too optimistic. The only electronic controls used in 1981 LDT's are a few California engine families (AMC, Ford), and to presume a 100 percent fleet conversion to EECs the very next model year (1982) is unreasonable. The EPA staff foresees a phased introduction of EECs into the Federal fleet beginning in 1982 and reaching universal incorporation by 1985. The motivating force for this introduction will be the need to maintain fuel economy with decreasing emission standards. This is the basis for EPA's position that no net fuel economy impact is attributable to the 1983 LDT standards, because moderately complex EECs will be incorporated at that time to allow simultaneous compliance with both emission and fuel economy standards. In short, no degradation in fuel economy is anticipated.

The staff also concludes that the exact control strategies used for 1983 will depend upon the fuel economy standards mandated by NHTSA. In the absence of a sizeable NOx reduction, the use of three-way catalysts and feedback carburetors is not necessary from an emissions standpoint. Compared to an engine with conventional EGR, however, a three-way system is more fuel efficient. With the statutory NOx reductions scheduled for 1985, the staff believes that three-way catalysts, feedback carburetors, and full electronic controls will be universally used in 1985 and later light-duty trucks. These will be basically the same systems which are already used on the 1981 passenger car fleet. Recognizing the fuel economy benefits of the three-way system, it is reasonable to conclude that this technology -- available today on a mass production basis - could, but most probably will not, be applied in 1983. On a fleetwide basis, electronic controls with infinitely variable calibration potential for spark timing and EGR modulation should alleviate any potential fuel economy penalty without the need for three-way systems, although that option does exist. These electronic controls need not be as complex as the more elaborate systems (e.g., General Motors' C-4) and hence need not be as expensive to manufacture.

In summary, the staff considers that the worst possible scenario for 1983 light-duty truck fuel economy involves absolutely no technological innovation. This "quick-fix" approach - with due regard to the relative stringency of the 1983 standards - would at most result in an engine fuel economy penalty of 4.0 percent. Even for this case, a net increase in fleet fuel economy is anticipated. However, tried and proven new control technologies are on the market today which can alleviate any engine fuel economy penalty attributable to the emission standards. More advanced technology - anticipated for 1985 at the latest - can increase fuel economy over and above the 1982 level. The staff believes that the majority of manufacturers will incorporate controls consistent with today's technologies (e.g., oxidation catalysts, EGR, air injection) in addition to electronic controls for spark timing and EGR modulation to maximize performance and fuel economy. Some manufacturers (Volkswagen, for example) may elect to introduce three-way catalyst/feedback carburetor systems in 1983 to enhance fuel economy. In conjunction with NHTSA's future fuel economy standards, the 1983 fleet will be more fuel-efficient than today's. As discussed above, technological modifications to achieve the 1983 emission standards need not degrade the fleet fuel efficiency of light-duty truck engines.

4. Recommendation

No net fuel economy penalty is attributable to the proposed light-duty truck emission standards within the range of cost effective technological options open to the industry.

References

1/ "Analysis of California 2% Audit Data," by T. Tesoriero, March, 1980, available in the Public Docket No. OMSAPC-79-2.

2/ "Preliminary Regulatory Analysis of Light-Duty Truck Fuel Economy Standards, Model Year 1982-85,", National Highway Traffic Safety Administration, December, 1979.

3/ "Optimization of Automotive Engine Calibration for Better Fuel Economy - Methods and Applications," U.E. Auiler, et al., SAE Paper 770076.

4/ "Spark Ignition Engine Fuel Economy Control Optimization - Technique and Procedure," T. Trella, SAE Paper 790179.

5/ "An Approach to a Standard Engine Management System for 1983 and Beyond," by R. Matney, et al., SAE Paper 800470, February, 1980.

6/ "Light Truck Average Fuel Economy Standards: Standards for 1982 Model Year," 45 FR 20874, March 31, 1980.

7/ "Electronic Engine Controls - Availability, Durability, and Fuel Economy Effects on 1983 and Later Model Year Light-Duty Trucks," by T. Cox, Z. Diatchun, T. Nugent, Draft EPA Technical Report, June 1980.

8/ "Passenger Car and Light Truck Fuel Economy Trends Through 1980," by J.D. Murrell, et.al., SAE Paper NO. 800853.

M. Issue: Environmental Impact

1. Summary of the Issue

In the draft Regulatory Analysis which accompanied the NPRM, EPA had, among other things, examined the environmental impact of the proposed regulations, the cost effectiveness of the proposal, and possible alternative actions. One reason for preparing these analyses was to satisfy the requirements of Executive Order 12044, Improving Government Regulations. A number of comments on the accuracy and completeness of the Regulatory Analysis materials were received during the comment period.

2. Summary of the Comments

Commenters identified what they felt were two missing elements in the analysis of the NPRM. These missing elements were in the cost effectiveness analysis and the requirement for preparation of pollutant specific studies.

Although EPA had evaluated the overall benefits and cost effectiveness of the rulemaking, comments were directed at a lack of analysis of individual components of the proposal. Such analyses, commenters believed, were required by Section 317 of the Clean Air Act and by Executive Order 12044. Included in the analysis of individual components (i.e., emission standards, diesel crankcase control, revised definition of useful life, revised durability provisions, revised maintenance provisions, SEA, PCA) should be a consideration of alternatives to those components.

Cummins engine company commented on EPA's failure to follow what it considered to be the standard setting framework of the 1977 Clean Air Act amendments for those light-duty trucks in the 6,000-8,500 lb. GVW range. Cummins interpretation of this standard setting framework is presented in Figure M-1. In that framework, the Administrator has two paths to follow in establishing target standards. The first is via the percent reduction requirements of Section 202(a)(3)(A)(ii). This section establishes the requirement for a 90 percent reduction in HC and CO for 1983, and a 75 percent reduction in NOx for 1985. The second path is via the "pollutant specific studies" of Section 202(a)(3)(E). On the basis of these studies, the Act allows the Administrator to change the above percent reduction standards for Section 202(a).

Once the target standards were established, the Administrator has the further option of a temporary revision to those standards based upon considerations of technology, cost and fuel penalty. If made, such a revision would be effective for a 3-year period, beginning 4 years after adoption.

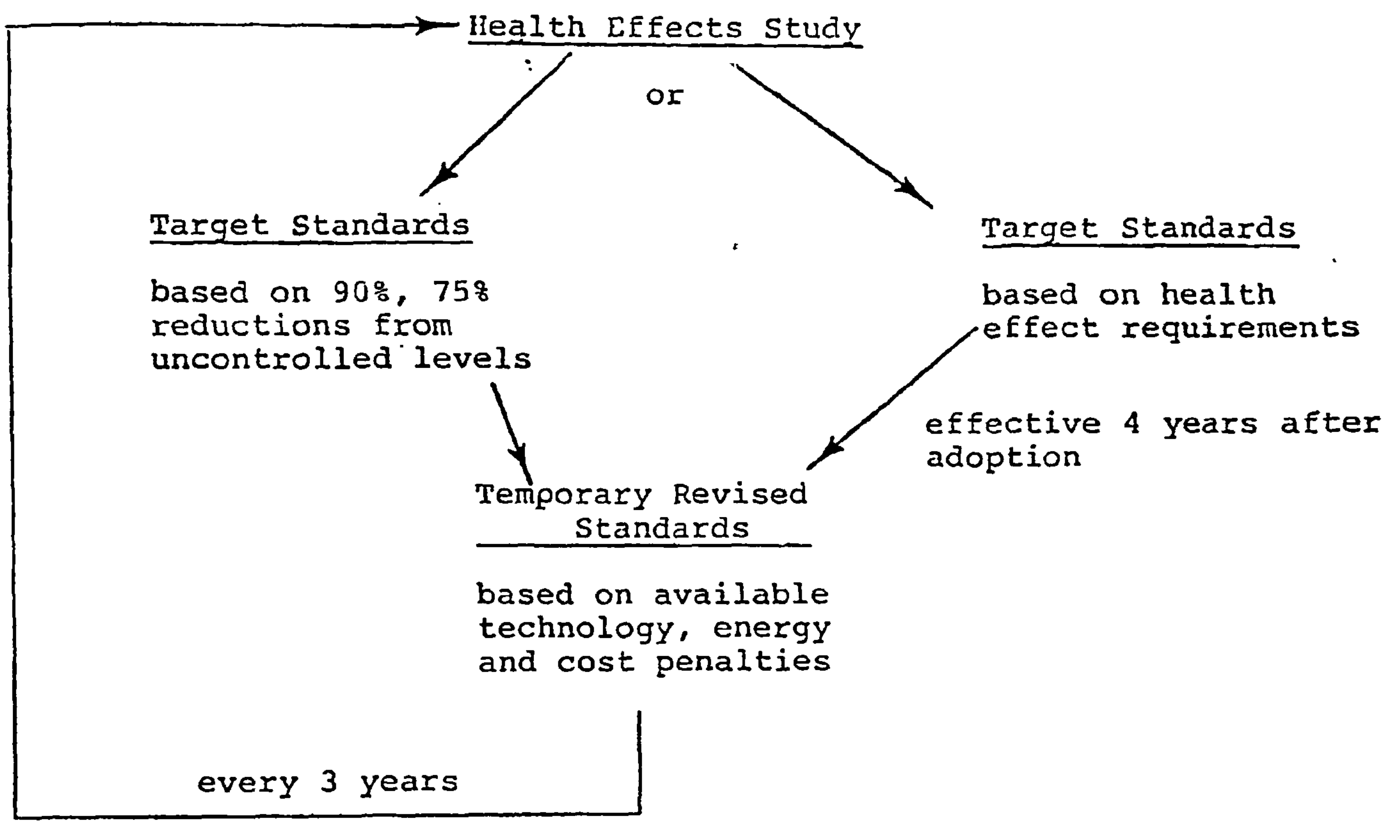
Cummins indicated that in its interpretation, this entire process was to have been completed by December 31, 1978, for standards effective in 1983. Every 3 years after that the process

FIGURE M-1

CLEAN AIR ACT

202(a)(3)(A), (B), and (E)

As Interpreted By Cummins



would be repeated, with an opportunity to change or vevise the standards once again. Cummins felt that, rather than simply relying on the statutory percentage reduction requirements, EPA was to conduct its standard setting while cognizant of the basic underlying purpose of the Clean Air Act to "promote the public health and welfare."

EPA received a number of specific comments (principally from Ford) on the methodology used to conduct its environmental analysis. Ford cited what it found to be incorrect treatment of California regions (which, of course, are subject to a distinct set of emission standards). Ford stated that "(t)he calculated air quality gains associated with this incorrect assumption are greater than the benefits associated with the proposed regulations." Ford also felt that the EPA analysis supported the position that most of the air quality gains expected in future years would occur whether or not the NPRM were finalized. Ford stated that redefined useful life and in-use vehicle durability testing were not proven to have a significant air quality impact. Ford indicated its belief that the benefits were so small as to be unnoticeable.

Ford went on to prepare air quality projections of its own, using the EPA MOBILE 1 and rollback models. The details of that analysis can be found in the Ford submission of October 11, 1979, beginning at page 4 of Section VI. The results supported Ford's position that the light-duty truck NPRM, as a whole, would have little air quality benefit compared to the air quality improvements already projected due to other source reductions, and that redefinition of useful life also has little or no associated benefit. Ford's analysis also indicated that a very moderate I/M program (10 percent stringency and no mechanics training) would provide a greater air quality benefit than those achieved by the proposed LDT standards in 1983.

In its air quality analysis, Ford also examined the proposed idle standards. Because of the regional nature of oxidant air pollution, Ford felt there was no basis for an HC idle standard. Relative to CO, Ford attempted to assess the effect of that proposed standard by applying speed correction factors to the EPA emission factors. These showed that the rollback model would predict a greater improvement in air quality for areas characterized by lower average traffic speeds than for areas characterized by higher average traffic speeds. Ford drew the implication that this "suggests that the idle mode for CO may not be as important as EPA seems to have implied ..."

Ford indicated that when the exhaust HC emission rates are broken down into methane and non-methane fractions, methane is shown to be a significant portion of the total. This methane fraction, Ford believes, should be excluded from exhaust measurements because it is photochemically inert.

Comment from GM and others pointed out that tamper-resistant components would be appearing on light-duty trucks. EPA's parameter adjustment regulations take effect in 1981 and 1982, and the impact of these regulations on in-use vehicle emissions needs to be accounted for in the analysis of benefits.

The Alaska Department of Environmental Conservation and the EPA Alaska Air Coordinator drew attention to the fact that emission rates for CO are known to be highly temperature dependent. They therefore felt that the projected emissions and air quality benefits for CO would not be fully realized in Alaskan regions.

3. Analysis of the Comments

The EPA staff shares the desire of commenters for a more detailed cost effectiveness analysis of the components of the rulemaking. However, as was noted in the preamble to the NPRM (44FR 40793, July 12, 1979), there was a lack of data on which to base such analysis. During the comment period, EPA has endeavored to collect sufficient information to examine costs and benefits associated with the several elements of the rulemaking. Although many of the difficulties facing the technical staff at the time of the NPRM are still present, an analysis of the elements of the final rulemaking has been prepared and can be found in Chapter VII of the Regulatory Analysis.

The Cummins interpretation of the 1977 Clean Air Act amendments regulatory scheme is not a new one to the EPA technical staff. This issue was also raised during the rulemaking action for 1984 and later heavy-duty engines.1/ Concerning the "pollutant specific studies" required under Section 202 (a) (3) (E), it is the technical staff's opinion that, although not specifically identified by that name, these studies have in fact been completed - first as part of the draft Regulatory Analysis, and now in the final Regulatory Analysis. The Regulatory Analysis takes a comprehensive look at the environmental impact (i.e. health and welfare effects via the ambient air quality standards) of the control strategy represented by the statutory 90 percent reductions. It also considers alternate standards of varying stringency, along with such aspects as costs and cost effectiveness.

The EPA technical staff does not subscribe to the dual path options as described by Cummins. In reality, if that approach were followed, the Congressionally prescribed percentage reduction targets would have no meaning and might never be used. It is most unlikely that the pollutant specific study would identify precisely the same percentage reductions contained in the Amendments. Rather, the process is a sequential one, wherein the pollutant specific study is used to evaluate the level or control desired by Congress from an environmental health viewpoint to determine its appropriateness. The study would consider the effects of the statutory percentage reductions, and if these were desireable and adequate in the context of emission reduction and air quality benefits, then those percentage reductions would be retained.

The Administrator could also decide to change the standard. Making this judgment would include consideration of such things as the gain or loss of benefits associated with more stringent or less stringent standards.

We do not view the pollutant specific studies as intended by Congress to double check the standard which it chose, or as a condition precedent to promulgating standards at the statutory levels. If that were the case, we would expect Congress to have first applied the concept to light-duty vehicles, not heavy-duty trucks. It is there that the greatest environmental and economic impacts of a given standard occur. Rather, the statutory percentage reductions serve as a starting point which represents the desire of Congress. The pollutant specific studies provide a means of changing those standards in the case of a significant environmental need to do so. This is consistent with the Clean Air Act provisions for the use of the pollutant specific study, which is, in the wording of Section 202 (a) (3) (E) (ii), for "changing any standard prescribed...." according to the statutory reductions.

The technical staff acknowledges that Congress had originally envisioned the above process as taking place in 1978, for standards applicable in the 1983 model year. For further discussion of this matter see "Issue E - Leadtime."

We will now turn to the comments on EPA's environmental assessment methodology. The technical staff agrees with the comments concerning analysis of California regions. Since California maintains its own emission standards, the staff recommends analyzing only non-California regions in the final Regulatory Analysis.

The technical staff also agrees with those commenters who pointed out that most of the overall air quality improvements projected for future years would occur whether or not new light-duty truck regulations are adopted. However, the staff strongly disagrees with the conclusion of commenters that the light-duty truck regulations are therefore unnecessary, or of minor value. For indeed, the overall air quality improvements can be broken down into any number of smaller increments related to various source categories - such as light-duty vehicles, heavy-duty trucks, and various stationary source categories. The fact that each of these categories produces incremental benefits which look small compared to the sum total cannot be used to dismiss the import of those categories, or the total benefit would soon be gone. The total array of air quality improvements resulting from other known control strategies here forms a backdrop or environment in which the light-duty truck regulations play a role commensurate with their relative emission rates.

Ford claimed that its air quality analysis indicated that redefined useful life and in-use durability testing had no proven benefit. That analysis was based upon Ford's interpretation and extension of work in the draft Regulatory Analysis. Ford used the "worst case" assumptions about in-use deterioration in its assessment. These worst case assumptions minimize the effects of extended useful life and over-state the relative importance of I/M programs. In preparing the final Regulatory Analysis, the technical staff has found that the worst case assumptions from the draft analysis were unnecessarily pessimistic, and has developed a more realistic approach. The final Regulatory Analysis also will analyze the benefits of individual components of the package and evaluate their cost effectiveness.

Concerning the need for idle standards, the technical staff has recommended elsewhere (Issue D - Idle Test and Standards) that the HC idle standard be deleted from the final rule. The staff has further recommended retention of the CO idle standard. The rationale for that decision is set forth in the above issue analysis. The argument here advanced by Ford using speed correction factors to the mobile source emission factors is tenuous at best. Ford itself hesitates to draw anything more than a "suggestion" from it. The speed correction factors are not valid means of estimating idle emissions. They apply to grams per mile emission rates, which clearly do not fit the idle case where the vehicle is emitting while standing still.

In agreement with the suggestion by Ford, the air quality analysis will be done on the basis of non-methane fractions of hydrocarbon emissions. This change makes the mobile source emission factors consistent with the non-methane hydrocarbon emission rates used for stationary source categories in the emission inventors data base. Cost effectiveness calculations, on the other hand, have historically been based on total hydrocarbons. Since total hydrocarbons are being reduced by the regulations, and since a prime function of cost effectiveness is to provide a measure for comparison with other strategies, total hydrocarbons will continue to be used for cost effectiveness.

The GM comments concerning the need to consider the pre-1983 impact of parameter adjustment regulations for light-duty trucks are well taken. The final Regulatory Analysis will include corrections to the emission factors to incorporate the effect of parameter adjustment.

Comments concerning CO problems in Alaskan regions were also valid. The emission factors used for the air quality assessment are not appropriate for areas of persistent low temperatures. Therefore, Alaskan regions, along with California and high-altitude regions, will be excluded from the air quality assessment. This does not imply a lack of benefit in Alaskan or high-altitude areas from this rulemaking. If, for example, manufacturers had to reduce cold-start emissions in order to meet their target emission levels, then Alaska might experience a substantially greater benefit than predicted. The staff does not believe that this rulemaking need include provisions or analysis for non-FTP test conditions since this problem is being looked at elsewhere. Further discussion can be found in Issue N: Special Exemptions.

4. Recommendations

The staff recommends that the following changes be included in the final Regulatory Analysis.

1. Expand the cost effectiveness analysis to include analysis of individual elements of the rulemaking.

2. Exclude California, Alaska, and high-altitude regions from the air quality assessment.

3. Consider non-methane hydrocarbon emissions in preparing the air quality impact analysis.

4. Incorporate the effect of light-duty truck parameter adjustment regulations into the 1981 and 1982 model year emission factors.

References

1/ For discussion see "Summary and Analysis of Comments to the NPRM: 1983 and Later Model Year Heavy-Duty Engines, Proposed Gaseous Emission Regulations," December 1979, p. 268.

N. Issue: Special Exemptions

1. Summary of the Issue

EPA has received comments in two areas that do not fall within the boundaries of major issue categories covered in this document. Both deal with special situations which the commenters believe require special treatment. These issues will be analyzed as Special Exemptions.

2. Summary of the Comments

a. Exemption From All Emission Regulations of Trucks up to 9000 Pounds Licensed as Agriculture Vehicles

The New Mexico Cattle Grower's Association (NMCGA) has requested an exemption from the new rulemaking and a modification of existing regulations for trucks up to 9,000 pounds that are licensed as agricultural vehicles. The following issues represent the Association's major justifications for exemption:

(1) Insignificant environmental degradation due to vast emission dispersion.

(2) Increased vehicle cost.

(3) Increased vehicle fuel consumption.

(4) Decreased vehicle reliability.

(5) Decreased vehicle power output.

(6) Catalytic Converters.

(a) Dual bulk storage requirement to handle unleaded fuel.
(b) Increased demand on unleaded fuel supplies.
(c) Conversion of other farm vehicles to unleaded fuel.
(d) Range fire potential.

(7) Electronic ignition problems of unreliability and unrepairability.

(8) Additional costs associated with these regulations will be borne by the consumer.

b. Low Temperature CO Emission Problem and Applicability of the Federal Test Procedure (FTP) to Areas With Typically Lower Operating Temperatures

The Alaska Department of Environmental Conservation (ADEC) and the Municipality of Anchorage have indicated concern over the proposed control measures and applicability of the FTP for areas that typically experience low-temperature winters. ADEC specifically addresses the need for certification or deterioration rate testing to be conducted over a full range of temperatures. Since Alaska's nonattainment problems are primarily related to cold starts, the Department indicates that if low cold-start test temperatures are not instituted, the added vehicular cost for emission control will not result in the stated 26 percent reduction of CO in Alaska or in other states experiencing wintertime CO problems.

Input from the EPA Air and Hazardous Waste Division and its Alaska Air Coordinator is in agreement indicating that the proposed regulations do not control cold temperature CO emissions or reduce CO emission by the aforementioned figure and should therefore be revised to control CO emissions at temperatures below 75° F.

3. Analysis of Comments

a. EPA's analysis of the NMCGA comments has indicated that direct application to non-agricultural vehicles can be made for a majority of the issues. EPA therefore, does not consider them adequate justification for regulatory exemption of the vehicles in question (light-duty trucks). Two concerns, however, the potential of catalyst ignited range fires and the requirement for dual bulk fuel storage capability, are directly related and deserve analysis.

Studies conducted principally by the U.S. Forest Service have indicated that catalyst equipped vehicles exhibit no significantly higher fire potential than pre-catalyst vehicles. This is because catalyst skin temperatures are similar to pre-catalyst exhaust system temperatures. These simple statements are not meant to evade the issue. EPA realizes the potential for some increased hazard in range or range like situations but we believe that control of the problem is the responsibility of the manufacturer. The failure or destruction rate of this equipment is an additional problem to be solved via the design route not through regulation revision.

Concerning the need to acquire bulk storage capability for storing unleaded fuel, it is important to note that catalysts are already in use on virtually all light-duty trucks as a result of existing regulations. Finalization of this rulemaking, therefore, will have no significant impact on that situation. Since the number of agricultural vehicles in this category is increasing each year it would appear reasonable to assume that a dual bulk storage capability is being acquired on an ever increasing number of ranches. Furthermore, the high potential that ranchers' private automobiles utilize unleaded fuel would serve as added incentive to acquire that capacity. It is also a logical assumption that the ever increasing demand for unleaded fuel will result in a proportional supply increase.

Other concerns, if these vehicles were exempt, include possible vehicle resale for full-time on road use. Emission control at that point would be nonexistent and it is unreasonable to assume, due to time and dollar costs involved, that control devices would be installed prior to resale. In addition, a production run to produce exempt vehicles would result in increased "special production" costs that may negate potential savings arrived at by catalyst or other emission control device elimination.

b. EPA recognizes the low temperature emission problem and that of applicability of the FTP to Alaska and further acknowledges existence of these problems in other areas of the country as well. The Agency is currently in the process of developing a cold room for the simulation of low temperature test conditions (20°F). Testing, to be conducted, will provide data required for the development of FTP guidelines for low temperatures.

The strategy for low temperature emission control assumes the use of electronic engine control systems. These systems provide the potential of greater benefit in the colder areas with Alaska being the case of point.

Since EPA recognizes that the current FTP does not accurately measure low temperature emissions it is understood that the estimated reductions of CO may not apply to Alaska or other low temperature areas. With the development of low temperature test procedures the Agency is, however, moving in a positive direction in its drive to reduce low temperature CO emissions and will continue to review potential alternative solutions to the issue presented.

4. Recommendations

No changes in the regulations are recommended in response to these issues.