Comments of the State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials on the U.S. Environmental Protection Agency's October 29, 1999 Notice of Proposed Rulemaking on the Control of Emissions from 2004 and Later Model Year Heavy-Duty Highway Engines and Vehicles and Revision of the Light-Duty Truck Definition (Docket No. A-98-32) December 2, 1999

The State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO) -- the two national associations of air quality officials in the 55 states and territories and more than 165 major metropolitan areas across the country -- would like to commend the U.S. Environmental Protection Agency (EPA) on its recent notice of proposed rulemaking (NPRM) on the control of emissions from 2004 and later model year onroad heavy-duty engines and vehicles and the revision of the light-duty truck definition, as published in the *Federal Register* on October 29, 1999 (64 FR 58471).

The regulation of heavy-duty engines and fuels is a critical issue for state and local air officials and we are pleased that, in its proposal, EPA not only looks beyond near-term needs, but also takes a comprehensive systems approach to controlling the onroad segment of this very significant source of air pollution.

As you are aware, for the past several years, STAPPA and ALAPCO have played an active role in the development of a systems approach for addressing emissions from cars and light trucks. We have been, and remain, vigorous advocates of strong programs for both federal Tier 2 motor vehicle standards and a national low-sulfur gasoline program because of a critical air quality need and the tremendous environmental benefits offered by these programs. We are equally committed to addressing heavy-duty engine emissions and diesel fuel quality with the same vigor.

We are, therefore, pleased to have this opportunity to provide our perspectives on this important proposal and offer the following comments and recommendations, both on background issues related to heavy-duty engines, vehicles and fuels and on specific aspects of the NPRM.

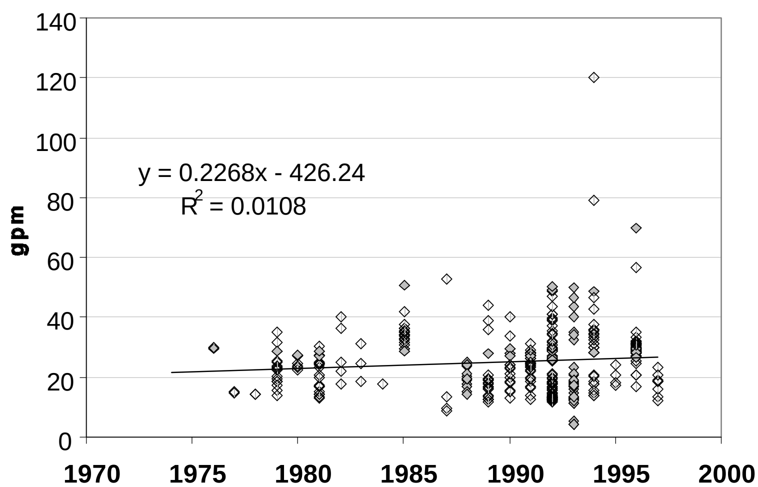
I. Background

A. Heavy-Duty Onroad and Offroad Vehicles and Engines Have Substantially Lagged Behind Light-Duty Vehicles in Terms of U.S. National Control Efforts

Although significant problems remain with regard to light-duty vehicles, as noted in EPA's recent Tier 2 proposal and STAPPA and ALAPCO's comments on that proposal (submitted to EPA Air Docket No. A-97-10 on July 28, 1999), no one can dispute that substantial progress has occurred with regard to the per-mile control of emissions from these vehicles, nor would we want to. However, at the same time, no one can question the fact that heavy-duty engines have received far less attention than light-duty vehicles, with offroad engines receiving even less attention than their onroad counterparts. As a result, advanced heavy-duty emission control technologies are far less utilized for these vehicles, as evidenced, for example, by the almost complete lack of aftertreatment technology on currently produced engines.

One measure of performance is the average actual in-use vehicle emissions rates of light- and heavy-duty vehicles. One recent study, summarized below, shows that per mile driven, a typical heavy-duty vehicle emits almost 50 times as much NO_x as a typical car.[1]

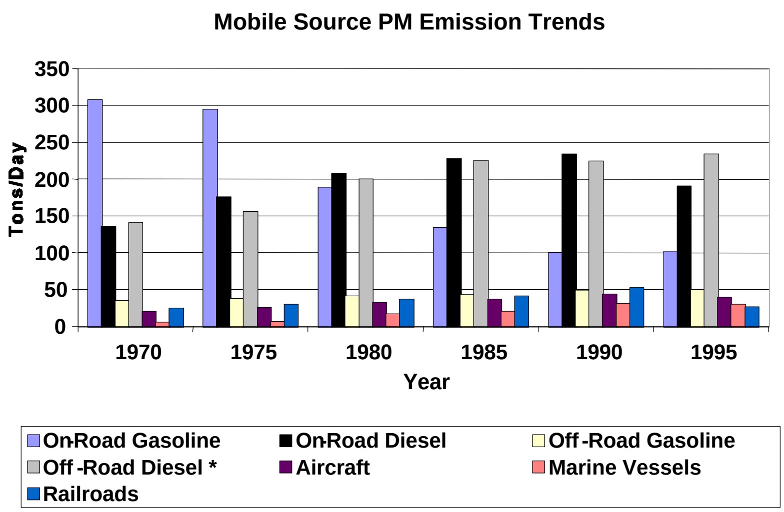
	Light Duty (gpm)	Heavy Duty (gpm)
CO	4.89 +/- 0.49	6.03 +/- 1.61
NMHC	0.29 +/- 0.06	0.68 +/- 0.20
NO_x	0.39 +/- 0.26	19.46 +/- 0.85



Another study, presented at a workshop organized by the California Air Resources Board (CARB), indicates that NO_x emissions rates from heavy-duty vehicles may actually have increased, rather than decreased, in recent years, as illustrated in the figure to the left.[2]

Further, as the bar chart below (from the same study as above) illustrates, whereas onroad gasoline vehicle emissions have declined substantially since 1970, both onroad and offroad diesel PM emissions have increased over this same time frame.

As a result of the newly emerging data, recent estimates of in-use heavy-duty vehicle emissions are much higher than those made just a few years ago. Summarized in the table below, for example, are CARB's previous (EMFAC 7G) and most recent (EMFAC '99) estimates.



*** Excluding farm equipment**

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(1) "Ambient Sampling of Diesel Particulate Matter," by Abu-Allaban, Coulombe, Gertler, Gillies, Pierson, Rogers, Sagebiel, Tarnay and Cahill.

(2) "Contribution of Motor Vehicles to Fine Particles and Hazardous Air Pollutants," presented by Eric M. Fujita, DRI, at CARB Workshop, July 29-30, 1999.

Heavy-Duty Vehicle Emissions in the South Coast Air District (tons per day)

	ROG		CO		NO_x		PM_{10}	
	EMFAC 7G	EMFAC '99	EMFAC 7G	EMFAC '99	EMFAC 7G	EMFAC '99	EMFAC 7G	EMFAC '99
1990	22.4	10.9	89.2	48.1	185.0	273.7	20.4	30.1
1995	22.6	11.9	107.6	49.6	177.7	286.3	15.6	20.7
2010	10.2	18.5	98.2	70.3	101.9	217.0	3.6	9.1

B. Heavy-Duty Vehicles and Engines Are An Increasingly Important Source of NO_x, PM, Toxics and Ozone Precursors

The national NO_x, VOC and PM_{10} inventories, summarized in the table below, indicate that emissions from "current" onroad and offroad vehicles account for about 54 percent of total NO_x emissions and 42 percent of total VOC emissions. These emissions are primary precursors to the formation of ground-level ozone. With close to 100 million people nationwide living in areas that continue to violate the one-hour standard for ozone, aggressive steps to address emissions from heavy-duty engines and their fuels are absolutely critical.

The PM emissions presented in this table represent total vehicle emissions, which include brake wear and exhaust. Excluding fugitive dust and wind erosion, vehicles account for about 10 percent of total PM emissions.

2000 National NO_x and VOC Emissions
(thousand short tons per year)

Emission Source	NO_x	VOC	PM_{10}
Light-Duty Vehicles	4,420	4,098	99
Heavy-Duty Diesel Vehicles	2,274	246	131
Heavy-Duty Gasoline Vehicles	318	198	8
Non-road	5,343	2,485	642
Other	10,656	9,567	8,206
Total Nationwide Emissions	23,011	16,594	9,086

In this proposed rulemaking, EPA has relied on very optimistic emission factors (as summarized below) to forecast future NO_x emissions from heavy-duty vehicles.

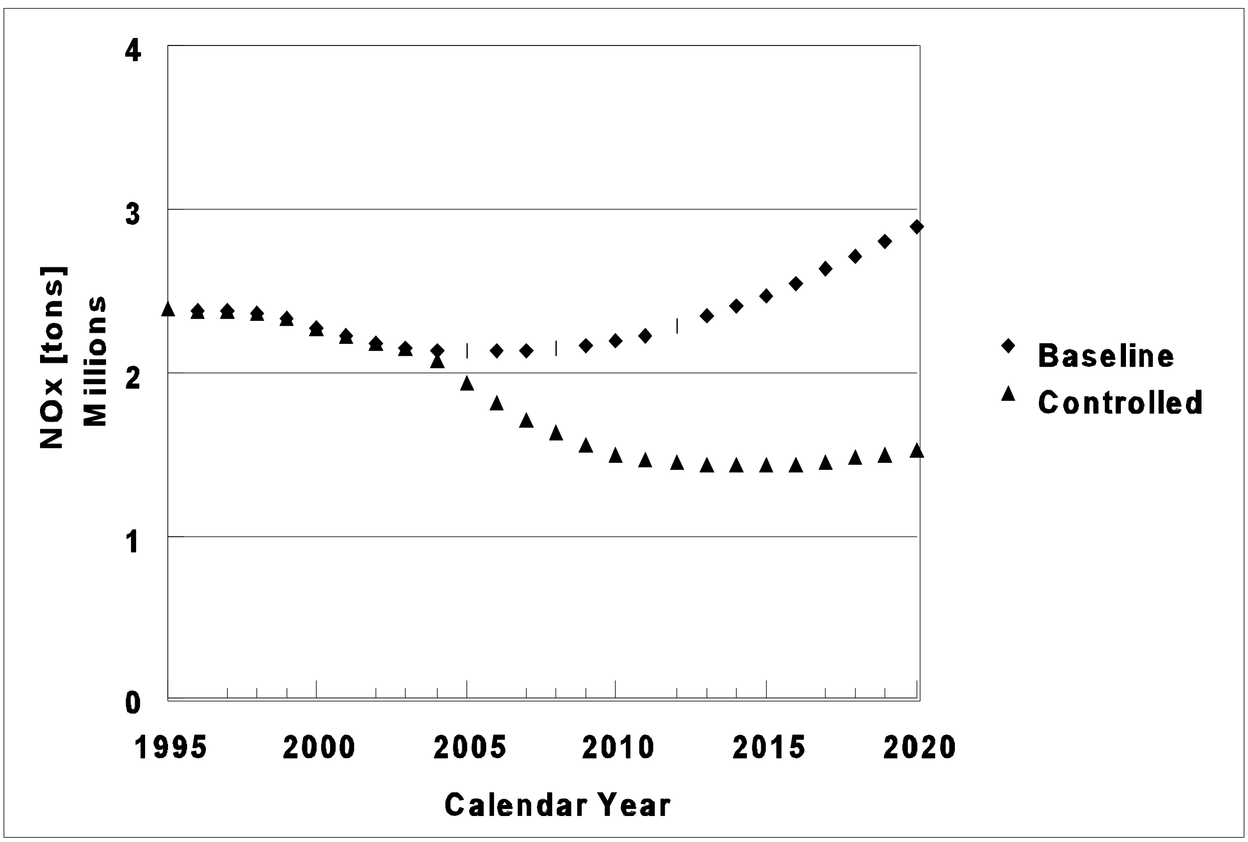
NO_x Emission Factors and Deterioration Rates for
2004 and Later Heavy-Duty Diesel Engines

	Zero-Mile Level (g/bhp-hr)	Deterioration Rate (g/bhp-hr per 10k miles)
Baseline	3.68	0.000
Controlled	1.84	0.000

It should be noted that each of these basic emission rate (BER) equations[3] predict that **emissions at the end of the useful life would be below the applicable standard**. Based on recent experience, this seems to STAPPA and ALAPCO to be a very optimistic approach.

The following figure (Figure 6-1 from EPA's Regulatory Impact Analysis for the NPRM) shows the national projections of total NO_x emissions with and without the proposed engine controls. The emissions are projected to decline over the next several years due to implementation of stricter controls, but even with the very optimistic assumption of no deterioration, they then begin to increase due to growth in the number of vehicle miles traveled, unless there are additional controls. By the year 2015, without these additional controls, total national NO_x emissions are projected to exceed current levels. The table following the figure presents these projections with the estimated NO_x benefits for selected years.

Projected National NO_x Emissions from HDDVs



(3) Basic emission rate (BER) equations describe emissions as a function of vehicle mileage for properly maintained non-tampered vehicles at specific standard conditions. The equations are in the form of zero-mile level (ZML) plus the product of a deterioration rate (DR) and mileage (M): BER = ZML + DR×M.

Estimated National NO_x Emissions and Proposed Benefits
from Heavy-Duty Diesel Vehicles (thousand short tons per year)

Year	Baseline	Controlled	Benefit
2000	2,274	-	-
2005	2,136	1,933	203
2010	2,191	1,504	686
2015	2,479	1,433	1,046
2020	2,900	1,535	1,365

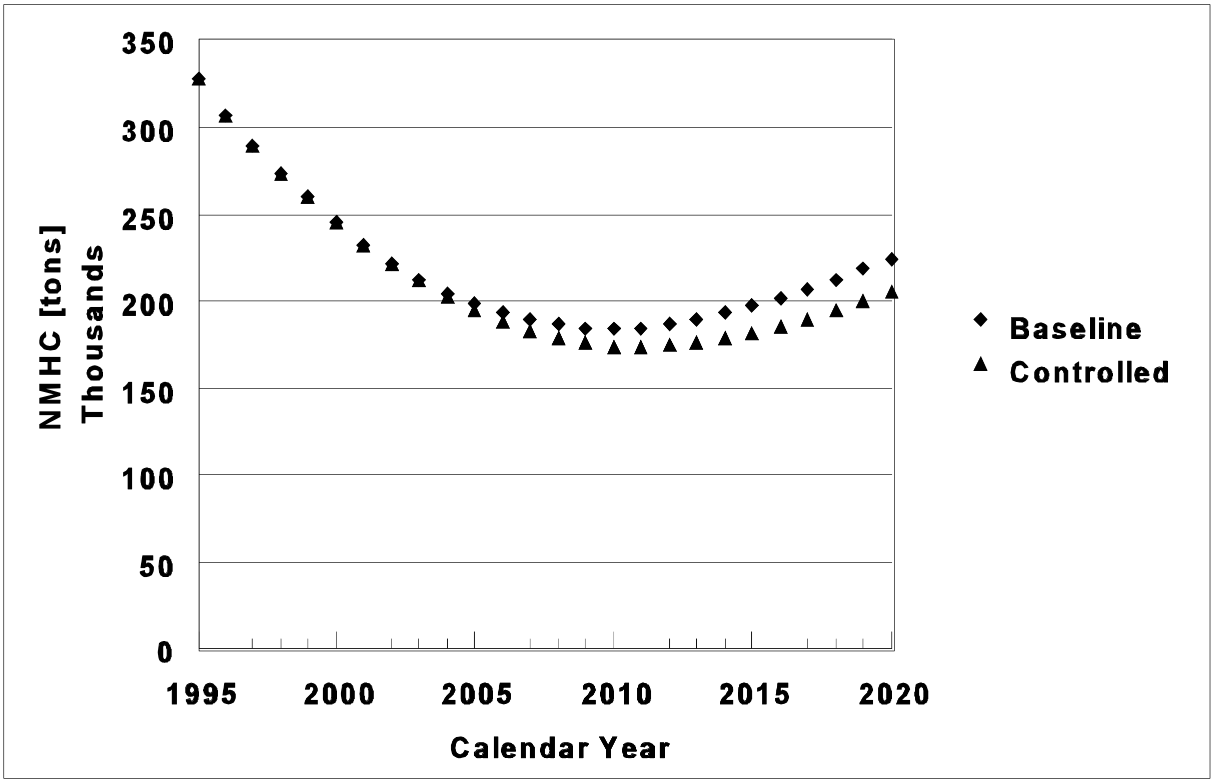
With regard to hydrocarbons, the emission factors were based on certification data with the assumption that the zero-mile level was equal to the sales weighted average certification emission level. The table below presents the baseline and controlled emission factors and deterioration rates; **again, EPA assumes no in-use deterioration**.

NMHC Emission Factors and Deterioration Rates for
2004 and Later Heavy-Duty Diesel Engines

	Zero-Mile Level (g/bhp-hr)	Deterioration Rate (g/bhp-hr per 10k miles)
Baseline	0.283	0.000
Controlled	0.257	0.000

The next figure (Figure 6-2 from EPA's Regulatory Impact Analysis) shows the national projections of total NMHC emissions with and without the proposed engine controls. The emissions are projected to decline over the next several years, due to implementation of stricter controls, but then begin to increase, even assuming no deterioration, due to growth in the number of vehicle miles traveled. The table following the figure presents these projections for selected years.

Projected National NMHC Emissions from HDDVs



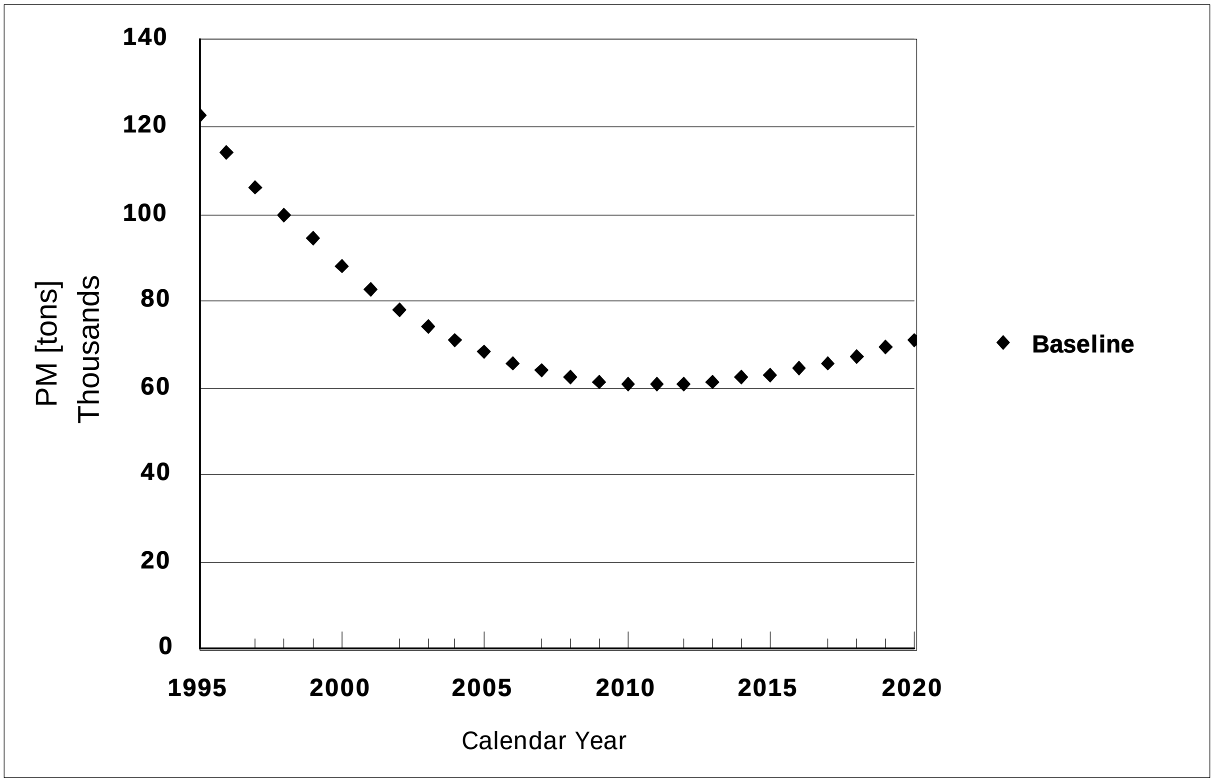
Estimated National NMHC Emissions and Proposed Benefits
from Heavy-Duty Diesel Vehicles (thousand short tons per year)

Year	Baseline	Controlled	Benefit
2005	198	196	3
2010	184	174	10
2015	197	182	15
2020	225	205	20

Particulate emissions pose a tremendous public health problem. The World Health Organization has concluded that, globally, particulate matter causes 460,000 premature deaths each year. The most hazardous particulate is that which is very small. It is these especially fine particles that are able to evade our respiratory defense mechanisms, lodge deep within our lungs and cause or contribute to a variety of health problems, including asthma, chronic bronchitis, pneumonia, heart disease and even premature death. Up to 95 percent of the fine particulate from diesels is smaller than one micron in diameter.

To show the impact of particulate matter from heavy-duty diesel engines on national air quality, EPA used the PART5 emission factor model for PM. This model assumes that engines certifying to the current heavy-duty diesel vehicle (HDDV) PM standard would have a zero-mile emissions level of 0.09 g/bhp-hr. **No deterioration was included in this analysis**. The following figure (Figure 6-3 from EPA's Regulatory Impact Analysis) presents the HDDV national PM emissions inventory.

Projected National PM Emissions from HDDVs



And, finally, there is the very serious health threat posed by the toxic emissions from diesels. Diesel exhaust contains over 40 chemicals that are listed by EPA and California as toxic air contaminants, known human carcinogens, probable human carcinogens, reproductive toxicants or endocrine disrupters. In 1998, California declared particulate emissions from diesel-fueled engines a toxic air contaminant, based on data that supported links between diesel exposure and human cancer.

There is also an array of other significant, adverse environmental impacts to which diesel emissions contribute, including regional haze, acid rain and global warming.

C. Due To The Interstate Nature of Heavy-Duty Vehicles and Engines, The Control Options Available To States Are Much More Limited Than For Light-Duty Vehicles

With regard to light-duty vehicles, California has demonstrated that it can effectively implement controls to the extent that federal controls are not considered sufficient. Further, other states can and have selected California's program when they have concluded that they need the additional control. However, a substantial fraction of heavy-duty vehicles is involved in interstate transport and if California attempted to regulate these vehicles, many truck companies could just move to another state. Therefore, California has deferred to the federal government on control of these vehicles and other states have no other option, as well.

In view of the above, STAPPA and ALAPCO conclude that the adverse health and environmental concerns associated with emissions from onroad and offroad heavy-duty vehicles and engines are very serious and will likely be growing in future years without significant additional control.

II. Aspects of The NPRM That STAPPA and ALAPCO Support

A. The previously adopted 2004 standards are determined to be technologically feasible

As EPA's Regulatory Impact Analysis makes clear, manufacturers have made significant progress towards meeting the 2004 standards, and, in fact, a large number of manufacturers will be meeting the 2004 model year standards by the end of 2002. Several key technologies for heavy-duty diesels that will allow them to meet the 2004 NMHC+NO_x standards are advancing rapidly. These areas include advanced fuel injection systems, EGR, advanced turbocharger systems and advanced electronic controls. In the relatively short time frame since the promulgation of the 1997 rule, manufacturers have either announced their intention to or begun to introduce second generation electronically controlled fuel injection systems, such as the Cummins Accumulator Pump system (CAPS), and the Navistar/Caterpillar second generation hydraulically actuated electronic unit injection (HEUI) and mechanically actuated electronic unit injection (MEUI) systems.[4,5,6,7,8] These newer systems provide manufacturers with enormous capabilities to tailor-fit engine injection pressures, injection rate shaping and pilot injection (or multiple pilot injections) to lower NO_x emissions while still complying with the current PM standard, and maintaining or improving upon the fuel efficiency, performance and durability expected by heavy-duty diesel engine users. These advanced fuel systems will be coupled with new, sophisticated EGR systems. Considerable research has been carried out in the last few years on the application of EGR to heavy-duty diesels in order to meet the 2004 standards. Based on this relatively recent information, it now appears manufacturers will use a combination of hot and cooled EGR, sometimes at relatively high EGR flow rates, on the order of 40-50 percent under certain operating conditions, to achieve the 2004 NMHC+NO_x standards. EGR is perhaps the single most significant advance in emission control technology for heavy-duty diesels and will enable the approximately 50-percent reduction in NO_x emissions required by the 2004 standards.

Cooled EGR is very effective at reducing NO_x emissions. Laboratory studies have shown that EGR can reduce NO_x emissions by up to 90 percent at light load and up to 60 percent at full load

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(4) "Advanced Technology Fuel System for Heavy-duty Diesel Engines," SAE Paper 973182,

(5) *Diesel Progress*, August 1998, "CAT Gears Up Next Generation Fuel Systems," available in EPA Air Docket A-98-32, Docket Item Number II-D-03

(6) *Diesel Progress*, August 1998, "Next Generation MEUI-B to Debut in 2001," available in EPA Air Docket A-98-32, Docket Item Number II-D-03.

(7) *Diesel Progress*, October 1998, "No Mistaking New Cummins ISL Engine," available in EPA Air Docket A-98-32, Docket Item Number II-D-04.

(8) "Cummins New Midrange Fuel System," presented by John Youngblood, Cummins Engine Company, at the SAE Diesel Technology TOPTEC, April 22, 1998; available in EPA Air Docket A-98-32, Docket Item Number II-D-01.

near rated speed.[9] Other studies have shown similar reductions at other speeds and loads.[10] In addition to fuel system changes and EGR, turbocharger manufacturers and engine manufacturers are in the process of developing new variable nozzle turbochargers (VNT, sometimes referred to as variable geometry turbochargers), as well as more advanced, electronically controlled wastegated turbochargers, for both performance and emission reasons. The new VNT systems will allow manufacturers more flexibility in how they design their EGR systems, and provide improved performance for engine users. Finally, engine manufacturers continue to develop and introduce highly sophisticated electronic control management systems based on the latest microprocessor technology available.[11] These next generation control systems integrate the complete engine/power train system, including the injection system, EGR and turbocharger, which allows the manufacturer to maximize the engine performance, as well as the emission control system.

The fact that several heavy-duty diesel engine manufacturers have agreed to meet the 2004 standards in 2002 gives additional confidence that the NMHC+NO_x standard being reaffirmed in the proposal is achievable for the 2004 model year.

B. The current loophole for SUVs and other passenger vehicles that weigh more than 8,500 pounds up to 10,000 pounds will be closed

Some sales in the heavy-duty vehicle category consist of vehicles that are more clearly designed for personal use, such as sport utility vehicles (SUVs) and passenger vans. All of these vehicles are below 10,000 pounds gross vehicle weight rating (GVWR). In addition, there will likely be an increase in new vehicle offerings marketed primarily for passenger transportation in this market segment in the future. As personal use passenger vehicles, they would be more likely to be used as personal transportation and operated under lightly loaded conditions most of the time. These passenger vehicles (both gasoline- and diesel-fueled) should be included in the Tier 2 program, tested as light-duty trucks and held to Tier 2 standards.

In order to accomplish this objective, the proposed regulations include a revised definition of "light-duty truck," designed to bring large models of SUVs and passenger vans into the proposed Tier 2 program. The proposed regulations also contain a parallel revision to the definition of "heavy-duty vehicle," in order to prevent an overlap in the vehicles covered by the two definitions.

Specifically, the proposed definition of light-duty truck seeks to include the targeted vehicles by stating that a light-duty truck, in addition to those vehicles that meet the current definition, is also any complete vehicle between 8,500 and 10,000 pounds GVWR that is designed primarily for

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(9) Dickey D.W., T.W. Ryan III, A.C. Matheaus: "NO_x Control in Heavy-Duty Engines-What is the Limit?," SAE Paper 980174, 1998; Zelenka P., H. Aufinger, W. Reczek, W. Cartellieri: "Cooled EGR-A Key Technology for Future Efficient HD Diesels," SAE Paper 980190, 1998.

(10) Kohketsu S., K. Mori, K. Sakai, T. Hakozaki: EGR "Technologies for a Turbocharged and Intercooled Heavy-Duty Diesel Engine," SAE Paper 970340, 1997; Baert R., D.E. Beckman, A.W.M.J. Veen: "EGR Technology for Lowest Emissions," SAE Paper 964112, 1996; and Heavy-Duty Engine Working Group, Mobile Source Technical Advisory Subcommittee of the Clean Air Act Advisory Committee: "Phase 2 of the EPA HDEWG Program - Summary Document," available in EPA Air Docket A-98-32.

(11) See, for example, Stover T.R., D.H. Reichenbach and E.K. Lifferth, Cummins Engine Co., Inc., "The Cummins Signature 600 Heavy-Duty Diesel Engine," SAE Paper 981035, February 1998.

personal transportation and has a capacity of up to 12 persons. STAPPA and ALAPCO support EPA's conclusion that such an expanded definition will capture SUVs, such as the Chevrolet Suburban and the Ford Excursion, and bring them into the proposed Tier 2 program. In fact, in STAPPA and ALAPCO's April 7, 1998 resolution on Tier 2, the associations urge EPA to consider applying the Tier 2 standards to those complete vehicles, such as SUVs, full-size vans and pickup trucks, weighing over 8,500 pounds GVWR used predominantly for personal transportation. With respect to EPA's proposed revised definition of light-duty truck, the associations recommend that the agency not limit affected vehicles to those with a capacity of up to 12 persons. Instead the definition should apply to all vehicles that otherwise fit the revised definition, irrespective of the number of passengers the vehicle can carry.

The table below identifies currently produced vehicles that STAPPA and ALAPCO believe should be subject to the Tier 2 program.

Passenger vehicles between 8,500 and 10,000 pounds GVWR

Vehicle	Vehicle Type	Manufacturer
Suburban	SUV	GM
Excursion	SUV	Ford
Express Wagon (G2500 and G3500)	passenger van	GM
Dodge Ram Wagon 3500	passenger van	Daimler Chrysler
Econoline Super-Duty Wagon (E250 and E350)	passenger van	Ford

Vehicles meeting the proposed additional element to the light-duty truck definition would be classified as heavy light-duty trucks (HLDTs) according to definitions that already exist in the regulations and, therefore, would be subject to the standards in EPA's proposed Tier 2 program.[12]

STAPPA and ALAPCO support EPA's proposal that vehicles weighing 8,500 to 10,000 pounds GVWR covered under the revised definition of light-duty truck discussed above, should meet the same standards as the LDT3 and LDT4 vehicles in Tier 2; that is, this new category of vehicles would be part of the Tier 2 HLDT program.

STAPPA and ALAPCO agree with EPA that these new HLDT vehicles are similar in engine design to existing LDT4 vehicles, and believe the technological feasibility arguments contained in the Tier 2 proposal apply to these vehicles, as well.

In addition, the tables below (from EPA's Regulatory Impact Analysis) provide certification results from either the 1998 or 1999 model year for various engines and vehicles. The engine data is from EPA certification data and the vehicle data comes from California medium-duty vehicle certification data. California vehicles were certified to the Tier 1 standards. The tables provide an indication of the emissions levels that have been achieved through the application of these technologies.

(12) LDT3s and LDT4s are considered heavy light-duty trucks.

1998 or 1999 Model Year Certification Data (g/mile)

Manufacturer	Model	Engine Size	GVWR (pounds)	NO_x (120k)	HC (120k)
Chrysler	Ram 3500 Cab Chassis	8.0	11,000	0.6 0.9	0.23 0.24
	Ram 3500 Cab Chassis	8.0	11,000	0.7 0.9	0.24
	Ram 3500 Cab Chassis	8.0	11,000	0.9	0.24
	Ram 2500 Pickup	8.0	8,800	0.5	0.19 0.21
	Ram 3500 Pickup	8.0	10,500	0.5	0.19 0.21
Ford	F250/F350	5.4	8,800- 9,700	0.209 0.212	0.301 0.314
	F250/F350 Dual rear wheel	6.8	8,800- 11,000	0.273	0.263
	E250 Econoline	5.4	8,550	0.289 0.446	0.295 0.300
	E350	5.4	9,100	0.278 0.654	0.263 0.283
	E250 Strip Chassis	4.2	8,550	0.161	0.111
	E350	6.8	9,400	0.299	0.270
	E350	6.8	9,300	0.308	0.296
	E350	6.8	9,300	0.364	0.276
	F250/F350	5.4	8,800- 9,700	0.209 0.212	0.301 0.314
	F250/F350 Dual rear wheel	6.8	8,800- 11,000	0.273	0.263
GM	K2500 Suburban	5.7	8,600	0.6	0.22
	K2500 Pickup	5.7	8,600	0.6	0.2
	K3500 Pickup	5.7	10,000	0.6	0.27
	K3500 Pickup	7.4	10,000	0.5	0.16
	C/K2500 4WD Pickup	6.0	8,600	0.4 0.5	0.14 0.12
	C/K2500 2WD Pickup	6.0	8,600	0.3	0.13
	C/K2500, 3500, Suburban, Express Van	6.0	8,600- 10,000	0.5 0.6	0.15 0.16

1998/1999 Model Year Engine Certification Data (g/bhp-hr)

Manufacturer	Engine size	NO_x	HC
Chrysler	5.9	3.8	0.4
	8.0	1.2	0.2
Ford	5.4	0.4	0.1
	6.8	0.1	0.1
	6.8	0.4	0.1
GM	4.3	1.1	0.3
	5.7	1.2	0.1
	5.7	1.7	0.2
	6.0	0.4	0.1
	7.4	2.3	0.3
	7.4	0.7	0.4

These data indicate that a large number of gasoline engine families between 8,500 and 10,000 pounds are already capable of meeting the NO_x standard of the highest bin under the Tier 2 interim program (0.6 g/mile), and a few are approaching the Tier 2 NO_x standard of 0.07 g/mile, and are within the highest NO_x bin under Tier 2 (0.2 g/mile NO_x). In addition, compared to the number of existing LDT3 and LDT4 vehicles, the number of vehicles captured by the new HLDT definition are relatively small (< 5 percent), and the averaging program proposed for Tier 2 will provide manufacturers with considerable lead time for applying control technology to these vehicles.

These new HLDTs are similar in their engine types and designs to existing LDT4 vehicles and, therefore, it is likely that these new HLDTs will employ essentially the same types of technologies as existing LDT4 vehicles to meet EPA's proposed Tier 2 standards. EPA estimates that bringing these new HLDTs under the Tier 2 program would cost $270 per vehicle, which is the same as for other LDT4s. Based on an estimate of approximately 75,000 vehicles affected, annual costs would equal about $20 million when the program is fully phased-in by 2009. Per-vehicle NO_x emission reductions of 4.3 g/mile would be expected from the current standards. This is a significantly larger per-vehicle reduction than expected for current LDT4s, so EPA anticipates the near-term cost effectiveness would be greater. STAPPA and ALAPCO agree with this conclusion.

Tier 2 standards are intended to be "fuel neutral." Under the principle of fuel neutrality, all cars and light trucks, including those using diesel engines, would be required to meet the same Tier 2 standards, as EPA has proposed. STAPPA and ALAPCO support this principle and agree with EPA that the proposed program, including the phase-in periods, would facilitate the advancement of clean diesel engine technologies. STAPPA and ALAPCO further believe that in the long term, the standards would be within reach for diesel-fueled vehicles in combination with appropriate changes to diesel fuel to facilitate aftertreatment technologies.

As discussed in the Tier 2 proposal, the emission reduction technology needed to meet these levels for a diesel HLDT would likely require advanced diesel aftertreatment devices, such as NO_x absorbers and PM traps. These technologies have the potential to provide emission reductions approaching 90 percent or greater. Considering the long lead time available to manufacturers, we believe these standards may be feasible for diesel HLDTs, including the vehicles that would be captured by the proposed change to the definition. In addition, the number of diesel-powered vehicles between 8,500 and 10,000 pounds GVWR that would be classified as HLDTs by the proposed new definition is very small, less than 0.5 percent of all HLDTs. EPA expects that averaging will likely provide the manufacturer with additional flexibility to meet both the interim and final Tier 2 standards.

Considering all of these factors (long lead time, averaging program, similarity to LDT3s and LDT4s and existing certification data), STAPPA and ALAPCO agree with EPA that these new HLDT vehicles will be able to meet the Tier 2 interim standards and the Tier 2 final standards. The conclusion of all of EPA's analyses is that the proposed Tier 2 standards for this new category of HLDT vehicles would be feasible for gasoline-fueled vehicles operated on low-sulfur gasoline. As gasoline-fueled vehicles represent the overwhelming majority of the HLDT population (>99.5 percent), including those covered by the proposed change in the HLDT definition, EPA proposes to find that the proposed standards would be feasible overall for HLDT vehicles. STAPPA and ALAPCO agree with this conclusion.

STAPPA and ALAPCO also believe the interim standards for HLDTs, as proposed under the Tier 2 program, are a key component of the Tier 2 program. The emission reductions to be achieved from this significant and ever-growing segment of the light-duty fleet as a result of the interim standards and, moreover, the timing of these reductions, are critical to state and local clean air efforts. The agency is considering adding a bin for HLDTs greater than 8,500 pounds GVWR for the 2004 thru 2008 model year time frame. This interim bin would not be available in 2009 and beyond, once the Tier 2 standards are fully phased in. This approach would create an appropriate opportunity for flexibility during the phase-in years. EPA believes that appropriate standards for an interim bin for HLDTs above 8,500 pounds GVWR are the existing California medium-duty vehicle LEV I standards for this category of vehicles (0.9 and 0.12 g/mile for NO_x and PM, respectively). Under this proposal, these chassis-based standards would already be in place for the heavy-duty vehicles between 8,500 and 10,000 pounds GVWR that would not be classified as HLDTs. In addition, manufacturers would already be meeting these standards in California, and could carry over California vehicles to the federal program. STAPPA and ALAPCO support this approach.

EPA specifically seeks comments on the appropriateness of the 10,000-pound GVWR limit as the upper cap for this program. Although we are concerned that wherever EPA places the dividing line, some manufacturers will go just beyond it if the standards above the line are more lenient, we believe the best solution is to have roughly equivalent standards for all categories of vehicles, thereby removing inappropriate incentives. Since it appears that by the 2007 timeframe this will be the case, STAPPA and ALAPCO support the proposal.

C. On-board diagnostic equipment will be required on vehicles up to 14,000 pounds

EPA's proposal also contains requirements for on-board diagnostic (OBD) systems (to check for faulty emission controls) on heavy-duty vehicles and engines up to 14,000 pounds GVWR, both Otto-cycle and diesel. The proposed OBD requirements are essentially equivalent to those already in place for light-duty vehicles and trucks, including the optional provision that allows demonstration of compliance with California OBDII requirements as a means of satisfying today's federal OBD requirements. The agency is proposing to include OBD requirements in this rulemaking because OBD systems help ensure continued compliance with emission standards during in-use operation and assist mechanics in properly diagnosing and repairing malfunctioning vehicles, while minimizing the associated time and effort. STAPPA and ALAPCO agree with this assessment of the benefits of OBD and EPA's related proposed requirements. The codification of OBD system requirements would also allow for potential inclusion of heavy-duty vehicles and engines in inspection/maintenance programs via a simple check of the OBD system.

STAPPA and ALAPCO agree with EPA that it is appropriate to extend OBD requirements to include heavy-duty vehicles and engines for many reasons. In the past, heavy-duty diesel engines have relied primarily on in-cylinder modifications to meet emission standards. For example, emission standards have been met through changes in injection timing, piston design, combustion chamber design, use of four valves per cylinder rather than two valves and piston ring pack design and location improvements. In contrast, the 2004 standards represent a significant technological challenge and, though manufacturers may make engine design changes to comply with those standards, EPA expects the 2004 standards will require EGR. Such "add on" devices can experience deterioration and malfunction that, unlike the engine design elements listed earlier, may go unnoticed by the driver.[13] Because deterioration and malfunction of these "add-on" devices can go unnoticed by the driver, and because their sole purpose is emissions control, some form of detection is crucial. Such detection can be effectively achieved by employing a well- designed OBD system.

The same argument is true for Otto-cycle heavy-duty vehicles and engines. While emission control is managed both with engine design elements and "add-on" devices, the "add-on" devices, particularly the catalytic converter, are the primary emission control features. The agency believes it is critical that the emission control system, particularly the "add-on" type systems, be monitored for proper operation to ensure that new heavy-duty vehicles and engines certified to the standards that EPA is proposing continue to meet those standards throughout their full useful life.

Further, the industry trend is clearly toward increasing use of computer and electronic controls for both engine and power train management, and for emission control. In fact, the heavy-duty industry has already gone a long way, absent any government regulation, to standardize computer communication protocols.[14] Computer and electronic control systems, as opposed to mechanical systems, provide enhancements in many areas including, but not limited to, improved precision and control, reduced weight and lower cost. However, electronic and computer controls also create increased difficulty in diagnosing and repairing the malfunctions that inevitably occur in any engine or power train system. EPA's proposed OBD requirements would build on the efforts already undertaken by the industry to ensure that key emission-related components will be monitored in future heavy-duty vehicles and engines and that the diagnosis and repair of those components will be as efficient and cost effective as possible.

For these reasons, most manufacturers of vehicles, trucks and engines have incorporated OBD systems that are capable of identifying when malfunctions occur and in what systems. In the

(13) Because these systems can deteriorate, STAPPA and ALAPCO believe, as noted earlier, EPA's forecast of future emissions from heavy-duty vehicles are unduly optimistic.

(14) See "On-Board Diagnostics, A Heavy Duty Perspective," SAE 951947 and "Recommended Practice for a Serial Control and Communications Vehicle Network," SAE J1939.

heavy-duty industry, those OBD systems traditionally have been geared toward detecting malfunctions causing driveability and/or fuel economy-related problems. Without specific requirements for manufacturers to include OBD mechanisms to detect emission-related problems, those types of malfunctions that could result in high emissions without a corresponding adverse driveability or fuel economy impact could go unnoticed by both the driver and the repair technician. The resulting increase in emissions and detrimental impact on air quality could be avoided by incorporating an OBD system capable of detecting emission control system malfunctions.

D. Some aspects of the heavy-duty diesel defeat device Consent Decrees, to make real-world emission control more likely, are codified

The goal of tighter standards is to ensure real-world emissions control over the broad range of in-use speed and load combinations that can occur, rather than just controlling emissions under certain laboratory conditions. Historically, EPA's approach to setting emission standards has been to establish a numerical emission standard on a specified test procedure and rely on the prohibition of defeat devices to ensure in-use control over the range of operation not included in the test procedure. No single test procedure can cover all real-world operation or conditions, particularly where certification is an engine-based test procedure rather than a vehicle-based procedure (i.e., heavy-duty diesel engines, heavy-duty Otto-cycle engines used in incomplete vehicles and heavy-duty Otto-cycle engines used in vehicles with a GVWR greater than 14,000 pounds). For example, the same engine used in both a 9,000-pound and a 15,000-pound vehicle would likely see much higher loads, on average, in the 15,000-pound vehicle. The defeat device prohibition is designed to ensure that emissions controls are employed during real-world operation and not just under laboratory or test procedure conditions. However, the defeat device prohibition is not a quantified numerical standard and does not have an associated test procedure. As a result, the current focus on a standardized test procedure makes it harder to ensure that engines will operate with the same level of control in the real world as in the test cell. To ensure that emission standards are providing the intended benefits in use, the agency must have a reasonable expectation that emissions under real-world conditions reflect those measured on the test procedure. The supplemental exhaust emission standards and test procedures for heavy-duty diesel engines are designed to supplement the current federal test procedure (FTP) standards and defeat device prohibition, and help ensure that the standards are providing the intended benefits in actual use.

In the Statement of Principles, signed by EPA, CARB and engine manufacturers, the signatories agreed to develop appropriate measures that ensure that emission controls are maintained throughout the engine's life. During the public comment period for the proposed 2004 standards for heavy-duty diesel engines, STAPPA and ALAPCO and others advocated establishing an in-use compliance program. The associations urged EPA to develop an effective in-use compliance program to ensure that heavy-duty engines comply with emission standards over their useful lives and noted that the current FTP does not adequately reflect all realistic driving conditions (for example, high speeds and loads), and that a more comprehensive approach is needed.

In the October 1997 final rule, EPA adopted a number of measures that STAPPA and ALAPCO supported, designed to improve in-use compliance for heavy-duty diesel engines. In summary, these measures included 1) extending the engines' useful life; 2) increasing the maintenance intervals for emissions-related components; 3) strengthening the warranty provisions for emissions defects and emission performance; 4) requiring that manufacturers provide owners with guidance on maintenance for emissions-related components and on responding to emission-related codes from on-board diagnostic systems; and 5) strengthening “anti-tampering” requirements for engine rebuilding.

Subsequently, it became clear that many heavy-duty engines currently are not meeting emission standards in use. EPA recently issued enforcement policy guidance to partially address this problem. Beyond this, EPA has proposed to add two supplemental sets of standards and test requirements for heavy-duty diesel engines: 1) a supplemental steady-state test and accompanying standards and 2) Not-To-Exceed limits. Like current standards, these new standards would apply to certification, production line testing and vehicles in actual use. All existing provisions regarding standards (e.g., warranty, certification, recall) would be applicable to these new standards, as well. The steady-state test is proposed because it represents a significant portion of in-use operation of heavy-duty diesel engines that is not adequately represented by the FTP. In addition, EPA proposed a third supplemental test procedure for heavy-duty diesel engines -- a Load Response Test -- as a data submittal requirement only; EPA does not propose emission limits for this test procedure at this time. The proposed Load Response Test also represents operation not adequately represented by the current FTP (harder accelerations), and could eventually be used to ensure effective control of NO_x and PM during this type of operation. STAPPA and ALAPCO strongly support adoption of these supplemental test requirements and emission standards because we believe they would enhance the likelihood that engine emissions are designed to achieve the expected level of in-use emissions control over all expected operating regimes in use.

STAPPA and ALAPCO believe that to ensure that emission standards actually achieve their intended environmental benefits, the emissions measured during engine test procedures must be indicative of emissions released during real-world operation. Recent advances in engine technology, such as electronic controls, have created the opportunity for a broader gap to exist between typical real-world operating conditions and those conditions represented by the current EPA test cycle. The inconsistencies between lab and real-world emissions reduce the certainty that emission standards will achieve their intended benefits. Enforcing compliance with the current regulations, including the defeat device prohibition, on a case-by-case basis has not been very successful and could actually become more difficult in future years as technology advances.

STAPPA and ALAPCO agree with EPA’s proposal to add a steady-state test cycle, similar to the test cycle found in the European “EURO III ESC Test,” to the current FTPs for heavy-duty diesel engines. Manufacturers should be required to meet the standards under this test cycle, as well as continue to meet the standards using the current test procedure (including the current transient test cycle).[15] The proposed supplemental steady-state test cycle is needed so that the FTP reflects a greater range of driving conditions experienced on the road, especially those relying on the increased use of electronic engine management systems. These electronic systems have the ability to optimize fuel economy during real-world driving, but often at the expense of emissions. The proposed steady-state test cycle represents an important type of modern engine operation in power and speed ranges that are typically used in practice. The mid-speeds and mid-to-high loads represented by the proposed steady-state test are the speeds and loads at which these engines are designed to operate for maximum efficiency and durability. Specifically, highway cruise speeds and loads fall into the operation represented by the proposed steady-state test.

(15) These requirements are consistent with those in the Consent Decrees recently signed with several heavy-duty diesel engine manufacturers.

STAPPA and ALAPCO strongly support the provision that the test must be conducted with all emission-related engine control variables in the maximum NO_x producing condition that could be encountered for a 30- second or longer averaging period at the given test point.

STAPPA and ALAPCO also strongly support the proposed provision that in addition to the 13 modes of the test cycle, EPA would have the opportunity to select an additional three test points as a check to ensure the effectiveness of the engine's emission controls within the control area (e.g., ensuring that emissions do not "peak" outside of the 13-mode test points). This requirement would ensure that an engine achieves emissions control throughout the typical operating range.

To help ensure that heavy-duty engine emissions are controlled over the full range of speed and load combinations commonly experienced in use, EPA is proposing to apply Not-To-Exceed (NTE) limits to heavy-duty diesel engines. The NTE approach establishes an area (the "NTE zone") under the torque curve of an engine where emissions must not exceed a specified value for any of the regulated pollutants.[16] The NTE standard would apply under any conditions that could reasonably be expected to be seen by that engine in normal vehicle operation and use. In addition, EPA has proposed that the whole range of real ambient conditions be included in NTE testing. STAPPA and ALAPCO strongly support the NTE proposal. These requirements should take effect starting in the 2004 model year and should apply to new engines, as well as in use throughout the useful life of the engine.

One of the important benefits of the NTE proposal, in the view of STAPPA and ALAPCO, in addition to helping to ensure emission benefits over the full range of in-use operating conditions, is that the NTE requirements are also expected to be an effective element of an in-use testing program. At the time of certification, manufacturers would have to submit a statement that their engines will comply with these requirements under all conditions that may reasonably be expected to occur in normal vehicle operation and use. The manufacturer must provide a detailed description of all testing, engineering analysis and other information that forms the basis for the statement. This certification statement must be based on testing and/or research reasonably necessary to support such a statement and on good engineering judgement.

STAPPA and ALAPCO agree with EPA that there are significant advantages to taking this sort of approach for heavy-duty engines. The test procedure is very flexible so it can represent most in-use operation and ambient conditions. Therefore, the NTE approach takes all of the benefits of a numerical standard and test procedure and expands it to cover a broad range of conditions. Also, with the NTE approach, in-use testing and compliance become much easier, since emissions may be sampled during normal vehicle use. A standard that relies on laboratory testing over a very specific driving schedule makes it harder to perform in-use testing, especially for engines, since the engines would have to be removed from the vehicle. Testing during normal vehicle use, using an objective numerical standard, makes enforcement easier and provides more certainty of what is occurring in use versus a fixed laboratory procedure.

Even with NTE requirements, EPA believes that it is still important to retain standards based on the current heavy-duty engine test procedure. This is the standard that EPA expects the certified

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(16) Torque is a measure of rotational force. The torque curve for an engine is determined by an engine "mapping" procedure specified in the Code of Federal Regulations. The intent of the mapping procedure is to determine the maximum available torque at all engine speeds. The torque curve is merely a graphical representation of the maximum torque across all engine speeds.

engines to meet on average in use. The NTE testing is more focused on maximum limits on emissions for segments of operation or engines used in certain applications or geographic regions and should not require additional technology beyond what is used to meet the applicable FTP standards. STAPPA and ALAPCO agree that basing the emissions standards on a distinct cycle and using the NTE zone to help ensure in-use control creates a comprehensive program. The existing duty cycle includes low speed and low torque operation that are not included in the NTE zone.

EPA has also proposed a supplemental Load Response Test for heavy-duty diesel engines, intended to represent a specific type of engine operation -- rapid transient acceleration -- that is not adequately represented in the current transient test procedure. Specifically, the supplemental Load Response Test is intended to address diesel engine emissions performance during rapid transient accelerations from any speed within the NTE zone. As proposed, the test focuses on quantifying PM and NO_x emissions during the portion of a truck's operation where it accelerates rapidly and where certain engine emission controls can be inadequate. In addition, this type of operation can often produce visible smoke, which is frequently noticed by the public and can influence their opinions about the cleanliness of diesel engines.

EPA is not proposing specific emission limits for this test procedure at this time, but only requiring that manufacturers of heavy-duty diesel engines submit test results as part of their application for EPA certification. The test results to be submitted at certification would include testing, at a minimum, at several engine speeds specified in the proposed regulations. The Consent Decrees with most of the heavy-duty diesel engine manufacturers establish target limits for the Load Response Test of 1.3 times the FTP standard for NMHC+NO_x and 1.7 times the FTP standard for PM. EPA notes that these limits may be appropriate and technologically feasible, but also recognizes that under the Consent Decrees there is a process of data collection and evaluation that could result in modifications to these limits sometime in the latter half of the year 2000. The data submittal requirements proposed in this NPRM are consistent with the requirements in the Consent Decrees.

EPA states that establishing a future Load Response Test with appropriate emission limits may be a valuable addition to EPA's compliance program, particularly for in-use onroad testing; when the process of evaluating the available data is complete, the agency intends to evaluate the addition of specific Load Response Test emission limits to the compliance program in a future supplemental proposal. The proposed data submittal requirement would enable a better understanding of the emissions that occur under this type of operation and would ensure that EPA establishes robust standards in a future action. Such a future action would consider including a requirement that manufacturers submit a statement of compliance at certification (similar to the approach proposed for the NTE emission limits). STAPPA and ALAPCO support the approach envisaged by EPA and will monitor the agency's follow through, as the data is collected, in taking future action to add appropriate emission limits and certification requirements.

The FTP and supplemental steady-state tests are laboratory-based test procedures that would be conducted under standard laboratory ambient conditions defined in the regulations, with emission results corrected according to existing regulations regarding laboratory testing procedures.[17] The

(17) The acceptable temperature range for FTP testing is defined by regulation as 68-86 degrees Fahrenheit. There is no specified humidity range, but NO_x emission results are to be corrected to 75 grains of water per pound of dry air.

NTE and verification of compliance with the Maximum Allowable Emission Limits could be conducted in the laboratory or during on-the-road driving, and the standards associated with these tests, where applicable, are proposed to apply under any ambient conditions. Within proposed temperature and humidity ranges, emissions from heavy-duty diesel engines must meet the requirements described above, without corrections for temperature and humidity. For situations in which the ambient conditions are outside these ranges, EPA proposes that NO_x be corrected for humidity and both NO_x and PM be corrected for temperature. Corrections would be to the end of the specified temperature or humidity range nearest the actual ambient conditions. STAPPA and ALAPCO strongly support applying this expanded range of ambient conditions to the new supplemental test procedures, and believe this expanded range should apply beginning with the 2004 model year, at the latest.

For emission results to be compared to the NTE emission limits, EPA has proposed that the temperature range be from 55 to 95 degrees Fahrenheit (12.8 to 35.0 degrees Celsius) and that the humidity range be from 50 to 75 grains of water per pound of dry air (7.14 to 10.71 grams of water per kilogram of dry air). The proposed temperature range encompasses the conditions exhibited on most days on which an exceedance of the ozone NAAQS is observed. In addition, EPA analyses pertaining to a recent rulemaking effort concluded that the “typical” ozone nonattainment day exhibits a maximum temperature between 90 and 95 degrees Fahrenheit. The relative humidity range being proposed reflects the current understanding of humidity corrections, in that higher humidity typically results in lower NO_x levels. Therefore, NO_x test results from a truly hot and humid day (e.g., a “typical” ozone exceedance day where the maximum temperature is in the 90s and the humidity is about 100 grains of water per pound of dry air, or 40 percent relative humidity) would be adjusted upward by the correction factor when correcting back to the drier conditions of the specified range, thus providing environmental protection during hot and humid conditions typical of ozone exceedance days. For emission results to be compared to the Maximum Allowable Emission Limits, EPA has proposed that NO_x emissions be corrected to a standard level of 75 grains of water per pound of dry air and that NO_x and PM emissions be corrected to the nearest endpoint of the range from 68 to 86 degrees Fahrenheit if tested outside this range. The proposed corrections for verifying compliance with the Maximum Allowable Emission Limits would correct emission results to standard laboratory conditions used for FTP testing because these emission limits are derived from testing under the standard laboratory conditions. STAPPA and ALAPCO support the concept that emissions limits be achieved under the range of conditions typical of days when ozone exceedences occur.

Modern heavy-duty diesel and gasoline engines make extensive use of electronics for engine control and management. Heavy-duty engines make extensive use of on-board computers for fuel system control and other emission-related component control, which in the future will likely include cooled EGR systems on heavy-duty diesel engines. Many of these newer systems make use of Controller Area Networks as a means of communicating information from the on-board electronic control module (ECM) to other on-board sensors and control devices (such as fuel injectors, rail pressure for common rail systems, boost-pressure sensors, coolant level sensors and coolant temperature sensors). These on-board systems control many aspects of emission related components, including fuel and air management components. EPA is concerned that electronic controls (or any other auxiliary emission control devices) not be used in such a way as to result in higher emissions from heavy-duty engines in use than would be seen during certification or laboratory testing. Therefore, EPA must have access to this information. EPA has, therefore, proposed that, upon the agency’s request, engine manufacturers must provide to EPA hardware and/or documentation necessary to read and easily interpret (in engineering units, if applicable) any information broadcast by on-board computers and ECMs that relates, in any way, to emission control devices and auxiliary emission control devices (AECD). This proposed requirement includes access to proprietary code information that could not otherwise be interpreted by parties other than the engine manufacturer; EPA would retain any legitimate confidential business information as such. This requirement could include the delivery, upon request by EPA, of the most up-to-date scan tool hardware used by the engine manufacturer for monitoring, interpreting and recording all emission-related electronic input and output data broadcast on an engine's on-board controller network. The requirement could also include access to passwords that would enable a generic scan tool or personal computer to read and interpret proprietary codes, if such passwords exist. Based on the recent experience involving the use by some engine manufacturers of defeat devices on heavy-duty vehicles, STAPPA and ALAPCO fully support EPA's proposal.

III. Aspects of The Proposal That STAPPA/ALAPCO Believe Need To Be Improved

While STAPPA and ALAPCO are pleased with the aforementioned aspects of the proposal, there are several significant deficiencies, as summarized below, which we urge be corrected in the final rule.

A. EPA should tighten the heavy-duty particulate standard to 0.05 g/bhp-hr by 2004

As noted above, particulate in the air is a major health and environmental concern and, due to its size and composition, diesel PM is more hazardous than most. In view of this, it is alarming that EPA has not tightened the heavy-duty standard since 1994 and is not now proposing that any tightening occur in 2004. In the draft Regulatory Impact Analysis, EPA states that it does not believe more stringent standards for the 2004 model year are technologically feasible, giving appropriate consideration to cost, energy and safety factors. However, STAPPA and ALAPCO believe that technologies exist or could exist by 2004, which could significantly lower PM emissions by at least 50 percent. Given the serious hazards associated with diesel PM, the standard should be reduced to 0.05 g/bhp-hr.

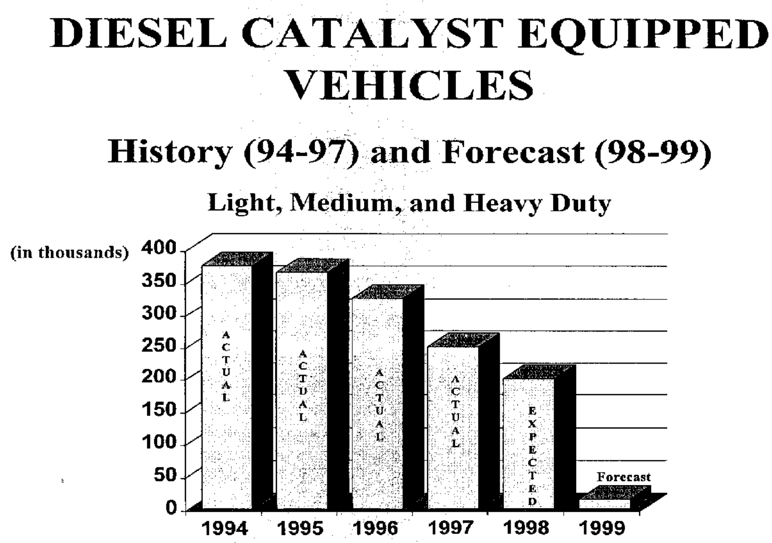
Two aftertreatment technologies have received the most attention for particulate control: the flow-through oxidation catalyst and the particulate trap. The oxidation catalyst provides relatively moderate overall PM reductions by oxidizing a portion of the particulate as the exhaust passes through it. Oxidation catalysts are relatively inexpensive and are now being used by engine manufacturers on some engines to meet the current 0.10 g/bhp-hr PM standard (0.05 for urban buses). They are also being retrofitted to many vehicles under EPA's retrofit-rebuild program.

Particulate traps capture a very high percentage of the particulate and hold it until the PM can be oxidized. Because diesel exhaust almost never reaches the high temperatures needed to ignite the PM, oxidation requires either an external heat source or engine modifications to temporarily raise temperatures or a catalyst material to lower the oxidation temperature of the PM. Particulate traps have not gained wide acceptance and use in the U.S. because, to date, EPA has not set standards sufficiently stringent to require their use. However, research on traps has been on-going, and some recent iterations look promising; in Europe, traps will be introduced on some new cars next year and many heavy-duty vehicles have been retrofitted with good success.

1. Diesel Oxidation Catalysts

As mentioned above, engine manufacturers have used diesel oxidation catalysts (DOC) for several years, but failure to tighten standards has allowed manufacturers to gradually reduce their use. For the 1994 model year, about 30 percent of engine families certified were equipped with oxidation catalysts (with the exception of urban buses, all of these were either light or medium heavy-duty diesel engines). Another 30 percent of the engine families were certified to PM levels above the 0.10 g/bhp-hr standard through the averaging, banking and trading program. Recent sales data on the use of oxidation catalysts for heavy-duty vehicles from the Manufacturers of Emission Controls Association (MECA) shows a continual decrease in the number of DOCs being sold in the U.S., as illustrated in this figure.

U.S. Sales Figures for HD Oxidation Catalysts



Flow-through oxidation catalysts oxidize both gaseous hydrocarbons and the portion of PM known as the soluble organic fraction (SOF). The SOF consists of hydrocarbons adsorbed to the carbonaceous solid particles and may also include hydrocarbons that have condensed into droplets of liquid.[18] The carbon portion of the PM remains essentially unaffected by the catalyst. In recent years, SOF has been reduced through new piston ring designs for oil control and fuel injection and combustion chamber modifications for more complete combustion of the fuel. The amount of SOF varies widely among engines, but SOF often makes up 30 to 60 percent of the total mass of PM. Catalyst efficiency for SOF varies with exhaust temperature in the range of about 50 percent conversion at 150°C to more than 90 percent above 350°C.[19] Typically, exhaust temperatures during the heavy-duty FTP fluctuate between 100°C and 400°C.

Improvements in catalyst technology have been hindered to some degree by sulfur contained in diesel fuel. Especially at higher exhaust temperatures, catalysts oxidize sulfur dioxide to form sulfates, which contribute to total PM emissions. Catalyst manufacturers have been successful in developing catalyst formulations that minimize sulfate formation.[20] Catalyst manufacturers have also compromised in the placement of the catalyst, such that the exhaust is warm enough to

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(18) Johnson, J., S. Bagley, L. Gratz, D. Leddy, "A Review of Diesel Particulate Control Technology and Emissions Effects - 1992 Horning Memorial Award Lecture," SAE Paper 940233, 1994.

(19) Meeting between EPA and the Manufacturers of Emission Controls Association, April 1995.

(20) Voss K., Y. Bulent, C. Hirt, R. Farrauto, "Performance Characteristics of a Novel Diesel Oxidation Catalyst," SAE Paper 940239, 1994.

achieve the needed SOF reduction, but not so warm as to cause substantial sulfate formation.[21] Manufacturers have noted that fuel with sulfur concentrations lower than 0.05 weight percent would permit the use of more active, higher efficiency oxidation catalysts. Recently published reports show that for modern heavy-duty diesel engines, palladium-based oxidation catalysts can achieve an approximate 30-percent reduction in PM under steady-state (European 13-mode) operation using current U.S. diesel fuel, and these formulations show good durability.[22]

A recent test program sponsored by MECA included the testing of several oxidation catalysts on a modern heavy-duty diesel engine certified to the 1998 U.S. heavy-duty standards. The results of this report showed up to a 29-percent reduction in PM over the transient FTP, and PM reductions ranging between 0 and 67 percent on a series of 13 steady-state modes, with one high-load mode showing a slight (15-percent) increase in PM due to sulfate formation. These results all occurred with a typical D2 diesel fuel used in the U.S. today (with a sulfur content of approximately 350 ppm).[23] This project also reported an additional 13-percent reduction in PM from the use of low-sulfur diesel fuel (54 ppm).

STAPPA and ALAPCO conclude that oxidation catalyst development and use are likely to continue and should enable engine manufacturers to achieve a standard of 0.05 g/bhp-hr by 2004.

2. Particulate Trap

The promise of particulate reductions of greater than 90 percent and the 1994 and later PM standard of 0.10 g/bhp-hr prompted the development of particulate trap technology in the late 1980s. Particulate trap filters that capture a high percentage of the PM in the exhaust stream were developed. These initial particulate trap filters needed to be regenerated (cleaned) after a period of time because the filters eventually began to fill up, creating unacceptable back pressure on the engine. Engine manufacturers have been able to meet the 1994 particulate standards with engine modifications, using oxidation catalysts where necessary, and no trap-equipped engines were certified for the 1994 model year.

Several companies and universities are developing a new generation of trap technologies that have the potential to be simpler, more reliable and less expensive than previous systems. The majority of research and development is focused on devising new methods for trap regeneration. A number of active and passive trap regeneration methods are in various stages of development and testing.

Many regeneration techniques being researched involve using catalyst materials that lower the PM oxidation temperature to the range normally experienced in diesel exhaust. The addition of a catalyst often provides HC reductions, as well. Such systems are often called passive regeneration systems because they do not require some action to take place for regeneration at regular intervals,

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(21) Johnson, J., S. Bagley, L. Gratz, D. Leddy, "A Review of Diesel Particulate Control Technology and Emissions Effects - 1992 Horning Memorial Award Lecture," SAE Paper 940233, 1994.

(22) Kawanami, M., M. Horichi, H. Klein, M. Jenkins, "Development of Oxidation and de-NO_x Catalysts for High Temperature Exhaust Diesel Trucks," SAE Paper 981196.

(23) "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels: Interim Report Number 1: Oxidation Catalyst Technology," prepared for the Manufacturers of Emission Controls Associations, December 1998; copies available in EPA Air Docket A-98-32, Docket Item II-D-07.

such as heating the PM or blowing the PM out of the trap. Instead, regeneration occurs somewhat continuously depending on the exhaust gas temperature. Catalysts, both in the form of coatings and fuel additives, are being developed. Johnson-Matthey has developed a system that places a catalyst at the inlet facing of the trap filter, such that the exhaust flows though the catalyst before entering the filter. The catalyst will oxidize sulfur and Johnson-Matthey is requiring the use of fuel with a sulfur level much lower than EPA specifications. One recent study utilizing this type of trap reported large reductions in both mass-based PM and HC on a modern, direct-injection, turbo-charged, intercooled, 6.8-liter heavy-duty engine, but the system requires ultra-low-sulfur fuel, less than 10 ppm.[24]

Several companies have explored the use of fuel additives that assist in the regeneration process by lowering the PM ignition temperature. For example, fuel additives including a cerium-oxide additive have been developed by Rhodia Chimie (formerly Rhone-Poulenc) and a copper-oxide additive has been developed by Lubrizol Corporation.

A recent test program sponsored by MECA included the laboratory testing of two PM filter technologies on a modern heavy-duty diesel engine certified to the 1998 U.S. heavy-duty standards.[25] One filter employed a catalytic coating applied directly to the filter element (System A), while the second filter technology utilized a catalyst element placed directly upstream of the filter element (System B). System A was tested on D2 diesel fuel with current sulfur levels (368 ppm), while System B, which required low-sulfur fuel, was tested with a low-sulfur (54ppm) diesel fuel. System A was tested over the transient U.S. FTP, while System B was tested on both the U.S. FTP, as well as a series of 13 steady-state modes. The table below contains a summary of the FTP results.

PM Trap Testing Results from MECA Test Program, U.S. HD FTP Test Cycle

	Engine Baseline (g/bhp-hr)	**Results w/Trap System Installed (g/bhp-hr)**
System A - tested w/ fuel sulfur level = 368 ppm	0.073	0.022
System B - tested w/ fuel sulfur level = 54 ppm	~ 0.06	0.008

Emission results on the 13-steady-state test cycle from the low-sulfur fuel with System B showed reductions ranging between approximately 20 and 70 percent, with the exception of one high-power mode, where PM increased approximately 30 percent. These emission results indicate that PM traps applied to a 1998 technology heavy-duty diesel engine can provide large reductions in PM with current fuel sulfur levels, and even lower PM levels may be achievable with the use of low-sulfur fuel. Durability information was not collected in this test program.

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(24) Hawker, P., et. al., "Effect of a Continuously Regenerating Diesel Particulate Filter on Non-Regulated Emissions and Particulate Size Distribution," SAE Paper 980189, February 1998.

(25) "Demonstration of Advanced Emission Control Technologies Enabling Diesel-Powered Heavy-Duty Engines to Achieve Low Emission Levels: Interim Report Number 2: Diesel Particulate Filter Technology," prepared for the Manufacturers of Emission Controls Associations, December 1998; copies available in EPA Air Docket A-98-32, Docket Item II-D-08.

With the current state of development, as well as the promise that aftertreatment technology provides for not only reducing the mass of PM, but also the ultrafine and toxic components[26], EPA should adopt a PM standard for 2004 that, at a minimum, requires oxidation catalysts and encourages the introduction of traps on some vehicles.

B. EPA should include an in-use test program for all heavy-duty vehicles

It is absolutely essential that heavy-duty engines operate in use the way they are expected to operate. STAPPA and ALAPCO remain very concerned with the loss of a significant level of anticipated and much-needed NO_x emission reductions that has resulted from the Consent Decrees settling complaints against seven heavy-duty diesel engine manufacturers who equipped their engines with "defeat devices," adversely affecting the engines' NO_x emission control systems in use. The associations' concern is only heightened by the fact that the agency has chosen to remove in-use testing and OBD provisions from this proposal and, instead, based on industry's objections to the scope of the proposal and the short time frame, merely include vague, noncommittal language to defer action to a subsequent rulemaking.

Both EPA and engine manufacturers have been aware for quite some time that significant in-use compliance problems exist and that these problems must be addressed in a timely manner. For engine manufacturers to argue that more time is now needed to address this issue is somewhat disingenuous. We strongly urge that, at a minimum, EPA explicitly commit in this rule not only to the implementation of a strong and effective in-use compliance program that will ensure against future transgressions, such as those that necessitated the recent Consent Decrees, but also to a firm starting date of no later than 2004.

EPA's proposal does not include a proposal for a manufacturer in-use testing program for heavy-duty diesels and heavy-duty Otto-cycle engines. However, as mentioned above, EPA believes, as do STAPPA and ALAPCO, that a manufacturer in-use testing program is a critical component of a comprehensive compliance program. While EPA states that it intends to work with interested parties towards the development of a proposal for an in-use testing program in the near future, we believe enough is known now to proceed with such a program. STAPPA and ALAPCO believe that an effective in-use testing program is necessary to ensure that the environmental benefits resulting from the emission standards for model year 2004 and beyond will be achieved in use.

C. EPA should require OBD equipment for vehicles weighing over 14,000 pounds

In this proposal, EPA makes compelling arguments regarding the many benefits of OBD systems. The agency explains that OBD systems help ensure continued compliance with emission standards during in-use operation and assist mechanics in properly diagnosing and repairing malfunctioning vehicles, while minimizing the associated time and effort. STAPPA and ALAPCO concur. Earlier in these comments, we support our concurrence with evidence attesting to the merits and

(26) See STAPPA and ALAPCO's July 13, 1999 comments on EPA's diesel fuel ANPRM (submitted to EPA Air Docket No. A-99-06).

feasibility of OBD. In light of these arguments, which we believe apply to vehicles in all weight classes, STAPPA and ALAPCO find EPA's proposal to limit OBD to vehicles only up to 14,000 pounds GVWR to be arbitrary and urge that OBD be mandated across the board.

D. EPA should require that heavy-duty gasoline engines (over 8,500 pounds) be subject to the same type of supplemental test procedures aimed at in-use compliance as contained in the heavy-duty diesel Consent Decrees

The agency notes in its proposal that it believes a supplemental standard and test procedure or an alternative mechanism is needed for heavy-duty Otto-cycle engines used in incomplete vehicles, as well as heavy-duty Otto-cycle engines used in vehicles with a GVWR greater than 14,000 pounds, in order to assure in-use compliance over a broad range of operating conditions. The proposal, however, does not include supplemental standards for test procedures for this class of engines because more information is needed to allow determination of appropriate emission levels and resolution of other specific technical issues. The agency has stated that it intends to gather further information related to the appropriate levels and scope of such standards over the next several months and to release a subsequent proposal within the next year that would include supplemental standards and test procedures for heavy-duty Otto-cycle engines. Given the importance of this issue, STAPPA and ALAPCO intend to closely monitor this effort and expect that the agency will resolve the remaining issues in time for the requirements to be in effect by the 2004 model year.

E. EPA should harmonize non-passenger gasoline vehicle standards for all vehicles 8,500-14,000 pounds GVWR not included in the revised light-duty truck definition (and, therefore, not subject to Tier 2) with California's LEV program, including LEV II

California has adopted a new generation of standards for light-duty and medium-duty vehicles, referred to as the LEV II standards. The new California standards for vehicles above 8,500 pounds GVWR are shown in the table below. The light-duty standards are phased in beginning in 2004 according to an established phase-in schedule. For heavy-duty vehicles there is no set phase-in schedule. California requires that 100 percent of heavy-duty vehicles comply with the standards shown in the table beginning with MY 2007. While the focus of EPA's notice is on 2004 standards, EPA notes that it is exploring the appropriateness of adopting standards equivalent to those in the table in a future rulemaking. Doing so would allow federal and California standards for heavy-duty Otto-cycle vehicles to continue to be harmonized beyond the 2007 model year. STAPPA and ALAPCO support this effort toward harmonization and encourage EPA to seriously consider this.

California LEV II Full-Life Emission Standards for
2007 and Later Model Year Vehicles over 8,500 Pounds GVWR
(grams per mile)

Vehicle Weight Category (GVWR)	NMOG	NO_x	CO
8,500 - 10,000 lbs	0.195	0.2	6.4
10,001 - 14,000 lbs	0.23	0.4	7.3

F. EPA should adopt tighter evaporative standards

EPA has not proposed any changes to the Otto-cycle evaporative numerical emission standards. However, the 1998 certification results show that, in general, heavy-duty Otto-cycle vehicles are meeting the current evaporative standards with a substantial safety margin. EPA is concerned that, in the absence of more stringent evaporative standards, manufacturers will reduce the safety margins they currently use in order to cut costs, resulting in rising evaporative emissions. STAPPA and ALAPCO share this concern. The 1999 certification results appear to demonstrate that this is beginning to occur.

CARB recently adopted new evaporative emission standards applicable to all categories of Otto cycle vehicles and engines in the context of the LEV II standards. Those new evaporative standards call for dramatic reductions in the levels of emissions for both the three-day diurnal plus hot soak and the supplemental two-day diurnal plus hot soak measurements. In response to CARB's recent LEV II proposal, the vehicle manufacturers presented CARB with an alternate proposal for revised evaporative emission standards. These proposed levels, while not as stringent as the standards CARB proposed and subsequently adopted, are significantly more stringent than the current federal standards. However, most 1998 model year heavy-duty vehicles were certified at levels below the manufacturers' proposed standards, including comfortable safety margins. The current federal standards, CARB's new standards and the manufacturers' proposed standards are all presented in the table below.

Existing Federal and CARB, and Manufacturer-Proposed Evaporative Emission Standards

	Three-day diurnal plus hot soak (g/test)	Two-day diurnal plus hot soak (g/test)
8,500 lbs <GVWR≤14,000 lbs		
Current federal standards	3.0	3.5
New CARB standards [A]	1.0	1.25

Manufacturer-proposed standards [A]	1.5	1.7
GVWR > 14,000 lbs		
Current federal standards	4.0	4.5
New CARB standards [A]	1.0	1.25
Manufacturer-proposed standards [A]	1.5	2.25

[A] Note - These standards would be phased in as a % of sales at a rate of 25, 50, 75, and 100 percent, beginning with the 2004 model year.

STAPPA and ALAPCO believe that more stringent evaporative emission standards for heavy-duty vehicles are appropriate, especially considering the current certification levels. In view of these levels, tighter standards, along the line of California's standards, seem feasible at little or no additional cost.

G. Diesel vehicles 8,500-14,000 pounds GVWR not included in the revised light-duty truck definition (and, therefore, not subject to Tier 2) should meet the same standards as gasoline vehicles

The Tier 2 proposal articulated a variety of excellent reasons why it makes very good sense to require vehicles doing the same job to meet identical emissions standards. The same reasons are just as applicable in the case of trucks in this category. As with cars and other light-duty vehicles, these vehicles are also used primarily in urban areas with potentially high public exposure to their emissions. STAPPA and ALAPCO strongly recommend, therefore, that diesel vehicles up to 14,000 pounds GVWR should meet the same standards as those that apply to Otto-cycle vehicles. In addition, such vehicles should be subject to chassis certification.

H. EPA should review certain aspects of the averaging, banking and trading program

Because multiple emission standards will be available in the future, it is important that individual consumers be aware of the level to which a vehicle has been certified. Also, for the purposes of in-use compliance, one must be aware of the standards that apply. These standards should be clearly identified by means of a label visible to the consumer when he/she purchases a vehicle or engine. Further, a permanent label should be affixed to the vehicle in a visible location.

An overriding principle of the averaging, banking and trading (ABT) program is that while flexibility can be helpful to the manufacturers, it is critical that this flexibility not undercut the overall enforceability of the program. We urge that this principle be preserved.

In addition, the ABT program should be structured in a way that encourages early introduction of cleaner vehicles without creating long-term loopholes that can enable manufacturers to put off significant technological advances by taking advantage of modest improvements in early years that may have occurred anyway. Toward this end, we believe the discounting and terms limits of credits applied by CARB should serve as a useful model for EPA.

I. EPA should proceed with phase two of the heavy-duty engine and vehicle strategy and require the use of extremely low-sulfur diesel fuel and much stricter emission standards for PM and NO_x, based on the best available emission control technology

1. As part of the second phase of the strategy, EPA should cap sulfur in diesel fuel at 30 ppm far enough in advance of the 2007 standards to ensure their successful implementation and, subsequently, based on additional study, further lower diesel sulfur

Earlier this year, STAPPA and ALAPCO adopted recommendations for low-sulfur diesel fuel, to take effect early in the next decade. Our associations have called upon EPA to cap sulfur in diesel fuel -- onroad <u>and</u> offroad -- at no higher then 30 ppm by 2004. In addition, we have recommended that, based on additional study, EPA further lower national standards for sulfur in diesel fuel and set appropriate standards for other characteristics affecting diesel fuel quality and/or emissions, to take effect in 2007. A copy of the associations' resolution on sulfur in diesel fuel is attached; we also refer you to STAPPA and ALAPCO's July 13, 1999 comprehensive written comments to EPA regarding the agency's May 13, 1999 Advance Notice of Proposed Rulemaking on the control of diesel fuel quality.

Of particular importance, we draw your attention to the fact that STAPPA and ALAPCO's recommendations to lower sulfur in diesel fuel apply not only to onroad diesel fuel, but to offroad diesel fuel as well and, further, include a preliminary step to cap sulfur in offroad diesel fuel at 500 ppm as soon as possible prior to 2004, so that this fuel is subject to the same sulfur standards as currently apply to onroad diesel fuel, before sulfur levels for both onroad and offroad diesel are cut even further.

2. In its second-phase rulemaking, EPA should set a PM standard more stringent than 0.01 g/bhp-hr, and a NO_x standard more stringent than 0.2 g/bhp-hr, to take effect no later than 2007

Although we believe that more stringent emission standards for onroad heavy-duty diesels would have been appropriate in 2004, we understand that EPA instead plans to move forward with implementation of the standards as promulgated in 1997, with the intent of pursuing more stringent standards in a next phase of regulations, to take effect in 2007. As noted earlier, we still urge EPA to adopt an interim tightening of the PM standard at 0.05 g/bhp-hr. Notwithstanding our disappointment in the timing of introducing more stringent standards, we commend the direction in which the agency appears to be moving regarding more stringent standards and strongly urge that at least three fundamental principles underlie EPA's efforts:

- First, 2007 must be a firm date; substantially more stringent emission standards must be in place for all on road heavy-duty diesels nationwide by *no later* than 2007.

- Second, these more stringent emission standards must be based on the most advanced technologies possible.

- And third, because compliance with more stringent future standards based on advanced technologies is dependent on the availability of low-sulfur diesel fuel, such fuel must be provided nationally far enough in advance to ensure successful implementation of the emission standards.

3. EPA should move ahead aggressively to address emissions from offroad diesel engines and fuels

STAPPA and ALAPCO view the control of offroad diesels to be as critical as the control of onroad diesels. EPA's own analysis, as summarized earlier, shows that offroad vehicles are a more significant source of NO_x, NMHC and PM than onroad vehicles. Further, we firmly believe that the technological advances that will occur in order to meet future, more stringent on road heavy-duty diesel standards will carry over to offroad equipment, but only if the low-sulfur diesel fuel is available for this sector as well. We are extremely concerned, however, that EPA may not be proceeding as quickly or aggressively as necessary to develop offroad diesel engine and fuel programs that are commensurate with the enormous contribution off-road engines make to air pollution; much more must be done.

To this end, STAPPA and ALAPCO urge EPA to integrate more closely its program development strategies for onroad and offroad diesel engines and fuels, so that we can more effectively reduce the huge air quality and public health problems posed by these sources.

IV. Conclusion

STAPPA and ALAPCO believe EPA has demonstrated tremendous leadership with the proposed Tier 2 and low-sulfur gasoline programs; the associations have applauded this proposal. The programs proposed by EPA and announced by President Clinton himself in May, and the time frames on which they are based, are absolutely critical to state and local efforts to achieve and sustain clean, healthful air nationwide. We urge EPA to exercise similar leadership in comprehensively addressing heavy-duty engines and their fuels. The regulatory program we envision is a comprehensive one that takes a systems approach that includes three fundamental prongs: stringent emission standards, tight controls on sulfur in diesel fuel and rigorous and effective programs to ensure continued compliance with standards when the vehicles are in use. STAPPA and ALAPCO are extremely pleased that EPA is pursuing such a three-pronged systems approach.

Once again, STAPPA and ALAPCO commend EPA for crafting a comprehensive, although initial, approach to addressing emissions from onroad heavy-duty diesel engines and fuels and look forward to working with the agency to further refine these programs.