California Environmental Protection Agency

**Air Resources Board**

Public Hearing to Consider Proposed Amendments to the
California Regulations Governing the:

# HEAVY-DUTY VEHICLE INSPECTION PROGRAM

# PERIODIC SMOKE INSPECTION PROGRAM

**October 1997**


Prepared by the

**Mobile Source Operations Division**

**Heavy-Duty Diesel Branch**

**State of California**

**California Environmental Protection Agency**

**AIR RESOURCES BOARD**

# STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

## PUBLIC HEARING TO CONSIDER PROPOSED AMENDMENTS TO THE CALIFORNIA REGULATIONS GOVERNING THE HEAVY-DUTY VEHICLE INSPECTION PROGRAM (HDVIP) AND THE PERIODIC SMOKE INSPECTION PROGRAM (PSIP)

**October 1997**

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## EXECUTIVE SUMMARY

Heavy-duty vehicles account for approximately 30 percent of the oxides of nitrogen (NOx) and 65 percent of the particulate matter (PM) emissions from the entire on-road fleet, despite the fact that these vehicles comprise only 2 percent of the California on-road vehicle fleet. To meet legislative mandates to reduce excess smoke emissions from in-use heavy duty diesel powered vehicles, the Air Resources Board (ARB or Board) staff is proposing amendments to the regulations governing the operation and enforcement of the Heavy-Duty Vehicle Inspection Program (HDVIP or the "roadside" program) and the Periodic Smoke Inspection Program (PSIP or the "fleet" program).

The existing roadside program was adopted in November 1990 in response to SB 1997 (stat. 1988, ch. 1544, Presley), and enforced from 1991 to 1993. It was suspended in October 1993, when the Board redirected staff to investigate reformulated fuels issues. The Board adopted the fleet program regulations in December 1992, but it had not yet been enforced. Both programs are currently being administered on a voluntary basis. Enforcement of these programs will resume when the staff's proposed regulatory amendments become effective.

Under the roadside program, heavy-duty diesel vehicles (including intrastate, interstate, and international vehicles) are tested for excessive smoke emissions and inspected for tampering at various field locations. The owners of vehicles failing prescribed test procedures are issued citations which require the prompt repair and carry civil penalties ranging from $300 to $1800 per violation. Failure to clear citations can result in vehicles being removed from service. Vehicle owners may appeal citations through the ARB's administrative hearing program.

The fleet program requires owners of two or more heavy-duty vehicles to perform an annual inspection of their diesel vehicles for excessive smoke emissions. This uses the same smoke test procedure as the roadside program.

The trucking industry has argued that the originally-specified snap-acceleration test using the "SAE J1243" type smokemeters can be unreliable and can fail "clean" trucks, although this test has been upheld by the California courts. To address this issue, the Legislature enacted AB 584 in 1993. This legislation requires that the smoke test procedure used must produce "consistent and repeatable" results and that the standards and test procedures result in no false failures unless they are remedied without penalty to the vehicle owner.

From 1992 through 1996, a Society of Automotive Engineers (SAE) committee (including ARB staff, the trucking industry, engine manufacturers, smokemeter manufacturers, et al) worked to develop a smoke test procedure specifically for inspection programs. The resulting procedure, SAE J1667, was adopted unanimously by this committee in 1996. AB 584 specifically states that SAE J1667 fulfills the requirements that the test procedure be consistent and repeatable.

In 1996 and 1997, the staff conducted two studies, the Random Truck Opacity Survey and the Truck Repair Study, that provide the technical basis for staff's proposed amendments. These

studies are discussed in detail in the Staff Report and its companion Technical Support Document.

The staff's proposal includes the following amendments to the existing regulations:

(1) Designate SAE J1667 as the test procedure for determining smoke opacity.

(2) Maintain the existing snap-acceleration opacity standards of 55 percent for pre-1991 model years and 40 percent for 1991 and newer model year heavy-duty diesel powered engines, as measured by the new test procedure.

(3) Establish a mechanism under which owners of pre-1991 model year heavy-duty diesel engines that have roadside snap-acceleration opacity levels exceeding 55 percent but not exceeding 69 percent are initially issued a Notice of Violation (NOV). An owner has 45 days without penalty to bring the vehicle into compliance with the 55 percent standard before a citation is issued. The NOV mechanism would not apply where a previous NOV or citation had been issued for the vehicle in the preceding 12 months.

(4) Retain exemptions to allow for less stringent standards for specific engine families based on data submitted by the engine manufacturers, and "grandfather-in" exemptions of engine families issued under the preexisting HDVIP regulations.

(5) Institute a new 15 month phase-in schedule for the PSIP, starting July 1, 1998.

(6) Allow the previous type of smokemeter to be used in PSIP testing at facilities that are not equipped with an SAE J1667 type smokemeter, until July 1, 1999.

(7) Exempt the newest four model years of heavy-duty engines from the PSIP requirements under a four year "rolling exemption" process.

Compared to having no heavy-duty inspection programs, the roadside and fleet programs with the proposed amendments are expected to achieve the following emission reductions of reactive organic gases (ROG), NOx and PM:

| | ROG | $NO_x$ | PM-10 |
|---|---|---|---|
| 1999 | 6.37 | 12.24 | 5.24 |
| 2010 | 5.30 | 14.03 | 3.19 |

Although the numerical opacity standards in the proposal are identical to the preexisting standards, they are somewhat less stringent in the proposal because the SAE J1667 smokemeter reads about 5 to 10 opacity points less than the prior SAE J1243 type smokemeter. The staff is recommending these standards because they are necessary to assure that the reinstated programs will comply with the AB 584 restrictions regarding an absence of false failures. The Staff Report compares the estimated emission reductions from the proposal with the somewhat larger reductions that would be estimated from the original regulations.

Diesel fuel consumption will be reduced by approximately 16.7 and 19.2 million gallons annually in 1999 and 2010, respectively. This represents a savings over the 12-year period of approximately 250 million gallons of fuel or over $212 million (at current fuel prices.)

# I. INTRODUCTION

In this rulemaking, the Air Resources Board (ARB) staff is proposing amendments to the regulations governing the operation of the Heavy-Duty Vehicle Inspection Program (HDVIP or the "roadside" program) and the Periodic Smoke Inspection Program (PSIP or the "fleet" program). The primary objective of these enforcement programs is to reduce the excessive smoke emissions from mal-maintained and tampered heavy-duty diesel powered vehicles operating in California. The proposed amendments are designed to assure that these statutorily mandated programs can be effectively and vigorously administered in accordance with recent legislative requirements.

The regulations for both of the programs are currently in place in the California Code of Regulations. They impose limits on the opacity of smoke from diesel engines when measured in accordance with a "snap-acceleration" stationary vehicle test procedure that uses an electronic smokemeter meeting the requirements of the Society of Automotive Engineers (SAE) SAE J1243 procedure. Opacity means the percentage of light obstructed from passage through an exhaust smoke plume. The HDVIP involves roadside inspections by ARB inspectors, who are to issue citations to trucks and buses that exceed the smoke opacity standards. In the PSIP, owners of fleets of two or more heavy-duty vehicles are to annually conduct inspections and smoke tests and to make any repairs necessary for the vehicles to meet the opacity standards.

The HDVIP regulations became operative on November 21, 1991. The program was actively enforced until October 15, 1993 when the ARB temporarily suspended enforcement of the program and redirected the staff to work on reformulated fuels issues. Around the same time, the legislature enacted a new law which included a requirement that the test procedures used in the HDVIP "produce consistent and repeatable results," stating that this requirement is satisfied by the adoption of the new SAE J1667 test procedure that was then under development. The ARB postponed resumption of the HDVIP pending the completion of SAE J1667 and the development of mechanisms for complying with the legislative mandates. The ARB also refrained from immediately enforcing the PSIP at the January 1996 implementation date. In the interim, the ARB staff has been administering the programs on a voluntary outreach basis.

The staff's proposed regulatory amendments are designed to comply with the mandates of the new 1993 law, Assembly Bill (AB) 584 (Stats. 1993, ch. 570, Cortese). The amendments provide that smoke opacity is to be determined using SAE J1667 as it was finally adopted by SAE in 1996. The staff conducted two major studies in 1996-1997 to identify appropriate opacity standards for use with the revised test procedure. The proposed opacity standards and other mechanisms are designed to satisfy the AB 584 requirement that the programs be designed to ensure that vehicles in good operating condition and adjusted to the manufacturers' specifications will not fail the standards, and that false failures be eliminated or remedied without penalty to the owner. The amendments also make a variety of other improvements to the programs.

With adoption of the proposed amendments, the ARB will be able to resume enforcement of the roadside program and fully implement the fleet self-inspection program. These programs will bring substantial benefits, both by reducing in the number of diesel powered trucks and buses with excessive smoke and reducing the contribution those vehicles make to overall poor air quality.

## II. BACKGROUND

### A. Emissions from Heavy-Duty Diesel Vehicles

Emissions from heavy-duty diesel trucks and buses have a major impact on California's air quality. Heavy-duty vehicles account for approximately 30 percent of the oxides of nitrogen (NOx) and 65 percent of the particulate matter (PM) exhaust emissions from the entire on-road fleet, even though these vehicles only comprise approximately 2 percent of the entire California on-road vehicle fleet and 4 percent of the vehicle miles traveled. The NOx emissions, when combined with various hydrocarbon (HC) emissions and sunlight, form ozone—commonly referred to as "smog." Consequently, the NOx emissions, and to a lesser degree the HC emissions from heavy-duty trucks and buses significantly contribute to violations of the state and federal ambient air quality standards for ozone. Diesel exhaust particulate emissions, commonly referred to as "soot," are fine particles designated as PM-10, most of which are designated as PM-2.5.[1] NOx emissions can also contribute to PM pollution through the formation of nitrates. These particulate emissions contribute to violations of the state and federal ambient air quality standards for particulate matter and contribute to reduced visibility. The HDVIP and PSIP are designed to reduce excessive in-use emissions of these pollutants that are primarily the result of improper vehicle maintenance practices and tampering.

[1] PM-10 is particulate matter less than or equal to 10 microns in size, and PM-2.5 is particulate matter less than or equal to 2.5 microns in size. Studies show that diesel exhaust is primarily PM-2.5.

Despite recent improvements in air quality, violation of the national ambient air quality standards for both ozone and particulate matter continue to occur on a regular basis in the State and especially in the South Coast Air Basin. During 1996, the federal and the more stringent State ozone standards were violated in the South Coast Air Basin on 90 and 152 days, respectively. Ozone and particulate matter pollution are of great concern because of their adverse effects on human health. Ozone is a known respiratory irritant that harms lung tissue and reduces breathing capacity. Its effects are strongest in sensitive individuals such as asthmatics, the elderly, and children. Based on recent epidemiological studies,[2] particulate matter pollution has been consistently related to premature mortalities. According to a recent Natural Resource Defense Council study,[3] particulate matter pollution causes between 8,600 and 19,400 premature deaths in California every year. In response to evidence relating ozone and particulate matter pollution to these and other health effects, the United States Environmental Protection Agency (U.S. EPA) recently tightened both the Federal ozone and particulate standards.

Constituents of diesel exhaust have been identified as toxic air contaminants under the ARB's Toxic Air Contaminant Program, and whole diesel exhaust is currently under review for identification. The International Agency for Research on Cancer has identified diesel exhaust as a probable human carcinogen.[4] Diesel exhaust was identified in 1990 under California's Proposition 65 as a chemical known to cause cancer.

Other environmental impacts of diesel exhaust include visibility degradation, acid deposition, and vegetation/forestry damage. Emissions from diesel vehicles contribute to the losses caused by air pollution to California agriculture. These losses are estimated to exceed $300 million per year in direct crop yield losses and $1 billion per year when processing and distribution effects are included, according to studies conducted by the ARB and the University of California. Also, excessive exhaust emissions (black smoke) from on-road heavy-duty vehicles continue to be the number one target of public complaints regarding air pollution.

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[2] Dockery, Douglas W. et al. "An Association Between Air Pollution and Mortality in Six U.S. Cities." New England Journal of Medicine, Vol. 329, No. 24, pp. 1753-9.

[3] Shprentz, Deborah Sheiman, et al., Natural Resource Defense Council. Breath-Taking: Premature Mortality due to Particulate Air Pollution in 239 American Cities May 1996.

[4] The Toxic Air Contaminant Identification Process: Diesel Exhaust. California Environmental Protection Agency, Air Resources Board, June 1994.

## B. Establishment of the Heavy-Duty Vehicle Inspection Programs

Heavy-Duty Vehicle Inspection Program

In 1988, the Legislature enacted Senate Bill 1997 (Stats. 1988 ch. 1544, Presley), directing the ARB in cooperation with the California Highway Patrol (CHP) to design and implement an in-use roadside smoke enforcement program for heavy-duty vehicles. The regulations governing the resulting program, the HDVIP, were adopted by the ARB following a November 8, 1990 hearing and became operative on November 21, 1991.

Under this program, heavy-duty diesel powered trucks and buses are tested for excessive smoke emissions, and heavy-duty diesel and gasoline powered trucks and buses are inspected for tampering. The program is designed as a roadside program, as opposed to the registration-based programs used in other states, in order to inspect all heavy-duty vehicles traveling on California's roads. Based on ARB studies, at any given time, approximately 28 percent of the miles driven by on-road heavy-duty vehicles are driven by out-of-state or out-of-country vehicles. Furthermore, with the promulgation of NAFTA, the presence of out-of-country vehicles traveling on California's roads is likely to increase. Intrastate, interstate, and international heavy-duty vehicles are tested statewide by ARB inspectors at CHP inspection facilities and weigh stations, and at random roadside locations.

In the original HDVIP regulations, all 1974 and subsequent model-year vehicles with federal peak smoke engine certification levels lower than 35 percent were subject to a 40 percent opacity standard; all others were subject to the 55 percent opacity standard. However, a provision stated that the only vehicles subject to a civil penalty for failing the 40 percent standard during the first year of the program were 1991 and subsequent model-year vehicles, and this provision was extended by the Executive Officer. In effect, all pre-1991 model-year vehicles were subject to a 55 percent standard. As noted above, the opacity of smoke from diesel engines was measured in accordance with a "snap-acceleration" (previously referred to as "snap-idle") test procedure that used an electronic smokemeter meeting the requirements of the SAE J1243 procedure. The vehicles are also inspected for tampered or defective emission control system components. The owners of failing vehicles are issued citations which require the prompt repair of the vehicle and carry civil penalties ranging from $300 to $1800 per violation. Failure to clear citations can result in vehicles being removed from service by the CHP, at the request of the ARB. Vehicle owners may appeal citations through the ARB's administrative hearing program established in sections 60075.1 through 60075.47, Title 17, California Code of Regulations.

The HDVIP proved very effective during the November 1991 - October 1993 period when it was actively enforced. During this time, the number of vehicles failing to meet the standard was reduced from 34 percent to 21 percent, resulting in an estimated 38 percent reduction in the number of heavy-duty smoking trucks and buses operating in California.

Periodic Smoke Inspection Program

The PSIP was mandated by Senate Bill (SB) 2330 (Stats. 1990, ch. 1453, Killea) to promote self-inspection of fleet vehicles. Under the PSIP, California-based truck and bus fleets with two or more vehicles are required to conduct annual smoke opacity and tampering self-inspections for all of their vehicles. To ensure program compliance, the ARB staff is required to audit these fleets by reviewing their maintenance and inspection records and by testing a representative sample of vehicles. The PSIP has the additional benefit of including fleet vehicles that would normally not be subject to the HDVIP roadside enforcement operations (i.e., local service and delivery vehicles).

The regulations governing the PSIP were adopted following a December 1992 hearing and were originally scheduled to become effective on January 1, 1995. Because of delays in the completion of the SAE J1667 test procedure, the Board amended the regulations to postpone their effective date to January 1, 1996 where the first 25 percent of an operator's fleet having to be tested by July 1, 1996. In a March 1996 notice, the ARB staff advised fleet operators that the PSIP would be administered as a voluntary program pending adoption of the SAE J1667 procedure into the program's governing regulations.

Vehicle Inspection Programs in Other States

Presently, several states have enforcement programs for in-use heavy-duty diesel vehicles. Arizona was the first to implement such a program in 1970, and four other states have active programs in effect today. Other states have regulations in place but, to date, have not enforced their programs.

## C. Enactment of Assembly Bill 584 and Related Developments

While the HDVIP has been effective in reducing emissions and the number of smoking vehicles in California, its snap-acceleration test has been the focus of controversy. The California Trucking Association (CTA) has asserted that the test can be unreliable and can incorrectly fail "clean" trucks. This debate has been on-going since the program's implementation in 1991. The legality of the HDVIP and its test procedure has been challenged in four lawsuits filed by CTA attorneys. In all cases, the test has been upheld by the California courts including two decisions from the Third District Court of Appeals that were left standing by the California Supreme Court. (The litigation over the HDVIP is described in Attachment E.)

However, as a result of this controversy and the proliferation of similar smoke enforcement programs in other states, the SAE formed a task group in 1992 to develop a recommended snap-acceleration smoke test procedure—SAE J1667—specifically designed for use in roadside inspections. This broad-based task group included representatives from the ARB, U.S. EPA, representatives from other states, engine manufacturers, the trucking industry (CTA and the American Trucking Association), and smokemeter manufacturers, as well as various academicians.

In response to testing concerns, in 1993, the Legislature enacted Assembly Bill 584, which was sponsored by the trucking industry. This legislation amended Health and Safety Code section 44011.6 to require that the smoke test procedure used in the HDVIP must yield

consistent and repeatable test results and not result in "false failures." The pertinent portions of H&SC Section 44011.6 now provide as follows:

> (c) Any smoke testing procedures or smoke measuring equipment, including any meter that measures smoke opacity or density and any recorder that stores or records smoke opacity or density measurements, used to test for compliance with this section and regulations adopted pursuant to this section, shall produce consistent and repeatable results. The requirements of this subdivision shall be satisfied by the adoption of Society of Automotive Engineers recommended practice J1667, "Snap-Acceleration Smoke Test Procedures for Heavy-Duty Diesel powered Vehicles."
>
> (d)(1) The smoke test standards and procedures adopted and implemented pursuant to this section shall be designed to ensure that no engine will fail the smoke test standards and procedures when the engine is in good operating condition and is adjusted to the manufacturer's specifications.
>
> (2) In implementing this section, the state board shall adopt regulations that ensure that there will be no false failures or that ensure that the state board will remedy any false failures without any penalty to the vehicle owner.

In 1996, the Legislature enacted additional limited changes to the HDVIP provisions of Health and Safety Code section 44011.6, (Stats. 1996 ch. 292 (AB 1460, Morrissey).)

The development and adoption of SAE J1667 proved to be a lengthy process. The group identified three primary technical issues. The first two concern the effect that a smokemeter's response time has on measured smoke values, and the third concerns the effect that ambient conditions can have on smoke emissions. (These issues are discussed in Section IV.A. below.) Ultimately, the procedure was adopted unanimously, and was issued in February 1996.

Subsequent to the SAE's adoption of the J1667 test procedure, the ARB staff, in consultation with the regulated industries and other interested parties, conducted two studies to assess the effectiveness of the J1667 test procedure and to provide the technical basis for the selection of opacity standards and other mechanisms that meet the requirements of AB 584.

The first study was called the "Random Truck Opacity Survey," or RTOS. As the name implies, heavy-duty diesel vehicles were randomly sampled from the in-use California fleet and tested using the SAE J1667 procedure. The purpose was to determine the distribution of the in-use smoke opacity of the fleet of heavy-duty diesel trucks currently operating in California. The RTOS served to quantify the extent of the smoky truck problem under a reinstated HDVIP. Between August and November 1996, SAE J1667 smoke test results were obtained for a usable sample of 1002 heavy-duty diesel vehicles. The study provided a detailed characterization of the smoke opacity distribution of heavy-duty diesel vehicles with engines from most model year

groups of interest. (A more detailed analysis of the RTOS is contained in the Technical Support Document.)

The second study became known as the "Truck Repair Study," or TRS. It was conducted from December 1996 to July 1997, after the RTOS had been completed. As noted above, AB 584 required that the HDVIP be designed so that no engine in good operating condition and adjusted to the manufacturer's specifications will fail the smoke standard. The object of the TRS was to determine the appropriate opacity standards by procuring and repairing a sample of heavy-duty vehicles spanning a range of smoke opacities. The opacity of the vehicles after repairs would provide the basis for determining the appropriate opacity level that could be met by engines in good operating condition and correctly adjusted. The repairs were performed by dealerships and factory-authorized personnel, to help assure the competence of the mechanics. A requirement that each repaired vehicle be within manufacturer specifications after the repair helped assure that the vehicles were properly adjusted. All tests were conducted in conformance with SAE J1667.

In all, 71 trucks and buses were recruited for the TRS. The initial SAE J1667 opacity tests had shown that these vehicles' opacities were in the range of interest. Numerous engine makes and model years, with a wide range of snap acceleration test opacities, were included in the sample. The following table shows the *pre*-repair opacity range distribution for the 63 pre-1991 engines in the sample. (The *post*-repair opacity distribution is shown in Section IV.B.1.)

**Table 1**

**Truck Repair Study**
**Pre-Repair Opacity Distribution**
**(63 Pre-1991 Model Year Heavy-Duty Engines)**

| ***Opacity Range*** | ***Sample Percentage*** |
|---|---|
| 35 to 45 | 15.87 |
| 45 to 55 | 17.46 |
| 55 to 65 | 15.87 |
| 65 to 75 | 26.99 |
| 75 to 85 | 4.76 |
| 85+ | 19.05 |

In general, the TRS revealed that the HDVIP, employing the SAE J1667 test procedure, would be a very effective enforcement program capable of identifying vehicles with excessive

smoke emissions without producing false failures. (A more detailed summary of the TRS is contained in the Technical Support Document.)

## D. Public Process and Outreach

Throughout the development of the original HDVIP and continuing to the present, the staff has solicited the participation of industry. As required by Senate Bill 1997, the ARB organized an Ad-Hoc Technical Advisory Committee to help formulate an effective HDVIP program and presided over its meetings. Committee members include the CTA, the EMA, the South Coast Air Quality Management District, the Highway Carriers Association, the California Bus Association, the CHP, California Transit Association, heavy-duty diesel repair facilities, a fuel refiner, and others.

The staff consulted with interested parties on an on-going basis in the development and implementation of the Random Truck Opacity Study and the Truck Repair Study. The Ad-Hoc Technical Advisory Committee participated in the design of the TRS. Throughout the RTOS and the TRS, the staff held monthly meetings with the CTA and the EMA to discuss both their design and progress. In particular, EMA provided technical and monetary assistance in the two engineering studies.

As part of the rulemaking process, staff held a public workshop on September 11, 1997 to discuss a draft of the staff's proposal as well as a draft Technical Support Document. As a result of the industry's ongoing participation in the development of the HDVIP and PSIP amendments, only the CTA proposed a modification to the staff's proposal. The CTA maintained that the originally-proposed standards for pre-1991 model year engines were too stringent to guarantee compliance with AB 584. This issue is discussed in Sections IV.B.5. and IV.C. below. The staff has also maintained communication with other interested parties, including numerous environmental organizations, throughout the development of this proposal.

In order to successfully resume the HDVIP and the PSIP, the staff has undertaken an extensive outreach effort to educate the affected industry. The ARB staff routinely conducts compliance seminars at both private and public trucking and bus entities. To date, the staff has conducted hundreds of training seminars.

Since it is also important to educate the heavy-duty diesel repair industry, in 1992, the ARB established a partnership with selected California community colleges to develop a formal training curriculum. The California Council on Diesel Education and Technology (CCDET) curriculum is designed to train heavy-duty diesel engine service personnel how to properly test vehicles for smoke opacity and diagnose and repair vehicles with high smoke emissions. This program is formally called. Currently, there are four colleges participating in this program with nine additional colleges ready to join. Since the formation of CCDET in 1992, approximately 1000 heavy-duty diesel engine service personnel have been trained and certified under this program. This program is being updated to include training on the proposed changes to the HDVIP and PSIP, including the incorporation of the SAE J1667 procedure.

## III. SUMMARY OF THE REGULATORY PROPOSAL

Staff recommends that the Board adopt the amendments to the HDVIP and PSIP regulations set forth in the Proposed Regulation Order in Attachment A. The proposed amendments are designed to assure compliance with AB 584 and to make a variety of other improvements developed from past experience with the programs. The significant proposed changes are summarized below and then discussed in the next Section. Attachment B provides a section-by-section explanation of all of the proposed amendments, including those intended to clarify existing regulatory provisions or to improve their readability.

(1) Designate the SAE J1667 "Snap Acceleration Smoke Test Procedure for Heavy-Duty Diesel Powered Vehicles," as issued February 1996, as the test procedure for determining smoke opacity under the HDVIP and PSIP.

(2) Maintain the existing snap-acceleration opacity standards of 55 percent for pre-1991 model year heavy-duty diesel powered engines and 40 percent for 1991 and newer model year heavy-duty diesel powered engines, without reference to the engines' federal peak smoke certification level. These standards reflect data on maximum emissions from vehicles in good operating condition and set to manufacturers' specifications, gathered from the ARB's recently completed 71 vehicle Truck Repair Study. These standards also include a significant safety margin to account for variability in smoke measurement.

(3) Establish a mechanism under which owners of pre-1991 model year heavy-duty diesel powered engines that have roadside snap-acceleration opacity levels exceeding 55 percent but not exceeding 69 percent are initially issued a Notice of Violation (NOV) in lieu of a citation. If, within 45 days, the owner demonstrates that he or she has made repairs that bring the vehicle into compliance with the 55 percent opacity standard, there will be no monetary penalty. If a demonstration of correction is not submitted within the 45-day period, a citation would be issued. The NOV mechanism would not apply where a previous NOV or citation had been issued for the vehicle in the preceding 12 months. Based on the initial experience with the NOV approach, the staff plans to report to the Board by the end of 1999 with its recommendation on whether the approach should be sunsetted.

A summary of the opacity standards described in (2) and (3) above is provided in the following table.

**Table 2.**

**Smoke Opacity Standards and ARB Actions**

**Vehicles with Pre-1991 Model Year Engines**
**Opacity Standard 55%**

| Test Opacity | ARB Action | Post-Repair Standard |
|---|---|---|
| *Higher than 70 %* | *Issue Citation* | *<55 %* |
| *Between 55 - 70%* | *Issue Notice of Violation** | *<55 %* |

**Vehicles with 1991 and Newer Model Year Engines**
**Opacity Standard 40%**

| Test Opacity | ARB Action | Post-Repair Standard |
|---|---|---|
| *Higher than 40 %* | *Issue Citation* | *<40 %* |

*Applicable only to first violation in 12-month period

(4) Retain exemptions to allow for technologically less stringent standards for specific engine families based on data submitted by the engine manufacturers and "grandfather-in" exemptions of engine families issued under the preexisting HDVIP regulations.

(5) Require explicitly that a demonstration of correction for a vehicle failing a roadside smoke test or visual inspection must include evidence that the vehicle has passed a post-repair test or inspection of the pertinent components.

(6) Institute a new 15 month phase-in schedule for the PSIP, starting July 1, 1998.

(7) Allow the SAE J1243 type smokemeter to be used in PSIP testing at facilities that are not equipped with an SAE J1667 type smokemeter, until July 1, 1999.

(8) Exempt the newest four model years of heavy-duty engines from the PSIP requirements. Vehicles equipped with these engines would remain subject to the roadside inspections under the HDVIP.

(9) Define "excessive smoke" as smoke opacity in excess of the opacity standards set forth in (2) and (3) above and summarized in Table 1 above.

(10) Retain the administrative hearing process for challenges to citations. The staff plans to propose various amendments to the administrative hearing regulations to be considered by the Board in the spring of 1998.

## IV. DISCUSSION OF THE PROPOSED AMENDMENTS

### A. Incorporation of the SAE J1667 Snap-Acceleration Test Procedure

The staff is proposing that the SAE J1667 "Snap-Acceleration Smoke Test Procedure for Heavy-Duty Diesel Powered Vehicles" be designated as the test procedure for determining smoke opacity. It is stated in AB 584 that the adoption of SAE J1667 satisfies the requirements that the smoke test procedure assures repeatable and consistent results.

The SAE J1667 snap-acceleration test procedure was designed to respond to three concerns about possible inconsistencies in different meters' measurements of snap-acceleration smoke emissions. The first two concerns involve the relationship between smokemeters' response times and the measured opacities. The third involves the effects of ambient test conditions on measured opacities. These three concerns are discussed in this section. (A more detailed discussion is contained in the Technical Support Document.)

1. Meter Response Time Specifications

Diesel engines with different technologies are likely to have significantly different snap-acceleration smoke opacity profiles. Some opacity profiles are sharply peaked while others are much broader. The different response times of smokemeters may significantly affect the opacities they report. For example, if an engine has a sharply-peaked opacity profile, a meter with a slower response time will measure a lower smoke value than a meter with a faster response time. To eliminate the effects of different response times, SAE J1667 requires that measurement response times be normalized to 0.5 second and suggests that a digital Bessel filter be used to achieve the prescribed response time. The ARB will use meters satisfying the meter specifications of SAE J1667 in the HDVIP and the PSIP.

2. Attenuation of Irrelevant Snap-Acceleration "Peak" Opacities

The second concern is closely related to the first. Experience has shown that engines whose snap-acceleration opacity profiles are highly peaked and of short duration may be in good operating condition, even though the peak opacities of their profiles are high. Meters satisfying the specifications of SAE J1667 have 0.5 second response times, which sufficiently attenuate the irrelevant high peak opacities of sharply-peaked profiles.

3. Corrections for Ambient Test Conditions

Because the opacity of smoke emissions is an indication of the completeness of combustion, any ambient condition that affects an engine's air/fuel ratio can be expected to affect the opacity of its smoke, whether or not the engine is within manufacturer's specifications. When a vehicle is tested at higher elevations, the lower oxygen content of the thinner air decreases the completeness of combustion and increases the opacity of smoke emissions. The emissions of mechanical engines that do not have effective feedback systems controlling the air/fuel ratio are especially affected. Measured opacities must be corrected to standard ambient conditions to account for the effects of different ambient test conditions before being compared to standards. The SAE J1667 procedure incorporates an algorithm for making these corrections and the ARB will use this algorithm when conducting inspections.

## B. Selection of Proposed Opacity Standards and Other Mechanisms to Avoid False Failures

Apart from the designation of the test method, AB 584 requires the ARB to satisfy the following two requirements in adopting HDVIP regulations and standards:

- **The standards and test procedures are to be designed to ensure that** no vehicle in "good operating condition" and "adjusted to the manufacturer's specifications" will fail, and

- The regulations must ensure that there will be no false failures or ensure that the ARB will remedy any false failures without penalty to the vehicle owner.

The first criterion has been addressed through use of the data generated in the Truck Repair Study. The smoke opacities of the vehicles after they were repaired to the manufacturers' specifications by factory authorized repair facilities were compiled to identify opacity standards that will be met by vehicles in good operating condition and correctly adjusted. Making appropriate additional allowances in the standards for variability in smoke measurements in the derivation of standards will also help prevent the occurrence of false failures.

1. Using the Post-Repair Smoke Opacity Levels Measured in the Truck Repair Study

The following table shows the *post*-repair opacity distribution for the 63 pre-1991 engines in the TRS:

**Table 3**

**Truck Repair Study Post-Repair Opacity Distribution**
**(63 Pre-1991 Model Year Heavy-Duty Engines)**

| ***Opacity Range*** | ***Sample Percentage*** |
|---|---|
| 5 to 10 | 6.3 |
| 10 to 15 | 23.8 |
| 15 to 20 | 17.5 |
| 20 to 25 | 15.9 |
| 25 to 30 | 20.6 |
| 30 to 35 | 6.3 |
| 35 to 40 | 4.8 |
| 40+ | 4.8* |

*This percentage represents one vehicle that did not undergo complete repairs (at owner's request.)

As can be seen by this distribution, over 80 percent of the engines were repaired to smoke levels below 30 opacity points. The highest post-repair opacity of a fully repaired pre-1991 engine in the TRS was 38.7 percent, which suggests that the standard should be 39 percent or higher. However, one engine received repairs that only brought the opacity value down to 47 percent; the mechanic suggested there may have been injector problems, but the owner was unwilling to wait for further diagnostics and potential additional repairs. Under a very conservative analysis, one could consider the opacity value for this engine to be the highest post-repair value for an engine in "good working order" because the injector problem remained

unconfirmed. This analysis suggests that a more conservative, less stringent opacity standard than 39 percent might be appropriate.

For the eight 1991 and newer engines in the TRS, the highest post-repair opacity was 30.6 percent, suggesting that the standard should be 31 percent or higher. However, the sample of 1991 and newer engines in the TRS was small, and the quality of some repairs may not have been satisfactory, suggesting that a more stringent standard may be appropriate.

2. Allowance for Variability in Measuring Opacity

There are three sources of variability when the opacity of an engine's exhaust is measured using the SAE J1667 procedures: (1) drift of the engine's opacities over time, (2) short-term variability of repeated measurements of the engine's opacity by the same model of smokemeter, and (3) variability of the measurements of opacities of the same SAE J1667 test by different models of meters satisfying the SAE J1667 smokemeter specifications.

The issue of engine variability over time, often referred to as engine drift, is complex since this variability is a function of the time period over which the engine's opacities are repeatedly measured. Engines tend to become more variable with use and over time because of deterioration of parts and malmaintenance. A principal consideration in allowing for measurement variability is that variability associated with such changes in the engine should not be accounted for in the standard setting process, because the causes are correctable malperformances.

The second source of variability is the short-term cycle-to-cycle variability of individual engines' opacities measured by the same smokemeter. The variability of the smokemeter's measurements of these opacities also contributes to this source. All other factors are assumed to be held constant. Data on this source of variability must be obtained from engines in good working order. The data are obtained from observed differences between the opacities of two tests performed within a relatively short time period during which in-use deterioration is very unlikely to have occurred.

An engine's cycle-to-cycle variability was estimated from pairs of post-repair smoke opacity tests in the TRS. The first test was performed by dealership staff and the second test by the ARB field staff. These pairs of measurements were performed on the same day or on successive days, but more importantly, the engine was presumably operated very little between the two measurements. Data from pairs of tests are available for 25 of the 71 engines in the TRS sample. Differences of these paired measurements had a mean of 0.20 percent and a standard deviation of 1.92 percent.

The third type of variability occurs when opacity is measured with different smokemeters that satisfy the SAE J1667 smokemeter specifications. The extent of this type of variability was estimated from the results of a study of the correlation of

five such smokemeters conducted in April 1996. Pairs of smokemeters simultaneously measured the same smoke plumes of six representative engines. The standard deviation of the paired differences of these smokemeters was 2.4 percent. The statistical independence of these two sources of variability is very plausible, because they were measured in completely independent experiments. The standard deviation of the combined independent sources of variability is 3.1 percent

An allowance for the combined measurement variability of the second and third sources is computed as a one-sided upper tolerance interval for their sum. The computed tolerance interval covers 95 percent of the population and has a confidence level of 95 percent. Their coverage of a high proportion of the population at a high confidence level makes such intervals well-suited to estimating allowances for variability in situations where the number of false failures is to be minimized. Assuming that the two sources of variation are normally distributed, the computed tolerance interval is an allowance for variability of 7.2 percent, which is conservatively increased to 8 percent.

3. Computing Standards from the Post-Repair Opacity Levels and an Allowance for Variability

Adding the 8 percent allowance for variability to the baseline maximum post-repair opacities of 47 percent for pre-1991 engines and 30.8 percent for 1991 and newer engines yields equivalent post-repair standards of 55 percent and 40 percent, respectively. These values are numerically identical to the previous HDVIP standards. However, for both older and newer engines, the maximum post-repair opacity values may not reflect complete or correct repairs. It appears possible and indeed likely that a larger sample of data on complete repairs could result in lower standards for both categories. The feasibility of significantly lower standards for 1991 and newer engines appears to be a distinct possibility.

4. Comparison to the Original HDVIP Standards and Test Procedures

Although the current standards for opacities measured with SAE J1243 smokemeters and the proposed standards for opacities measured with SAE J1667 smokemeters have the same numerical values, the proposed standards are in fact less stringent for almost all engines. On average, an SAE J1667 type smokemeter reads about 5 to 10 opacity points less for mechanical and electronic engines, respectively, compared to an SAE J1243 type smokemeter. Accordingly, the proposed standards are somewhat less stringent than the standards and test procedures now specified in the HDVIP regulations.

The reduced stringency of the proposed standards is due to the 0.5 second response time requirement for SAE J1667 smokemeters, which attenuates the peak opacities of sharply-peaked smoke profiles. In analyzing the differences between opacities of the same engines measured by SAE J1243 and SAE J1667 smokemeters a few minutes apart the SAE J1667 opacities were almost always smaller. For engines with electronically controlled fuel systems, only 1 percent of the SAE J1667

opacities were larger. For engines with mechanically controlled fuel systems, only 10 percent of the opacities were more than 3 opacity points or larger.

The fact that fewer vehicles will be failed under the new SAE J1667 procedure than would be failed under the SAE J1243 procedure with numerically identical opacity standards will provide an additional safeguard against possible false failures.

5. Standards for Pre-1991 Engines

The CTA has expressed concern that a possibility exists for false failures to occur if the proposed 55 percent standard is adopted for pre-1991 engines. They have indicated that an alternative standard of 70 percent would provide a stronger assurance that false failures will not occur, that the HDVIP would be consistent with the mandates of AB 584, and that enforcement of this standard would achieve the goals of the HDVIP and PSIP. CTA further maintains that most of the programs' benefit can be achieved by simply targeting gross polluting trucks—a position consistent with the belief that in-use enforcement programs tailored towards gross polluters tend to be very cost effective.

However, the data generated in the Truck Repair Study demonstrate that a 55 percent opacity standard for pre-1991 model-year engines is both prudent and consistent with the mandates of AB 584. However, to provide a distinction between gross polluters and those with lower but still objectionable and unnecessary smoke emissions, the staff is proposing the NOV mechanism discussed in Section IV.C. below.

6. Standards for 1991 and Newer Engines

The technological feasibility of the staff's proposed 40 percent snap-acceleration opacity standard for newer technology engines (1991 and newer model year engines) is not being disputed. Prior to 1991, heavy-duty diesel truck and bus engines had to meet a particulate matter standard of 0.60 or greater gram per brake-horse-power hour (g/bhp-hr). The engine certification process is very rigorous, and engines are required to be tested on an engine dynamometer. Since 1991, California urban bus engines must be certified to a new engine particulate matter standard of 0.10 (or less) g/bhp-hr. On-road heavy-duty diesel engines (including engines used in non-urban buses), for both California and federal certification in model years 1991 through 1993, had to meet a 0.25 g/bhp-hr PM standard. The same engines for the 1994 and subsequent model years have to meet a California and federal standard of 0.10 g/bhp-hr. Such low particulate emission standards ensures that these engines, if properly maintained, should have extremely low snap-acceleration opacities. This is confirmed by the data from the RTOS.

However, it is not clear that industry repair personnel can always properly diagnose the problems that cause these engines to have unexpectedly high smoke emissions. In the TRS, there were several instances of repairs of 1991 and newer engines which achieved only marginal reductions in smoke opacity. These results

suggest that a 40 percent standard is a prudent choice to minimize the occurrence of false failures, even though it is plausible that 1991 and newer engines can be repaired to significantly lower opacity levels.

7. Exemptions with Substitute Standards.

There are a limited number of families of diesel engines that have snap-acceleration test opacities exceeding the relevant standard even when the engines, which satisfy U.S. EPA and California emission standards, are set to the manufacturers' specifications. These engines typically have sharply-peaked smoke profiles of short duration due to design of the engine and control systems. The current HDVIP regulations allow the manufacturers of these engine families to request that the ARB exempt the engine families from the relevant standard and substitute a technologically appropriate less stringent standard. For example, some models of engines in the Detroit Diesel Series 60, Caterpillar 3176, and Cummins L-10 engine families have been granted exemptions allowing snap-acceleration test opacities up to 75 percent.

Attenuating irrelevant sharp opacity peaks of short duration was a fundamental design goal of the SAE J1667 procedure. Use of the SAE J1667 procedure should, therefore, minimize the likelihood that properly maintained engines with sharp opacity peaks will fail to satisfy the relevant proposed standard. However, there is a possibility that properly maintained engines in some engine families may still have test opacities exceeding the standard.

The staff proposes that the current exemption process be retained to prevent false failures of this type. Exemptions for specific engine families that have been previously granted will be rolled over into the proposed HDVIP. For new exemption requests, manufacturers would have to provide the ARB with test data justifying the exemption, as at present. If the Executive Officer finds that the exemption request is technically sound and meets the requirements of the revised section 2182, an exemption will be granted. The staff will continue to work with engine manufacturers to assure that such exemption requests are processed smoothly and efficiently.

## C. Issuance of Notices of Violation for Pre-1991 Model-Year Diesel Engines With Tested Opacities Between 55 Percent and 70 Percent

As noted above, staff has not supported the CTA's request that a 70 percent opacity standard be established for pre-1991 engines. Staff believes that a 55 percent standard is justified by the data and is consistent with AB 584.

An analysis of data from the suspended HDVIP and the RTOS suggests that a 70 percent standard is likely to reduce the number of citations issued by about 10 percent. During the suspended HDVIP, approximately 8.8 percent of the citations were issued to vehicles with opacities between 55 percent and 70 percent. About 13

percent of the complete RTOS sample (i.e., all model years) had opacities in the 55 to 70 percent range. In contrast, of the RTOS sample of pre-1991 vehicles with opacities exceeding 55 percent, 29 percent had opacities in the 55 to 70 percent range.

In order to maintain the emission reductions attributed to this program while making an accommodation for less culpable vehicle owners, the staff is proposing to maintain the 55 percent opacity standard with a NOV mechanism for pre-1991 engines with measured opacities exceeding 55 percent but not exceeding 69 percent. The proposal will result in a significantly greater number of trucks being repaired to opacities of 55 percent or less and thereby reducing emissions, compared to a 70 percent standard.

Under the proposed compromise, if vehicles with pre-1991 model year engines had
snap-acceleration test opacities exceeding 55 percent the ARB would take the following actions:

- If the exceedance is above 69 percent, a citation imposing a financial penalty would be issued; second citations within a year would result in a penalty of $1800;
- If the opacity exceeds 55 percent but does not exceed 69 percent, an NOV (often referred to as a "fix-it ticket") would be issued;
- If a demonstration of correction is submitted within 45 days of receipt of the NOV, there will be no monetary penalty;
- If a demonstration of correction is not timely submitted, a citation would be issued and the normal penalties would apply.

The NOV mechanism would not apply where a previous NOV or citation has been issued for the vehicle in the preceding 12 months. Where a pre-1991 engine inspected under the HDVIP has a measured opacity exceeding 55 percent but not exceeding 69 percent within 12 months of issuance of an NOV for which a timely demonstration of correction was issued, a citation will be issued with a penalty of $800. If the opacity is measured within that range and a citation had been issued for the vehicle within the preceding year, a citation will be issued and the penalty will be $1800 — the penalty applicable for second citations within a year. This higher penalty would apply for both prior citations issued in the first instance and prior citations issued after the owner failed to make timely repairs in response to an NOV.

The staff proposes that the above mechanism for pre-1991 model-year engines be reviewed after it has been in place for a year. The staff would report to the Board by December 31, 1999 on the results of enforcing this procedure and recommend whether the regulations should be amended to require that citations be issued to all vehicles with pre-1991 model year engines whose test opacity exceeds 55 percent. Any elimination of the NOV mechanism would need to be implemented in a subsequent rulemaking with the normal notice and comment period. (Because of

projected fleet turn-over, the emissions impact of heavy-duty diesel vehicles with pre-1991 model year engines will be reduced over time.)

### D. Interim Use of SAE J1243 Smokemeters

The present HDVIP and PSIP regulations specify the use of smokemeters complying with the specifications of SAE J1243. To facilitate a smooth transition from these smokemeters to the SAE J1667 type smokemeters specified in the proposed amendments, staff is proposing that facilities that are not equipped with a working SAE J1667 type smokemeter be permitted to conduct PSIP tests with SAE J1243 smokemeters until July 1, 1999. The measurements of opacities with SAE J1243 smokemeters would be subject to the testing procedures specified in the present HDVIP and PSIP regulations.

Vehicles brought into compliance using the older style SAE J1243 smokemeters will have greater assurance of compliance with the proposed standards because the older style smokemeters tend to read higher than newer SAE J1667 smokemeters.

### E. Definition of "Excessive Smoke"

Assembly Bill 1460 (Stats. 1996, ch 292, Morrissey) amended Health and Safety Code section 44011.6(a) to prohibit the use of a heavy-duty vehicle that "emits excessive smoke." Accordingly, staff proposes a regulatory amendment providing that a heavy-duty vehicle has "excessive smoke" if it fails to comply with the applicable smoke opacity standard.

### F. Administrative Hearing Process

As a further safeguard against possible false failures, owners of cited vehicles will continue to have administrative appeal rights. Under the existing HDVIP administrative hearing process, cited vehicle owners may contest a citation before a State-appointed Administrative Law Judge (ALJ). Under this process, a citee has 30 days from the day of service of the citation to request a hearing (this time period will be changed to 45 days). During the appeal, the citation is stayed, and the vehicle owner is not required to pay the civil penalties or take any other corrective actions until a decision is issued. At the hearing, the citee may present any information she/he believes is relevant to show that the citation was wrongfully issued. The administrative hearings will continue to be conducted by an impartial administrative law judge who has broad authority to take actions necessary for a full and fair adjudication of a contested citation. Under the administrative hearing procedures, citees may request that the ALJ's decision be reconsidered by the ARB's Executive Officer and may ultimately seek independent judicial review by filing a petition for a writ of administrative mandamus in Superior Court.

As noted above, the ARB is planning a separate rulemaking, with a hearing in the Spring of 1998, to update the administrative hearing regulations.

### G. Issues of Controversy

In an August 1997 public mailout, draft proposed regulatory amendments, along with support documents including a draft Technical Support Document, were sent to interested parties. On September 11, 1997, the ARB staff conducted a public workshop to hear comments on the regulatory proposal. The current proposal reflects many of the comments received at the workshop, as well as those received prior and subsequent to it. Sections IV.B.5. and IV.C. address CTA's position that the opacity standard for pre-1991 model-year engines should be
70 percent. Staff is not aware of any other major issues of controversy.

## V. ENVIRONMENTAL AND ECONOMIC IMPACTS

### A. Identifying the Baseline for Evaluating the Impacts of the Proposed Amendments

Although the ARB has not yet resumed active enforcement of the HDVIP and the PSIP, the regulatory requirements have not been repealed and remain part of the California Code of Regulations. Accordingly, the analyses of the impacts of the proposed amendments set forth below are based on a comparison to the existing regulatory requirements, rather than a comparison to a situation where no heavy-duty inspection programs exist.

Following the evaluation of the environmental and economic impacts of the proposed amendments, this Section concludes with a discussion of the overall cost effectiveness of the HDVIP and PSIP. This cost effectiveness discussion is based on an analysis of the overall emissions benefits and costs of the roadside and fleet inspection programs.

### B. Environmental Impacts of the Proposed Amendments

1. Emissions Impacts

As noted above, the staff's evaluation of the air quality impacts of the proposed amendments is based on a comparison of the HDVIP and PSIP with the proposed amendments, to the HDVIP and PSIP regulations as they now exist in the California Code of Regulations. In conducting an emissions impact analysis, it is also necessary to identify the "baseline" emissions starting point with which the original and amended programs will be compared. The staff has identified that baseline as the expected emissions from on-road heavy-duty diesel vehicles in 1998 prior to resumption of either the original or amended program. These estimated baseline emissions reflect the residual impact of the 1991-1993 HDVIP enforcement activities on the in-use emissions of heavy-duty trucks and buses in California.

In performing this analysis, staff modeled the years 1999 and 2010 using the MVEI7G emissions model as opposed to the Radian model used for the original program analyses. The MVEI7G is the current "state of the art" emissions model and reflects the most recent heavy-duty diesel vehicle inventory, activity and emission

factors. As discussed in the Technical Staff Document, the staff updated the model in September 1997 to reflect the most recent repair data from the TRS and the resultant emission benefit factors. Based on the updated MVEI7G model, the environmental impacts presented in this section cover reactive organic gases (ROG), NOx, PM-10, and the percentage of smoking vehicles reduced (%). Except for the percentage of smoking vehicles reduced, all quantities are in the units of tons per day (tpd) statewide. The tables below summarize the combine incremental emissions reductions for the existing HDVIP and PSIP versus the programs as modified by the proposed amendments.

**Table 4**

**Year 1999 - Incremental Emissions Reductions for Existing Programs vs. Proposed Amendments**

| | Existing Programs | Proposed Amendments | Difference |
|---|---|---|---|
| ROG (tpd) | 7.71 | 6.37 | -1.34 |
| NOx (tpd) | 14.70 | 12.24 | -2.46 |
| PM-10 (tpd) | 6.30 | 5.24 | -1.06 |
| Smoking Vehicles Reduced (%) | 35.4% | 29.0% | -6.4% |

The above table shows the incremental environmental impacts in 1999 for the existing program compared to the programs with the proposed amendments incorporated. As shown by the negative sign in the "difference" column, the benefits associated with the proposed amendments are slightly less than would be realized under the existing programs. The emissions reduced statewide are -1.34 tpd (ROG), -2.47 tpd(NOx), and -1.06 tpd (PM-10).

**Table 5**

**Year 2010 - Incremental Emissions Reductions for Existing Programs vs. Proposed Amendments**

| | Existing Programs | Proposed Amendments | Difference |
|---|---|---|---|
| ROG (tpd) | 7.22 | 5.30 | -1.92 |
| NOx (tpd) | 19.13 | 14.03 | -5.10 |
| PM-10 (tpd) | 4.37 | 3.19 | -1.18 |
| Smoking Vehicles | 48.9% | 36.0% | -12.9% |

| | Existing Programs | Proposed Amendments | Difference |
|---|---|---|---|
| ROG (tpd) | 7.22 | 5.30 | -1.92 |
| NOx (tpd) | 19.13 | 14.03 | -5.10 |
| PM-10 (tpd) | 4.37 | 3.19 | -1.18 |
| Reduced (%) | | | |

Table 5, above, provides the same comparison as Table 4, but for the year 2010. Again the proposed amendments indicate that fewer benefits will be realized when compared incrementally to the existing program. For 2010, the differences are: -1.92 tpd, -5.10 tpd, and -1.18 tpd statewide for the emissions of ROG, NOx, PM-10, respectively.

With respect to smoking vehicles, the proposed amendments, when compared to the existing program, will be less effective because some heavy-duty vehicles that marginally exceed the opacity standards under the preexisting test procedures will not fail under the new text procedures. This lessens the overall reduction of "smoking" vehicles, but it is important to realize that the affected vehicles will be those that exceed the preexisting smoke requirements by the smallest amount. In 1999, the existing program would reduce the numbers of smoking vehicles by an estimated 35.4 percent while the proposed amendments will realize estimated reductions of 29.0 percent. In 2010, under the existing program smoking vehicles would be reduced by an estimated 48.9 percent, as compared to an estimated 35.7 percent if the proposed amendments are adopted.

As can be seen, the proposed amendments will result in fewer environmental benefits when compared on an incremental basis to the programs as they now exist in the California Code of Regulations. However, it bears emphasizing that resuming the amended program will result in significant emission reductions compared to the emissions experienced during the current hiatus. The causes for the reduced benefits are due primarily to the incorporation of the AB 584 requirements which direct the ARB to adopt the SAE J1667 testing protocol and smokemeters, and to ensure that there are no false failures or that any false failures will be remedied without penalty. The reduced benefits also reflect the proposed four-year rolling exemption under the PSIP. This exemption will allow newer fleet vehicles (less than 4 years old) to forego the annual smoke inspections. It is estimated that, while the exemption will affect approximately 26 percent of the fleet vehicles, these vehicles are expected to fail at a rate of less than 1 percent of the time. This exemption will allow limited inspection personnel to focus attention to vehicles of greater concern.

2. Effect on the State Implementation Plan

The 1994 State Implementation Plan (SIP) is California's strategy for attaining the federal ambient ozone standard. The 1994 SIP for ozone requires that current

emissions of ozone precursors be reduced to meet the federal ozone ambient air quality standard. Although the HDVIP/PSIP were not included in the list of SIP control measures for ozone attainment, an estimate of the projected HDVIP/PSIP emissions benefits was included in the baseline emissions inventory for the SIP. Those projections were based an earlier emissions model (EMFAC7F) that reflected the impacts of heavy-duty vehicle repairs in a relatively rudimentary fashion. The projected year 2010 ROG + NOx emission benefits from the HDVIP/PSIP included in the baseline emissions inventory for the SIP was 5.9 tpd. Since the amended programs are now expected to result in year 2010 ROG+NOx emission benefits of 19.33 tpd, the amendments will not have an adverse impact on the ozone attainment demonstration in the SIP.

3. Other Environmental Impacts

The staff has not identified any significant non-emissions adverse environmental impacts that would result from the proposed amendments.

## C. Economic Impacts Analysis of the Proposed Amendments

1. Legal Requirements

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic and cost impacts of proposed regulations on California business enterprises and individuals when proposing to adopt or amend any administrative requirements. The assessment shall include a consideration of the impact of the proposed regulation on California jobs; business expansion, elimination or creation; and the ability of California business to compete with businesses in other states.

Also, state agencies are required to estimate the cost or savings to any state or local agency and school district in accordance with instructions adopted by the Department of Finance. The estimate shall include nondiscretionary costs or savings to local agencies and the cost or savings in federal funding to the State.

2. Affected Businesses

Any business involved in the operation and service of heavy-duty diesel vehicles can potentially be affected by the proposed amendments. Also affected are businesses which manufacture the test equipment. All heavy-duty diesel trucks and buses operating on California roads,--whether they are operated by an intrastate, interstate or international owner--are subject to the HDVIP. According to the ARB's MVEI7G model, an estimated 570,561 and 777,214
heavy-duty diesel vehicles will be operating in California in 1999 and 2010 respectively. Approximately 81 percent of these vehicles or an estimated 462,164 in 1999 and 629,543 in 2010 will be registered in California. Of these California-registered vehicles, 63.1 percent will operate in fleets of two or more, and thus will also be subject to the requirements of the PSIP. These estimates compute to an

estimated 291,625 vehicles in about 9,200 fleets subject to the PSIP in 1999, and an estimated 397,242 vehicles in about 12,600 fleets subject to the PSIP in 2010.

3. Potential Impacts of the Amendments on Business

**Administrative costs to fleets.** The PSIP results in various administrative costs for the operators of fleets containing two or more heavy-duty diesel powered vehicles that are registered in California. The PSIP administrative costs can be broken into three categories: labor costs, capital costs for acquisition of smokemeters, and the cost of contractual PSIP Inspections.

The proposed amendments do not change the basic PSIP requirement that fleet owners conduct annual smoke tests and inspections. The two significant changes made by the proposed amendments to the PSIP are (1) changing the smoke opacity test procedure from SAE J1243 to SAE J1667, and (2) exempting heavy-duty vehicles powered by 1994 and subsequent model year engines until those engines are more than four model years old. The TSD indicates that in-house inspections with company smokemeters will be more economical than contractual service testing when the fleet size exceeds 16 vehicles. The cost of SAE J1667 smokemeters are, on average, about the same as the cost of SAE J1243 smokemeters, according to a September 1997 survey conducted by staff and shown in Table 6 below. Further, the steps taken to conduct an SAE J1667 test are similar to those associated with an SAE J1243 test. Accordingly, the change in the test procedure is expected to have no significant impacts on the costs of labor or of contractual smoke tests, and, in most cases, the cost of smokemeters.

**Table 6**

**Smokemeter Costs**

| | **Meter A** | **Meter B** | **Meter C** | **Meter D** |
|---|---|---|---|---|
| Cost of SAE J1243 Smokemeter | $3,000 | $8,250 | $4,995 | $3,580 |
| Cost of SAE J1667 Smokemeter | $4,500 | $8,470 | $4,995 | $2,500 |
| Cost to Upgrade from SAE J1243 to SAE J1667 Smokemeter | N/A | $200 | $1,750 | N/A |

The one instance where the proposed change to the designated test procedure could have an adverse impact on fleet administrative costs involves firms that have already acquired an SAE J1243 type smokemeters and will need to replace it with an SAE J1667 type smokemeter. However, there are several factors that suggest that the overall costs associated with replacing SAE J1243 type smokemeters will be minimal. First, it appears that relatively few fleet operators acquired SAE J1243 type

smokemeters in anticipation of complying with the PSIP. The ARB amended the regulations to delay implementation of the PSIP from January 1995 to January 1996 so that fleet operators would not have to buy SAE J1243 type smokemeters that would soon be outmoded. Second, as shown in Table 6 above, two manufacturers of more expensive smokemeters have substantially lower prices for replacing or updating SAE J1243 type instruments (in one case, the upgrade is only $200). Third, the proposed regulations include a grandfather clause that allows a facility that does not have an SAE J1667 type smokemeter to perform PSIP testing with an SAE J1243 type smokemeter until July 1, 1999. By that date, fleets that had purchased SAE J1243 type smokemeters several years ago would be approaching the date the smokemeters would need to be replaced, since the estimated useful life of such smokemeters is 5-10 years.

**With regard to the exemption for new engines during the first four model years, the staff estimates that 26 percent of the diesel engines in covered fleets will at any one time be no more than four model years old. Thus the exemption is expected to reduce fleet administrative costs by an average of 26 percent, although only those fleets with the newer engines will be affected. Overall, this reduction in cost would be expected to offset any additional costs resulting from a need to replace SAE J1243 smokemeters.**

**Other costs to heavy-duty vehicle owners. The remaining cost impacts for heavy-duty vehicle owners can be separated into four categories. These categories include the following:**

- **(a) repair costs for vehicles failing an HDVIP or PSIP test;**
- **(b) increased costs for improved maintenance conducted by owners in order to avoid HDVIP or PSIP failures;**
- **(c) the lost opportunity cost of time spent undergoing HDVIP inspections;**
- **(d) the savings from the reduced fuel costs that result from repairs and improved maintenance.**

**The staff estimates that, overall, the amendments will result in a very small cost savings for these categories, due to the slightly reduced failure rate under the new test procedure.**

**The minimal cost impacts of the proposed amendments on businesses are not expected to affect freight or passenger rates, or the costs of goods transported by heavy-duty diesel vehicles.**

For the above reasons, the proposed amendments are not expected to have a significant adverse economic impact on large or small businesses, including the ability of California businesses to compete with businesses in other states, or on directly affected private persons. In addition, the proposed amendments should have no significant effect on the creation or elimination of jobs within the State of

California, the creation of new businesses or elimination of existing businesses within California, or the expansion of businesses currently doing business within California.

4. Fiscal Impacts on State and Local Governmental Entities

A significant number of state and local agencies and school districts operate heavy-duty vehicles that are subject to the HDVIP and the PSIP. The cost analysis for businesses set forth above is equally applicable to these public entities. Accordingly, the amendments are not expected to result in an overall increase in costs for state and local entities.

## D. Cost Effectiveness of the Overall Amended Programs

**The preceding discussion analyzed the emission and economic impacts of the proposed amendments to the HDVIP and PSIP, comparing the programs as amended to the programs as they now exist in the California Code of Regulations. The discussion that follows analyzes the cost effectiveness of the *overall* programs with the proposed amendments. These cost effectiveness values are derived from the emission benefits and economic impacts of the amended programs, when compared with having no roadside or periodic inspection programs at all.**

### 1. Emission Benefits of the Overall Programs

**The implementation of the HDVIP and PSIP produces several overall benefits:**

- **A reduction in the number of heavy-duty diesel vehicles emitting excess smoke;**
- **A reduction in criteria and toxic air pollutant emissions from heavy-duty diesel vehicles;**
- **A reduction in heavy-duty diesel vehicle fuel consumption;**
- **A potential improvement in heavy-duty diesel vehicle reliability and performance.**

**As noted, the primary goal of the HDVIP and PSIP is to reduce the number of excessively-smoking heavy-duty diesel vehicles. Reductions in criteria and toxic air pollutants, reductions in fuel consumption, along with any improvements in vehicle reliability and performance are other benefits that will accrue as a result of repairing engines to manufacturer's specifications.**

**The reduction in the number of excessively-smoking heavy-duty diesel vehicles due to the implementation of the HDVIP and PSIP was estimated using data collected during the original HDVIP. During that program, the observed failure rate declined from 34 percent at the start of enforcement to 21 percent for the year 1993. This decline in failure rate can be directly converted to an estimate of the number of vehicles whose excess smoke emissions have been eliminated.**

**Based on the assumption that vehicle maintenance practices will equilibrate at the levels observed during the original HDVIP, the proposed amendments will reduce the number of excessively-smoking heavy-duty vehicles operating in California by approximately 29,000 in 1999, increasing to approximately 38,000 in 2010. This equates to reducing the number of excessively-smoking vehicles from California's roadways from 1999 through 2010 by approximately 625,000 due to the combined effects of the HDVIP and PSIP amendments.**

**The improved maintenance practices/repairs resulting from both the HDVIP and PSI program will also bring about a reduction in emissions of ROG, NOx and particulate. By using a "detailed engine malperformance model" along with the MVEI7G emissions inventory model, the statewide emission reduction impacts (in tons per day) are estimated as follows:**

| | ROG | NOx | PM-10 |
|---|---|---|---|
| 1999 | 6.37 | 12.24 | 5.24 |
| 2010 | 5.30 | 14.03[5] | 3.19 |

**This malperformance model was used to estimate changes in the volume of diesel fuel consumed by heavy-duty vehicles due to HDVIP and PSIP implementation. The estimated reduction in diesel fuel consumption of 0.69 percent in 1999 and 0.66 percent in 2010 translates to a savings of 16.7 million gallons of diesel fuel annually in 1999 and 19.2 million gallons of diesel fuel annually in 2010 or approximately 250 million gallons over the 12-year period, a savings of over $212 million based on current diesel fuel prices.**

**The renewed enforcement of the HDVIP and PSIP is also expected to cause reductions in the total toxic mass emissions from heavy-duty diesel vehicles and potentially improve heavy-duty diesel vehicle reliability and performance. However, due to the lack of definitive analytical tools for assessing the magnitude of these benefits, no quantitative estimate of program benefits in these areas has been developed**

**2. Costs of the Overall Programs**

**The Technical Support Document contains an extensive analysis of the estimated costs resulting from compliance with the HDVIP and the PSIP as amended by the staff's proposal. These costs are shown in Table 7.**

**When the overall costs of the HDVIP and PSIP are considered, it is likely that these costs will have no noticeable on the profitability of the California trucking industry, which earned about $1 billion in operating profit 1994 according to the U.S. Department of Commerce. In some instances, the programs can actually result in an increase in profitability for truck and bus operators because fuel cost savings that could result from timely repairs and improved maintenance would exceed the costs of inspections and repairs. The overall programs also benefit some businesses directly. Smokemeter manufacturers, testing stations, and repair and maintenance shops are likely to experience an increase in demand for their products and services.**

[5] The TRS demonstrated that newer-technology diesel engines have greater NOx reductions per repair; increasing numbers of these newer-technology engines in the 2010 fleet will result in more NOx reductions realized than in 1999.

### 3. Overall Cost Effectiveness

**As discussed previously, the HDVIP and PSIP will reduce the emissions of criteria pollutants as a result the of repairs performed to reduce excessive smoke emissions. These reductions can be combined with program costs values to estimate the cost effectiveness of reducing criteria pollutants in terms of dollars per pound of emission reduction. Based on the estimated program costs and criteria pollutant emission reductions presented in the previous sections, the cost effectiveness of the benefits of the HDVIP and PSIP is estimated to be $1.12 per pound in 1999 and $1.05 per pound in 2010. These estimates compare favorably to alternative emission control programs which typically cost between $2.50 and $5.00 per pound of emissions reduced.**

**Table 7**

**Summary of HDVIP and PSIP Costs**

| | 1999 | 2010 |
|---|---|---|
| **Administrative Cost to Fleets** | | |
| Annual Labor Cost (PSIP) | $1,255,761 | $1,642,385 |
| Annual Capital Cost for Smokemeters (PSIP) | $5,005,009 | $6,817,787 |
| Annual Cost of Contractual PSIP Inspections (PSIP) | $10,725,351 | $14,027,474 |
| Total Fleet Annual Administrative Cost | 16,986,121 | 22,487,646 |
| **Costs to Vehicle Owners** | | |
| Annual Repair Cost (HDVIP + PSIP) | $21,162,379 | $16,229,616 |
| Annual Increased Maintenance Cost (HDVIP + PSIP) | $2,267,097 | $2,947,141 |
| Annual Lost Opportunity Cost of Time (HDVIP) | $771,936 | $567,603 |
| Annual Cost of Fuel (HDVIP + PSIP) | ($21,764,145) | ($24,983,116) |
| Total Cost to Vehicle Owners | $2,437,267 | ($5,238,756) |
| **Total HDVIP and PSIP Cost** | | |
| Total Program Cost | $19,423,388 | $17,248,890 |