SUMMARY OF BOARD ITEM

ITEM # 00-12-5: PUBLIC HEARING TO CONSIDER AMENDMENTS TO ADOPT NOT-TO-EXCEED AND EURO III EUROPEAN STATIONARY CYCLE EMISSION TEST PROCEDURES FOR THE 2005 AND SUBSEQUENT MODEL YEAR HEAVY-DUTY DIESEL ENGINES

STAFF RECOMMENDATION: The staff recommends that the Board adopt California Code of Regulations (CCR), title 13, article 1.5 and section 2065; amend CCR, title 13, section 1956.8; and the incorporated "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles."

DISCUSSION: Heavy-duty diesel engines are used in vehicles with a gross vehicle weight rating of 14,001 pounds and greater. The primary pollutants of concern from diesel engines are oxides of nitrogen (NOx) and particulate matter. The high temperatures of combustion and excess air cause the nitrogen in the air to combine with available oxygen to form NOx. Particulate matter emissions result from fuel droplets that have not completely combusted. Additionally, lubrication oil that enters the cylinder contributes to particulate matter emissions.

The current certification requirements for new heavy-duty diesel engines produced for sale in California are based on compliance with emission standards under conditions specified by the Federal Test Procedure (FTP). In the 1990s, it was found that seven of the largest heavy-duty diesel engine (HDDE) manufacturers violated certification regulations by turning off, or defeating, emission control devices during in-use highway driving. The seven engine manufacturers entered into individual consent decrees with the Department of Justice and United States Environmental Protection Agency (U.S. EPA) and individual settlement agreements with the Air Resources Board (herein after "consent decrees) to resolve the violations of federal and state standards. The settling manufacturers are

required, among other things, to produce HDDEs that meet a 2.5 g/bhp-hr FTP limit on non-methane hydrocarbons plus NOx emissions no later than October 1, 2002, more than a year earlier than would otherwise be required. The majority of these settling manufacturers have also agreed to produce engines by October 1, 2002, that meet supplemental certification procedures including the Not-To-Exceed (NTE) and the EURO III European Stationary Cycle (ESC) tests. The consent decrees stipulate that these requirements must be met for a period of two years. Together with the FTP test, these supplemental test procedures will require control of emissions over the majority of real world conditions. The U.S. EPA has already adopted the supplemental test procedures for the 2007 and subsequent model years.

The proposal includes adoption of two supplemental test procedures identical to those required in the consent decrees for 2005 and subsequent model year HDDEs, two years earlier than required under the recently adopted Federal regulations. The proposed NTE test procedure provides a wider range of transient test conditions during certification of an engine. Additionally, this test procedure can be used for chassis and in-use testing. The emissions cap in this test is 1.25 times the applicable FTP limit. The proposed ESC test procedure tests an engine over 13 specific steady-state modes of operation. Emissions over the test modes are weighted and the emissions cap for this test is equivalent to the applicable FTP limit. The 12 non-idle test points of this test procedure are used to determine maximum allowable emission limits. The proposal also includes two exemptions from the proposed tests for the 2005 and 2006 model years, one for "ultra-small volume manufacturers" and another for "urban buses."

Since the consent decree requirements expire in 2004, adopting the proposed supplemental test procedures will require settling manufacturers to continue producing clean engines during 2005 and subsequent model years, and require other

manufacturers to produce similarly clean engines beginning in 2005.

SUMMARY AND IMPACTS: The affected businesses are the manufacturers, dealers, and purchasers of HDDEs sold in California. Based on previous sales data, there are 21 companies that manufacture these engines. The proposed supplemental test procedures may be expected to result in some engine design modifications, which in turn, may result in increased costs to the engine manufacturers. These costs are expected to be passed on to the purchasers of heavy-duty vehicles with a gross vehicle weight rating of 14,001 pounds and greater. Since the manufacturers who entered the consent decrees account for approximately 60 percent of heavy-duty diesel vehicle sales and are required to comply with the supplemental test procedures beginning in 2002, most purchasers are expected to experience no increase in vehicle cost as a result of the proposed supplemental test procedures.

If the entire costs were passed on to the purchaser, the U.S. EPA estimates that heavy-duty vehicle retail prices would increase by a maximum of approximately $674 per medium heavy-duty vehicle (14,001 to 33,000 pounds gross vehicle weight rating) and $824 per heavy heavy-duty vehicle (33,001 pounds and greater gross vehicle weight rating) in the 2005 model year. U.S. EPA also estimates that average vehicle costs are $52,000 per medium heavy-duty vehicle and $108,000 per heavy heavy-duty vehicle. Based on U.S. EPA's estimated vehicle costs, the estimated price increase would represent a 1-2 percent price increase. A price increase of this magnitude is not expected to dampen the demand of heavy-duty vehicles. Consequently, the impact to dealers of heavy-duty vehicles is not expected to be significant. The expected price increase is also not expected to impact California employment, business expansion, creation and elimination, or the ability of California businesses to compete with businesses from other states.

The estimated excess NOx emissions expected to be reduced due to the proposed supplemental test procedures is 8.4 tons per day in 2005 and 17.3 tons per day in 2006. This estimate is for California registered vehicles only. Based on the costs described above, the cost effectiveness is estimated to range from $0.09 to $0.63 per pound of excess NOx reduced. The range depends upon the weight class of the heavy-duty vehicle. Based on current sales distribution of the two weight classes, overall cost effectiveness is estimated at $0.17 per pound of excess NOx reduced. This is well within the range of cost-effectiveness determined by previous regulatory action within the past decade.

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER AMENDMENTS TO ADOPT NOT-TO-EXCEED AND EURO III EUROPEAN STATIONARY CYCLE EMISSION TEST PROCEDURES FOR THE 2005 AND SUBSEQUENT MODEL YEAR HEAVY-DUTY DIESEL ENGINES

The Air Resources Board (Board or ARB) will conduct a public hearing at the time and place noted below to consider amendments to regulations to adopt supplemental test procedures for 2005 and subsequent model year heavy-duty diesel engines. The supplemental test procedures include the Not-to-Exceed and EURO III European Stationary Cycle emission test procedures.

DATE: December 7, 2000

TIME: 9:00 a.m.

PLACE: Air Resources Board
Board Hearing Room, Lower Level
2020 L Street
Sacramento, California

This item will be considered at a two-day meeting of the Board, which will commence at 9:00 a.m., December 7, 2000, and may continue at 8:30 a.m., December 8, 2000. This item may not be considered until December 8, 2000. Please consult the agenda for the meeting, which will be available at least 10 days before December 7, 2000, to determine the day on which this item will be considered.

This facility is accessible to persons with disabilities. If accommodation is needed, please contact the Clerk of the Board at (916) 322-5594 or TDD (916) 324-9531 or (800) 700-8326 for TDD calls from outside the Sacramento area by November 22, 2000.

INFORMATIVE DIGEST OF PROPOSED ACTION AND PLAIN ENGLISH POLICY STATEMENT OVERVIEW

Sections Affected: California Code of Regulations (CCR), title 13, article 1.5; section 1956.8; and section 2065, and the incorporated "California Exhaust Emission Standards And Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles."

In the 1990s, seven large manufacturers of heavy-duty diesel engines (HDDEs) violated certification regulations by turning off, or defeating, emissions control equipment during in-use highway driving. To address this violation, the Department of Justice, the United States Environmental Protection Agency (U.S. EPA) and the ARB signed consent decrees with the seven engine manufacturers. A consent decree is a judicial decree

that recognizes a mutual settlement between the parties — in this case, between the government and the engine manufacturers (herein referred to as the "settling manufacturers").

In the consent decrees, the settling manufacturers are required, among other things, to produce HDDEs that comply with prescribed emission standards that are lower than those required in current state and federal regulations, as measured by the Federal Test Procedure (FTP). Specifically, these engines must meet a 2.5 gram per brake horsepower (g/bhp-hr) hour standard for non-methane hydrocarbons (NMHC) plus oxides of nitrogen (NOx) emissions no later than October 1, 2002 (about 50 percent cleaner than current engines). In addition, because it was found that the FTP was not adequate to ensure that exhaust emissions were controlled during all in-use driving, it was agreed that compliance with supplemental test procedures would be necessary. Thus, the majority of the settling manufacturers agreed to produce engines by October 1, 2002, that would meet supplemental test procedures including the Not-To-Exceed (NTE) test and the EURO III European Stationary Cycle (ESC) test. The consent decree states that these requirements must be met for a period of two years. Together with the FTP test, the supplemental test procedures will require control of emissions during the majority of real world operating conditions, ensuring that in the future defeat devices will no longer be employed.

Recognizing the effectiveness of the supplemental tests, the U.S. EPA published a Notice of Proposed Rulemaking (Vol. 64, Federal Register, pp. 58472- 58566, October 29, 1999) proposing to adopt similar supplemental test procedures for 2004 and subsequent model year HDDEs. However, because of federal timing constraints, the NTE and ESC test procedures will not be required until the 2007 model year for federally certified HDDEs (65 FR 59896, October 6, 2000). Therefore, once the HDDE consent decree requirements expire in 2004, the settling manufacturers will not be obligated to comply with the supplemental test procedures in 2005 or 2006. Not until the 2007 model year, when the federal rule comes into effect, will HDDE manufacturers be required to comply with similar supplemental test procedures federally.

In order to assure continued compliance during model years 2005 and 2006 by the settling manufacturers and to begin compliance by all other manufacturers in 2005, staff proposes the inclusion of the NTE and ESC tests in the required California certification process for 2005 and subsequent model year HDDEs. The proposed supplemental test procedures are identical to those in the Consent Decrees. In addition, staff proposes the exemption of "ultra-small volume manufacturers"[1] and "urban buses"[2] from the proposed supplemental test procedures until the 2007 model year in order to allow additional lead time for compliance. Below is a summary of the proposed amendments:

[1] An "ultra-small volume manufacturer" is defined as any manufacturer with California sales less than or equal to 300 new passenger cars, light-duty trucks, medium-duty vehicles, heavy-duty vehicles, and heavy-duty engines per model year based on the average number of vehicles and engines sold by the manufacturer in the previous three consecutive model years.

[2] An "urban bus" is defined in proposed title 13, California Code of Regulations, section 1956.2.

1. Not-to-Exceed Test Procedure

The NTE test establishes an area (NTE control area) under the torque curve of an engine where emissions must not exceed a specified cap for a given pollutant. The NTE cap is set at 1.25 times the FTP emission limit. For 2005 model year heavy-duty engines, the FTP emission limit for NMHC plus NOx is 2.5 grams per brake horsepower-hour, and thus the NTE cap is 3.125 grams per brake horsepower-hour. As in the consent decree requirements, an additional 0.5 grams per brake horsepower-hour is proposed for determining compliance with the supplemental procedures in in-use compliance testing.

The basic NTE control area for diesel engines has three primary boundaries. The first is the upper boundary, which is represented by the engine's torque and speed map. This shows an engine's maximum torque at a given speed. The second boundary is 30 percent of maximum torque. Only operation above this boundary is included in the NTE control area. The third boundary is determined based on the lowest engine speed at 50 percent of maximum power and highest engine speed at 70 percent of maximum power. Only engine operation above the engine speed boundary is included in the NTE control area. Additionally, there are two small areas which are "carved out" of the basic NTE control area because of uncertain technical feasibility.

Notwithstanding the conditions outside the NTE control area specified above, the NTE requirement would apply under any engine operating conditions that could reasonably be expected in normal vehicle use. A vehicle can be tested for compliance with the NTE procedure either on the road or in emissions testing laboratory using an engine or chassis dynamometer. Instead of using a specific driving cycle such as the FTP, compliance testing can involve driving of any type which could reasonably be expected to occur in normal vehicle operation within the boundaries of the NTE control area, including operation under steady-state or transient conditions and under varying ambient conditions. Measured emissions are averaged over a minimum of thirty seconds and compared to the NTE test cap. These requirements would apply to new engines and throughout their useful life.

The NTE test procedures are applicable for a wide range of ambient conditions. For example, NTE ambient temperature coverage can range from 55 °F to 95 °F compared to the FTP ambient conditions of 68 °F to 86 °F. Two different options related to temperature and altitude will be available for manufacturers to comply with the NTE requirements. Under option one, manufacturers must comply with the NTE requirements within the ambient temperature range of 55 °F to 95 °F, and an altitude range of up to 5,500 feet above sea level. Within this NTE altitude and temperature zone, the engine must meet the NTE requirements. For testing at a given altitude outside of this zone, NOx and PM emission results may be corrected for temperature.

Under option two, manufacturers must comply with the NTE requirements between 55 °F and 100 °F at sea-level and between 55 °F and 86 °F at 5,500 feet above sea-level. The maximum temperatures for the corresponding altitudes between those points are determined linearly. At temperatures above the NTE zone, NTE requirements do not apply. Additionally, defeat devices may not be used in the temperatures above the NTE control area. This option is not contained in the consent decrees although it is in the U.S. EPA's Final Rule. It is provided here because it provides even better control of off-cycle emissions under typical California conditions.

In U.S. EPA's Final Rule, a NTE deficiency provision for 2007 through 2009 model year engines provides manufacturers with a relief mechanism for failing to comply with some of the NTE requirements. Because the NTE control area and test procedures in the proposed regulation are identical to the NTE requirements in the HDDE consent decree for model years 2003 and 2004, the settling manufacturers will be in compliance with proposed NTE requirements prior to the effective date of this proposal. However, it may be possible that manufacturers will have technical difficulties that are limited in nature. Therefore, staff proposes the inclusion of NTE deficiencies from 2005 through 2007 model years. This provision is optional and increases manufacturer flexibility compared to the consent decrees.

2. EURO III European Stationary Cycle Test Procedure

The Euro III ESC test cycle, or the "supplemental steady state test," consists of 13 modes at different speed and power conditions, primarily representing the typical highway cruise operating conditions of heavy-duty diesel vehicles.

During the test cycle, the engine is initially operated at idle, then through a defined sequence of 12 modes at various speeds and engine loads. The test modes are at three different operational engine speeds and at 25%, 50%, 75%, and 100% of maximum load. The engine is operated for two minutes at each mode, except for idle. The emission results at each mode are then weighted and averaged.

Manufacturers would be required to show compliance with the following:

Average Allowable Testing Caps

At each mode of operation of the ESC test, the concentration of the gaseous pollutants is measured. The weighted average emissions for each pollutant must not be greater than the existing FTP emission limit which is 2.5 grams per brakehorsepower-hour for NMHC plus NOx for 2005 and subsequent model year engines. A single, particulate matter measurement is made of the entire 13 modes at the end of the test. The ARB may select 3 additional test points between the 12 non-idle test

modes for gaseous pollutants only. The purpose of the additional tests is to ensure that the engine emission controls are not optimized for the specific test modes and then defeated when operating in modes not specified for testing.

Maximum Allowable Testing Caps

Maximum allowable emission caps are determined from the 12 non-idle test points of the ESC tests. The maximum allowable emission cap at any set of speed and load conditions between the test points can be determined by using a four-point interpolation procedure. Emissions of gaseous pollutants at any point within the maximum allowable emission capped operational zone must not exceed the emissions standard as determined by interpolation. Maximum allowable emission caps only apply to gaseous pollutants and do not apply to particulate matter.

3. Measuring Smoke Emissions Within the NTE Control Area

Within the NTE control area, an engine must meet either a filter smoke cap or an opacity cap. The filter smoke cap is 1.0 on the Bosch number scale, a measure of smoke opacity. There are two alternatives for the smoke opacity cap. The first opacity cap is 4 percent averaged over 30 seconds using a 5-inch path. This cap is for transient testing. The second opacity cap is also 4 percent, but averaged over 10 seconds using a 5-inch path. This cap is for steady state testing. Smoke emissions at these low levels would not be visible.

AVAILABILITY OF DOCUMENTS AND AGENCY CONTACT PERSON

The Board staff has prepared a Staff Report which includes the initial statement of reasons (ISOR) for the proposed action and a summary of the environmental impacts of the proposal. Copies of the Staff Report, and the full text of the proposed regulatory language may be obtained from the Board's Public Information Office, 2020 L Street, Sacramento, CA 95814, (916) 322-2990. The Board staff has compiled a record which includes all information upon which the proposal is based. This material is available for inspection upon request to the agency contact person identified immediately below.

The ARB staff has determined that it is not feasible to draft the regulation in plain English due to the technical nature of the regulation; however, a plain English summary of the regulation is available from the agency contact person named in this notice, and is also contained in the ISOR for this regulatory action.

To obtain the ISOR in an alternate format, please contact the Air Resources Board's ADA Coordinator at (916) 323-4916, TCC (916) 324-9531, or (800) 700-8326 for TDD calls from outside the Sacramento area. This notice, the ISOR, and subsequent regulatory documents will also be available on the ARB's Internet site for this rulemaking at: http://www.arb.ca.gov/regact/NTEtest/NTEtest.htm .

Further inquiries regarding this matter should be directed to the agency contact person for this rulemaking, Ms. Susan O'Connor, Manager, On-Road Heavy-Duty Diesel Section, at (626) 450-6162 of the Air Resources Board, Mobile Source Control Division, 9528 Telstar Avenue, El Monte, California 91731.

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred in reasonable compliance with the proposed regulations are presented below.

The Executive Officer has determined that the proposed regulatory action will not create costs or savings, as defined in Government Code section 11346.5(a)(6), to any state agency or in federal funding to the state, costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to part 7 (commencing with section 17500), division 4, title 2 of the Government Code, or other non-discretionary savings to local agencies.

The Executive Officer has also determined that adoption of the proposed regulatory action will not have a significant adverse economic impact on businesses, including the ability of California businesses to compete with businesses in other states, except as noted below.

The businesses affected by the proposed supplemental test procedures are the manufacturers of HDDEs sold in California. Based on previous sales data, there are 21 companies that manufacture these types of engines. The proposed test procedures may be expected to result in some engine design modifications, which in turn, may result in increased costs to the engine manufacturers. However, these costs are expected to be passed on to the consumers or purchasers of heavy-duty vehicles with a gross vehicle weight rating of 14,001 pounds and greater. Since the settling manufacturers, account for approximately 60 percent of heavy-duty diesel vehicle sales and are required to comply with identical requirements beginning two years prior to 2005, most purchasers are not expected to experience an increase in vehicle cost as a result of the proposed regulations.

If the entire costs are passed on to the consumer, heavy-duty vehicle retail prices would increase by a maximum of approximately $674 per medium heavy-duty vehicle and $824 per heavy heavy-duty vehicle in the 2005 model year. U.S. EPA estimates that average vehicle costs are $52,000 per medium heavy-duty vehicle and $108,000 per heavy heavy-duty vehicle. Based on U.S. EPA's estimated vehicle costs, the estimated

price increase would represent a 1-2 percent price increase. The price increase of this size is not expected to dampen the demand of heavy-duty vehicles. Consequently, the impact to dealers of heavy-duty vehicles is not expected to be significant. The expected price increase is also not expected to impact California employment, business expansion, creation and elimination, or the ability of California businesses to compete with businesses from other states.

Due to the additional emission control technologies that may be required, manufacturers of those technologies may experience higher sales volume. The higher sales volume may also increase employment for those businesses that supply parts between the related businesses. Compared to overall California employment, this effect is expected to be minor. Additionally, to the extent that manufacturers use contract laboratories located in California for testing or other research and development efforts, there is a potential increase in contract laboratory employment. No other associated businesses are expected to be affected by the proposed supplemental test procedures.

The estimated excess NOx emissions expected to be reduced due to the proposed supplemental test procedures is 8.4 tons per day in 2005 and 17.3 tons per day in 2006. This estimate is for California registered vehicles only. Based on the costs described above, the cost effectiveness is estimated to range from $0.63 to $0.09 per pound of excess NOx reduced. The range depends upon the weight class of the heavy-duty vehicle. Based on current sales distribution of the two weight classes, overall cost effectiveness is estimated at $0.17 per pound of excess NOx reduced. This is well within the range of cost-effectiveness determined by previous regulatory action within the past decade.

In accordance with Government Code section 11346.54, the Executive Officer has determined that the proposed regulatory action will not adversely affect the creation or elimination of jobs with 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. The Executive Officer has also determined, pursuant to Government Code section 11346.5(a)(3)(B), that the proposed regulatory action will affect small business. A full assessment of the economic impact of the proposed regulatory action can be found in the Staff Report.

The Executive Officer has considered proposed alternatives that would lessen any adverse economic impact on businesses and invites you to submit proposals. Submissions may include the following considerations:

(i) The establishment of differing compliance or reporting requirements or timetables which take into account the resources available to businesses.

(ii) Consolidation or simplification of compliance and reporting requirements for businesses.

(iii) The use of performance standards rather than prescriptive standards.

(iv) Exemption or partial exemption from the regulatory requirements for businesses.

Before taking final action on the proposed regulatory action, the Board must determine that no alternative considered by the agency would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

SUBMITTAL OF COMMENTS

The public may present comments relating to this matter orally or in writing. To be considered by the Board, written submissions must be addressed to and received by the Clerk of the Board, Air Resources Board, P.O. Box 2815, Sacramento, CA 95812, no later than 12:00 noon, December 6, 2000, or received by the Clerk of the Board at the hearing. To be considered by the ARB, e-mail submissions must be addressed to NTEtest@listserve.arb.ca.gov and received at the ARB no later than 12:00 noon, December 6, 2000.

The Board requests but does not require that 30 copies of any written statement be submitted and that all written statements be filed at least 10 days prior to the hearing. The Board encourages members of the public to bring to the attention of staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

STATUTORY AUTHORITY

This regulatory action is proposed under that authority granted in California Health and Safety Code sections 39600, 39601, 43013, 43018, 43101, 43104, 43105, 43210, and 43806, and Vehicle Code section 28114. This action is proposed to implement, interpret and make specific California Health and Safety Code sections 39002, 39003, 39500, 43000, 43012, 43013, 43018, 43100, 43101, 43101.5, 43102, 43104, 43106, 43202, 43203, 43204, 43210-43213, and 43806, and Vehicle Code section 28114.

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, title 2, division 3, part 1, chapter 3.5 (commencing with section 11340) of the Government Code.

Following the public hearing, the Board may adopt the regulatory language as originally proposed, or with non-substantial or grammatical modifications. The Board may also adopt the proposed regulatory language with other modifications if the text as modified is sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action; in such event the full regulatory text, with the modifications

clearly indicated, will be made available to the public, for written comment, at least 15 days before it is adopted. The public may request a copy of the modified regulatory text from the Board's Public Information Office, 2020 L Street, Sacramento, CA 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

Michael P. Kenny
Executive Officer

Date: October 10, 2000

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS

PUBLIC HEARING TO CONSIDER AMENDMENTS TO ADOPT NOT-TO-EXCEED AND EURO III EUROPEAN STATIONARY CYCLE EMISSION TEST PROCEDURES FOR THE 2005 AND SUBSEQUENT MODEL YEAR HEAVY-DUTY DIESEL ENGINES

Date of Release: October 20, 2000
Scheduled for Consideration: December 7, 2000

This report has been reviewed by the staff of the California Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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EXECUTIVE SUMMARY

In the 1990s, seven large manufacturers of heavy-duty diesel engines (HDDEs) violated certification regulations by turning off, or defeating, emissions control equipment during in-use highway driving. To address this violation, the Department of Justice, the United States Environmental Protection Agency (U.S. EPA) and the Air Resources Board (ARB) signed consent decrees with the seven engine manufacturers. A consent decree is a judicial decree that recognizes a mutual settlement between the parties — in this case, between the government and the engine manufacturers (herein referred to as the "settling manufacturers").

In the consent decrees, the settling manufacturers are required, among other things, to produce HDDEs that comply with prescribed emission standards that are lower than those required in current state and federal regulations, as measured by the Federal Test Procedure (FTP).[1] Specifically, these engines must meet a 2.5 gram per brake horsepower (g/bhp-hr) hour standard for non-methane hydrocarbons (NMHC) plus oxides of nitrogen (NOx) emissions no later than October 1, 2002 (about 50 percent cleaner than current engines). In addition, because it was found that the FTP was not adequate to ensure that exhaust emissions were controlled during all in-use driving, it was agreed that compliance with supplemental test procedures would be necessary. Thus, the majority of the settling manufacturers agreed to produce engines by October 1, 2002, that would meet supplemental test procedures including the Not-To-Exceed (NTE) test and the EURO III European Stationary Cycle (ESC) test. The consent decrees state that these requirements must be met for a period of two years. Together with the FTP test, the supplemental test procedures will require control of emissions during the majority of real world operating conditions, ensuring that in the future defeat devices will no longer be employed.

Recognizing the effectiveness of the supplemental tests, the U.S. EPA published a Notice of Proposed Rulemaking (Vol. 64, Federal Register, pp. 58472- 58566, October 29, 1999) proposing to adopt similar supplemental test procedures for 2004 and subsequent model year HDDEs. However, because of federal timing constraints, the NTE and ESC test procedures will not be required until the 2007 model year for federally certified HDDEs (65 FR 59896, October 6, 2000). Therefore, once the consent decree requirements expire in 2004, the settling manufacturers will not be obligated to comply with the supplemental test procedures in 2005 or 2006. Not until the 2007 model year, when the federal rule comes into effect, will HDDE manufacturers be required to comply with similar supplemental test procedures federally.

In order to assure continued compliance during model years 2005 and 2006 by the settling manufacturers and to begin compliance by all other manufacturers in 2005, staff proposes the inclusion of the NTE and ESC tests in the required California certification process for 2005 and subsequent model year HDDEs. The proposed supplemental test

[1] During the FTP, an engine operates through a narrowly defined test cycle.

procedures parallel those in the consent decrees and the U.S. EPA's Final Rule for 2007 and subsequent model year HDDEs,[2] but differ by adding options for flexibility and by exempting "ultra-small volume manufacturers"[3] and "urban buses"[4] until the 2007 model year in order to allow additional lead time for compliance.

The proposal closes the two-year span, after the termination of the consent decrees, from which time engine manufacturers need only satisfy the FTP test procedure under current state and federal regulations. By adopting the proposed additional test procedures, which cover wider ranges of engine operating conditions, potential excess NOx emissions greater than 17 tons per day and 13 tons per day in 2006 and 2010, respectively, can be eliminated from California registered heavy-duty vehicles. Additional emission reductions could also be realized when other states adopt these procedures under the authority granted in section 177 of the federal Clean Air Act.[5] When other states support the proposal by adopting California's proposed supplemental test procedures, the success and effectiveness of the proposal is maximized. Adoption of the proposal by other states ensures that manufacturers produce "clean" HDDEs on a national basis. Additional emission reductions would be realized from "clean" out-of-state HDDE vehicles travelling in California.

Lifetime excess emissions have been calculated at approximately 1 ton per engine from medium heavy-duty diesel engines and approximately 5 tons per engine from heavy heavy-duty diesel engines if the engines are required only to comply with the existing FTP test procedure. Based on an aggregate lifetime net present value cost ranging from $717 to $915 per heavy-duty diesel vehicle, the cost effectiveness of the proposed supplemental test procedures ranges from $0.09 to $0.63 per pound of excess NOx emissions eliminated.

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[2] U.S. EPA Final Rule on the Control of Emissions of Air Pollution from 2004 and Later Model Year Heavy-Duty Highway Engines and Vehicles; Revision of Light-Duty On-Board Diagnostics Requirements (65 FR 59896, October 6, 2000).

[3] An "ultra-small volume manufacturer" is defined as any manufacturer with California sales less than or equal to 300 new passenger cars, light-duty trucks, medium-duty vehicles, heavy-duty vehicles, and heavy-duty engines per model year based on the average number of vehicles and engines sold by the manufacturer in the previous three consecutive model years.

[4] An "urban bus" is defined in proposed Title 13, California Code of Regulations, Section 1956.2.

[5] Section 177 allows the adoption of California standards under specified circumstances.

I. INTRODUCTION

Despite significant improvements in California's air quality over the last forty years, more must be done to improve air quality and protect the health of those living in California. California does not attain the one-hour federal ambient ozone standard in many areas of the state. Mobile source controls are vital to attaining air quality standards statewide because mobile sources account for about 60 percent of ozone precursors. Thus, the need for emission reductions from mobile sources is great. Diesel engines, in particular, can be targeted for major reductions from the mobile source sector. California's plan for attaining the federal ozone ambient air quality standard, as set out in the 1994 Ozone State Implementation Plan (SIP), calls for more exhaust emission reductions from diesel engines.

The current certification requirements for new heavy-duty diesel engines produced for sale in California are based on compliance with emission standards under conditions specified by the Federal Test Procedure (FTP). The FTP is a prescribed engine test cycle conducted in the laboratory that represents the typical operation of a vehicle in-use. In the 1990s, it was found that seven of the largest heavy-duty diesel engine (HDDE) manufacturers violated certification regulations by turning off, or defeating, emission control devices during in-use highway driving. Consequently, the Department of Justice, the United States Environmental Protection Agency (U.S. EPA) and the Air Resources Board (ARB or "Board") signed consent decrees with the seven engine manufacturers. A consent decree is a judicial decree that recognizes a mutual settlement between the parties — in this case, between the government and the engine manufacturers (herein referred to as the "settling manufacturers").

In these consent decrees, the settling manufacturers are required, among other things, to produce HDDEs that meet a 2.5 gram per brake horsepower-hour (g/bhp-hr) FTP limit on non-methane hydrocarbons (NMHC) plus oxides of nitrogen (NOx) emissions no later than October 1, 2002 (about 50 percent cleaner than current engines on the FTP). The majority of these settling manufacturers, herein referred to as the "signing manufacturers" (Caterpillar, Cummins, Detroit Diesel, Mack Trucks, Renault (RVI), and Volvo Trucks), have also agreed to produce engines by October 1, 2002 that meet supplemental certification procedures including the Not-To-Exceed (NTE) test and the EURO III European Stationary Cycle (ESC) test. The consent decrees stipulate that these requirements must be met for a period of two years. Together with the FTP test, these supplemental procedures will require control of emissions over the majority of real world conditions.

Recognizing the effectiveness of the supplemental tests, the U.S. EPA published a Notice of Proposed Rulemaking proposing to adopt the supplemental test procedures for 2004 and subsequent model year HDDEs.[6] However, because of federal timing

[6] See 64 FR 58472, October 29, 1999.

constraints imposed on the U.S. EPA, the NTE and ESC test procedures will not be required nationally until the 2007 model year. Therefore, once the consent decree requirements expire in 2004, the signing manufacturers will not be obligated to comply with the supplemental test procedures in 2005 or 2006. Not until the 2007 model year, when the federal rule comes into effect, will HDDE manufacturers be required to comply with similar supplemental test procedures federally.

The balance of the Staff Report provides greater detail on the proposal, including the supplemental test procedures themselves, the feasibility of the supplemental test procedures, and the preliminary emission benefit calculations for the excess emissions reduced. The proposal is designed to be consistent with the consent decrees so that engines produced by the signing manufacturers will not have to make any design changes in 2005. Several features contained in the U.S. EPA's Final Rule are provided as options that increase the flexibility of this proposal.[7] Staff believes that complying with the proposed test procedures in 2005 and subsequent model years is feasible. Staff is not proposing any changes to the existing emissions standards. It should be noted that support and adoption of the proposal by other states under the authority granted in section 177 of the federal Clean Air Act is important in ensuring that manufacturers produce "clean" heavy-duty diesel engines nationwide. The adoption of the proposal by other states is integral to maximizing the success and effectiveness of the proposal.

Sections I and II of the Staff Report contain the introduction and background, respectively. Section III contains a discussion on the need for the proposed supplemental test procedures. Section IV is a summary of the proposed requirements, while Section V describes the areas in which the proposal differs from the federal requirements. The technological feasibility of the proposed program is addressed in Section VI. Section VII discusses remaining issues that have arisen during the development of the requirements, and discusses how the issues are addressed by the proposal. Section VIII describes the regulatory alternatives that were considered, while Section IX discusses the economic impacts. The environmental impacts and cost-effectiveness of the proposal follow in Section X, along with the cost-effectiveness analysis for the proposed requirements. Finally, Section XI summarizes the staff's findings and recommendations, followed by a list of references in Section XII.

[7] See 65 FR 59896, October 6, 2000.

II. BACKGROUND

This section provides an overview of the exhaust emissions from heavy-duty diesel engines, the current regulations and the SIP commitments for heavy-duty engines.

A. HEAVY-DUTY DIESEL ENGINE EMISSIONS

Heavy-duty diesel engines are used in vehicles with a gross vehicle weight rating of 14,001 pounds and greater.[8] Diesel engines are compression ignited, which means that the fuel and air mixture is ignited by high pressure in the combustion chamber instead of by spark plugs as used in gasoline-fueled vehicles. Regulating the amount of fuel injected into the combustion chamber controls the power output. The primary pollutants of concern from diesel engines are oxides of nitrogen (NOx) and particulate matter (PM). The high temperatures and excess air cause the nitrogen in the air to combine with available oxygen to form NOx. Because of the presence of excess air (and thus oxygen), hydrocarbons (HC) evaporating in the combustion chamber tend to be mostly burned, and HC and carbon monoxide (CO) are not emitted at high levels. Evaporative emissions from diesel engines are insignificant due to the low evaporation rate of diesel fuel. However, PM emissions result from fuel droplets that have not completely combusted. Lubrication oil that enters the cylinder also contributes to PM emissions.

B. EMISSIONS INVENTORY

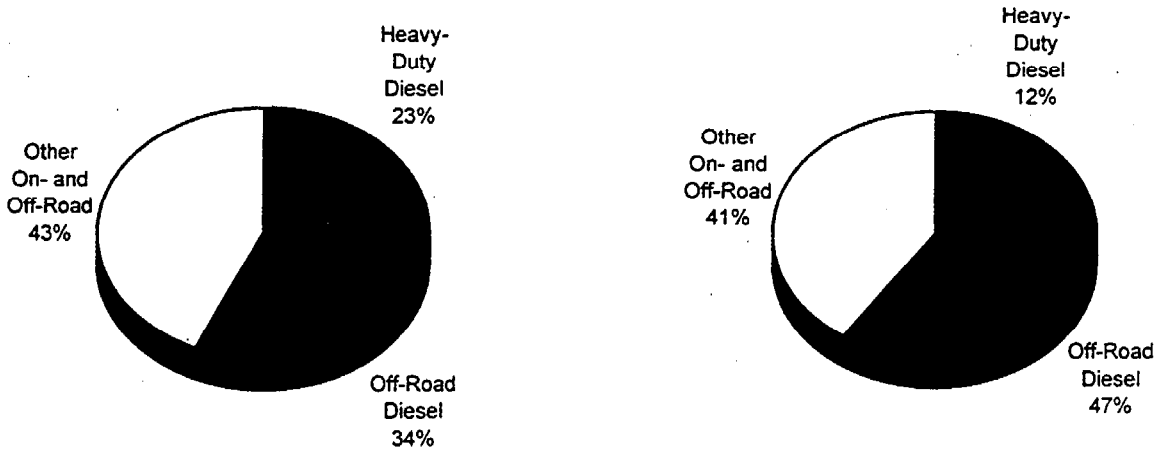
The California emissions inventory for HDDEs has recently been updated. The updated inventory, called EMFAC2000, was adopted by the Board in May 2000. The emissions information in this report is based on the updated emissions inventory from EMFAC2000 Version 2.0.

As shown in Figures 1, the projected statewide NOx and PM emissions from on-road heavy-duty diesel engines in 2010 will contribute approximately 23 percent of the mobile source NOx emissions and 12 percent of the diesel PM exhaust emissions, in the State of California.

[8] The proposed supplemental test procedures are optional for engines used in medium-duty vehicles 8,501 pounds and greater, up to 14,000 pounds gross vehicle weight rating, pursuant to the LEV II requirements in Title 13, California Code of Regulations, Section 1956.8(h).

Figure 1

Statewide Mobile Source Emissions in 2010



Oxides of Nitrogen (NOx) Particulate Matter (PM)

C. EXISTING EMISSION STANDARDS

California is the only state that has the authority to establish new mobile source emission standards and/or test procedures that differ from federal standards and test procedures (Federal Clean Air Act Section 209(b)). Section 177 of the Clean Air Act, however, allows other states to adopt standards and test procedures identical to California's. California standards and test procedures must be, in the aggregate, at least as protective of public health and welfare as applicable federal standards and test procedures.

In October 1997, the U.S. EPA adopted new emission standards for model year 2004 and subsequent model year HDDEs. In February 1998, the ARB subsequently adopted parallel new HDDE standards for the same model years to harmonize the heavy-duty vehicle regulations between the ARB and the U.S. EPA. The standards reflect the provisions of the Statement of Principles signed in 1995 by the U.S. EPA, ARB, and the leading manufacturers of heavy-duty diesel engines. For 2004 and subsequent model year engines, manufacturers will have the flexibility to certify their engines to one of the two options given in Table 1.

Table 1 - U.S. EPA Emission Standards for MY 2004 and Subsequent Heavy-Duty Diesel Engines

Option	NMHC plus NOx	NMHC
1	2.4	n/a
2	2.5	0.5

D. STATE IMPLEMENTATION PLAN (SIP)

In November 1994, the ARB approved the State Implementation Plan (SIP) for ozone, which outlines the measures to be taken to bring the state's air quality into attainment with the federal ambient air quality standards for ozone. During the SIP's development, it became clear that reducing emissions of NOx from on-road HDDEs operating within the state is imperative for cleaning California's air.

A SIP measure (M6) calls for the adoption of a 2.5 g/bhp-hr NMHC plus NOx emission standard for new on-road HDDEs beginning in 2004. This would represent a 50 percent decrease of NOx emissions from the existing federal standard. The SIP assumes that a 50 percent decrease would not only result during driving as measured by the FTP, but during all driving.

III. NEED FOR CONTROL

The NTE and ESC test procedures that staff proposes to the Board for adoption will ensure that original emission benefits associated with the State Implementation Plan M6 are achieved. This section summarizes the air quality benefits that justify the proposed supplemental test procedures.

Ozone is created from the photochemical reaction of primarily NOx and HC. Growing evidence shows that ozone is the cause of harmful respiratory effects, including chest pain, coughing, and shortness of breath. Those who may be severely affected include children, the elderly, and people with poor respiratory systems. Even healthy people may be affected by the elevated ozone levels if they are active outdoors during smoggy days. NOx alone can also directly harm human health by aggravating common respiratory illnesses, such as asthma and bronchitis, and contributes to the premature aging of lung tissue and various other chronic lung diseases. In addition to their human health effects, negative environmental effects are also associated with ozone and NOx. Ozone has been shown to adversely impact plants and many man-made materials, while NOx contributes to the secondary formation of PM (nitrates), acid deposition, and the overgrowth of algae in coastal estuaries.

Prior to entering the consent decrees, the U.S. EPA discovered that many engine manufacturers were optimizing their engines to run at peak fuel efficiency. This optimization resulted in NOx emissions greater than certified levels and greater than regulatory limits, at steady state conditions. Facing federal and California enforcement action, engine manufacturers signed consent decrees that required the reduction of NOx emissions by meeting a 2.5 g/bhp-hr limit on NOx plus NMHC, by October 1, 2002. Additionally, these engines must also be certified using the NTE and ESC test procedures. The supplemental test procedures, when used with the FTP test cycle, will cover a broader range of actual operating conditions. As a result, there will be a reduction of the excess NOx emissions which are not accounted for when certification is completed solely with the FTP test cycle. However, the consent decree requirements are valid for only two years, and will not include 2005 and subsequent model year engines. The current proposal will bridge the NTE and ESC requirements for those two model years and reduce any excess NOx emissions that may be emitted during that time frame.

IV. SUMMARY OF PROPOSED TEST PROCEDURES

The staff recommends that the Board amend section 1956.8, Title 13, California Code of Regulations, and the incorporated "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles", as set forth in Appendices 1 and 2. The proposed regulatory language for the supplemental test procedures duplicates the technical requirements in the consent decrees. They also include several options to conform with portions of the federal regulations adopted in July 2000.[9] Staff proposes to adopt the NTE and ESC test procedures beginning in the 2005 model year.

A. APPLICABILITY

The provisions in this proposal apply to all heavy-duty diesel engines produced for sale in California in the 2005 and subsequent model years. Heavy-duty diesel engines are used in vehicles with a Gross Vehicle Weight Rating of 14,001 pounds and greater. The proposed supplemental test procedures would be optional for medium-duty diesel engines with a Gross Vehicle Weight Rating from 8,501 pounds to 14,000 pounds. Additionally, "ultra-small volume manufacturers"[10] and "urban buses"[11] are exempted from the proposed supplemental test procedures until the 2007 model year in order to allow additional lead time for compliance.

Specific provisions of this proposal include the:

- NTE test procedure with associated emission caps for NMHC plus NOx, CO, and PM from 2005 and subsequent model year heavy-duty diesel engines,

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[9] The federal regulations are published at 65 FR 59896, October 6, 2000.

[10] An "ultra-small volume manufacturer" is defined as any manufacturer with California sales less than or equal to 300 new passenger cars, light-duty trucks, medium-duty vehicles, heavy-duty vehicles, and heavy-duty engines per model year based on the average number of vehicles and engines sold by the manufacturer in the previous three consecutive model years.

[11] "Urban bus" is defined in proposed Title 13, California Code of Regulations, Section 1956.2, and means a passenger-carrying vehicle powered by a heavy heavy-duty diesel engine, or of a type normally powered by a heavy heavy-duty diesel engine, with a load capacity of fifteen (15) or more passengers and intended primarily for intra-city operation, i.e., within the confines of a city or greater metropolitan area. Urban bus operation is characterized by short rides and frequent stops. To facilitate this type of operation, more than one set of quick-operating entrance and exit doors would normally be installed. Since fares are usually paid in cash or token, rather than purchased in advance in the form of tickets, urban buses would normally have equipment installed for the collection of fares. Urban buses are also typically characterized by the absence of equipment and facilities for long distance travel, e.g., restrooms, large luggage compartments, and facilities for stowing carry-on luggage.

- Euro III ESC test procedure with associated emission caps for NMHC plus NOx, CO, and PM from 2005 and subsequent model year heavy-duty diesel engines, and

- MAEL test procedure with associated emission caps for NMHC plus NOx, and CO from 2005 and subsequent model year heavy-duty diesel engines.

B. EMISSION CAPS

There are three sets of proposed emission caps in the test procedures, which are identical to those contained in the consent decrees. Two of these emission caps are based on the existing emission limits determined by the FTP test cycle. The first proposed emission cap is for the NTE test. This cap is set at 1.25 times the emission limit. The second proposed emission cap is for the Euro III ESC test. This cap is equivalent to the FTP emission limit, although the test procedure for measuring the limit is different. The third proposed emission cap is for the MAEL test. This cap is derived from the Euro III ESC test by using the emission results from the 12 non-idle modes. Emissions from any of these modes may not exceed the Euro III ESC test results at the corresponding modes of operation. The cap at intermediate points between the 12 basic modes are calculated by interpolation, which assumes a linear relationship between the 12 basic modes.

C. TEST PROCEDURES

1. Not-to-Exceed Test Procedure

The NTE test, as defined in CFR 86.1370-2007, establishes an area (NTE control area) under the torque curve of an engine where emissions must not exceed a specified emission cap for a given pollutant. The NTE cap is set at 1.25 times the FTP emission limit as described in the subsection above. For 2005 model year heavy-duty engines, the NTE emission cap for NMHC plus NOx is 1.25 times 2.5 grams per brake horsepower-hour, or 3.125 grams per brake horsepower-hour. The basic NTE control area for diesel engines has three basic boundaries on the engine's torque and speed map. The first is the upper boundary that is represented by an engine's maximum torque at a given speed. The second boundary is 30 percent of maximum torque. Only operation above this boundary is included in the NTE control area. The third boundary is determined based on the lowest engine speed at 50 percent of maximum power and highest engine speed at 70 percent of maximum power. This engine speed

is considered the "15 percent operational engine speed". Only engine operation above the engine speed calculated with Equation 1 is included in the NTE control area.

$$\text{15\% Operational Engine Speed} = n_{lo} + [\, 0.15 \times (n_{hi} - n_{lo}) \,]$$

Equation 1 : Minimum engine speed for NTE control area

Where,

n_{lo} = Point on engine map at 50 percent of maximum power and lowest engine speed

n_{hi} = Point on engine map at 70 percent of maximum power and highest engine speed

As in the consent decrees, there are two areas which are "carved out" of the basic NTE control area. The first carve out area applies to emissions of all air contaminants. All engine operation less than 30 percent of maximum power is removed from the basic NTE control area on the engine's torque and speed map, since excess emissions are unlikely to occur in this operating region. Excess emissions are more likely to occur under higher torque and speed conditions, as when a truck is carrying a load up a grade. The second carve out area applies solely to PM emissions. This carve out area depends upon the "75 percent operational engine speed" as calculated in Equation 2 below.

$$\text{75\% Operational Engine Speed} = n_{lo} + [\, 0.75 \times (n_{hi} - n_{lo}) \,]$$

Equation 2 : 75% Operational engine speed

If the "75 percent operational engine speed" is less than 2400 revolutions per minute, the PM carve out area of the NTE control area is determined as described below. The carve out area begins at 30 percent of maximum torque or 30 percent of maximum power, whichever is greater at the "50 percent operational engine speed" (shown in Equation 3 below). The carve out extends linearly to a point at 70 percent of maximum power and the highest engine speed (this is also defined as n_{hi} or the "100 percent operational engine speed"). Operation of the engine within the area below and to the right of this line and within the basic NTE control area is excluded from the NTE requirements for PM.

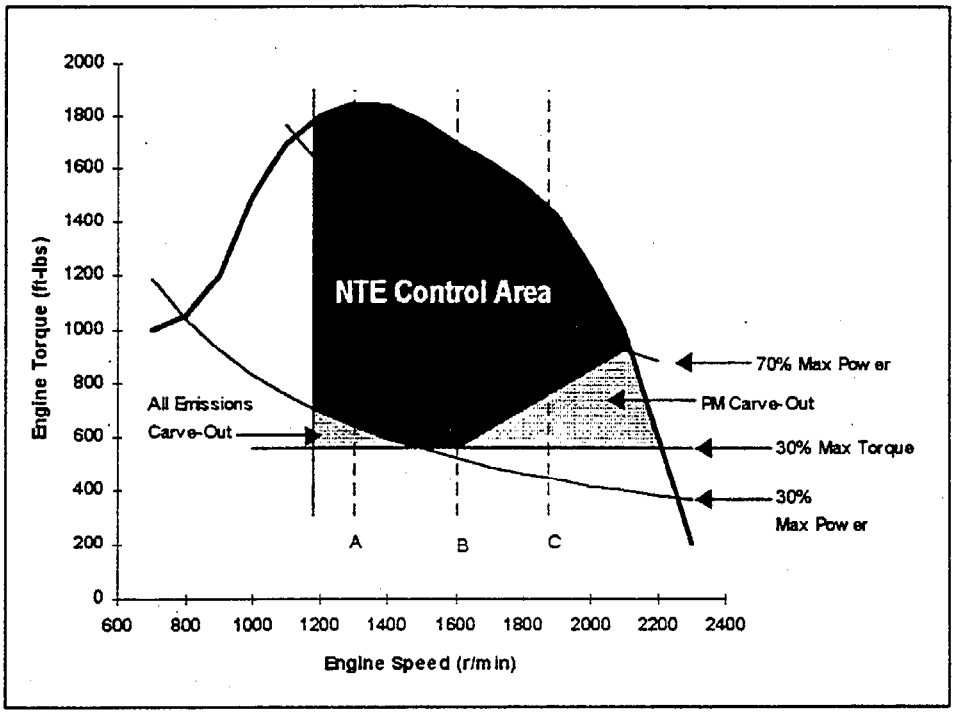
$$\text{50\% Operational Engine Speed} = n_{lo} + [\, 0.50 \times (n_{hi} - n_{lo}) \,]$$

Equation 3 : 50% Operational engine speed

In the U.S. EPA's Final Rule and consent decrees, the U.S. EPA has plotted a sample engine map for a heavy-duty diesel engine with a 100% operational engine speed less than 2400 rpm, shown below in Figure 2.

Figure 2

Example NTE Control Area for Heavy-Duty Diesel Engine With 100% Operational Engine Speed Less Than 2400 rpm

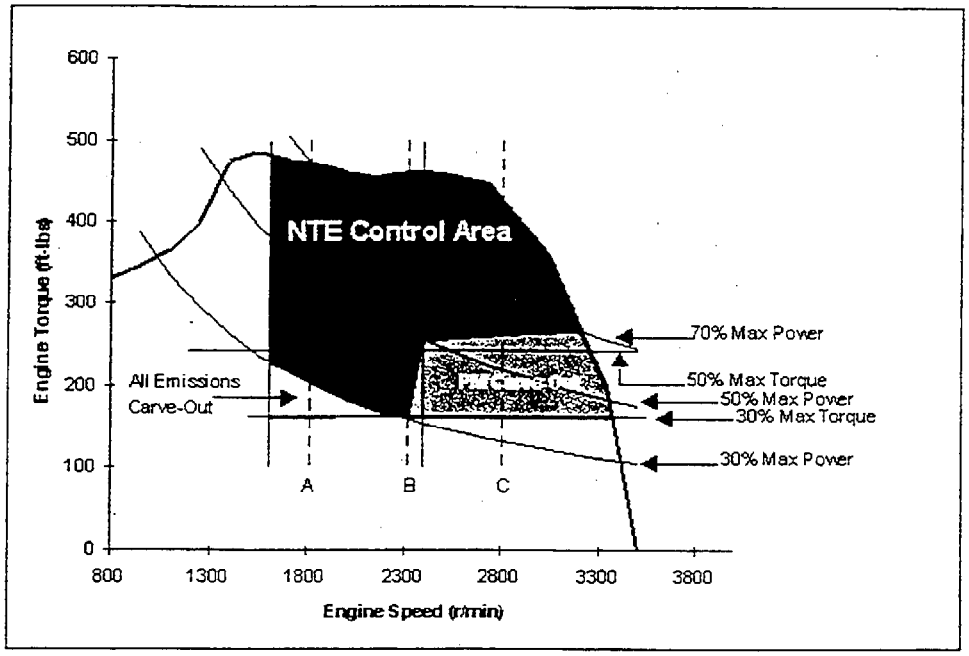


If the "75 percent operational engine speed" is greater than 2400 revolutions per minute, the PM carve out area of the NTE control area is determined as described below. The carve out area begins at 30 percent of maximum torque or 30 percent of maximum power, whichever is greater at the "50 percent operational engine speed" (shown in Equation 3 above). The carve out extends linearly to a point at 50 percent of maximum power and 2400 revolutions per minute. The carve out then extends linearly to a point at 70 percent of maximum power and the highest engine speed. Operation of the engine within area below and to the right of this line and within the basic NTE control area is excluded from the NTE requirements for PM.

In the U.S. EPA's Final Rule and consent decrees, the U.S. EPA has plotted a sample engine map for a heavy-duty diesel engine with a 100% operational engine speed greater than 2400 rpm, shown below in Figure 3.

Figure 3

Example NTE Control Area for Heavy Duty Diesel Engine With 100% Operational Engine Speed Greater Than 2400 rpm



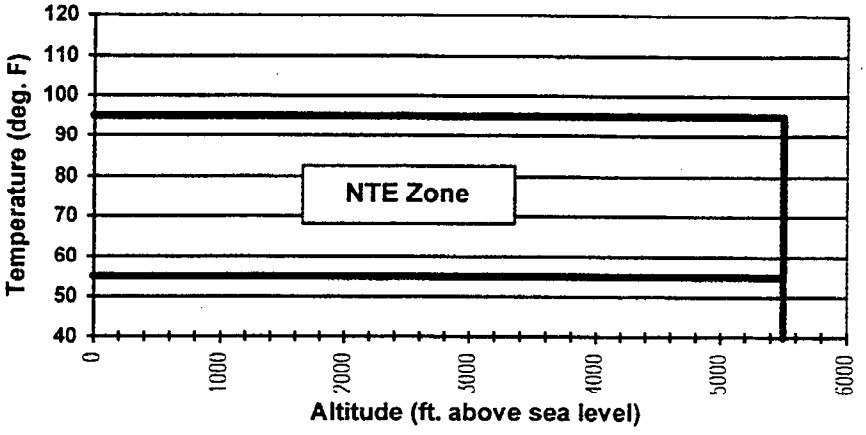
The NTE requirement would apply under any engine operating condition that could reasonably be expected in normal vehicle use. A vehicle can be tested over the NTE procedure either on the road or in an emission testing laboratory using an engine or chassis dynamometer. Instead of using a specific driving cycle such as the FTP, it can involve driving of any type which could reasonably be expected to occur in normal vehicle operation within the boundaries of the NTE control area, including operation under steady-state or transient conditions and under varying ambient conditions. Measured emissions are averaged over a minimum of thirty seconds and compared to the NTE test limit. These requirements would apply to new 2005 and 2006 engines throughout their useful life.

In addition, the NTE test procedures are applicable in a wide range of ambient conditions. For example, NTE ambient temperature coverage can range from 55° to 95°F compared to the FTP ambient conditions of 68° to 86°F. The proposal, however, includes two options related to temperature and altitude that will be available for manufacturers to comply with the NTE requirements. Under option one, which is contained in the consent decrees, manufacturers must comply with the NTE requirements within the ambient temperature range of 55 °F to 95 °F, and an altitude range of up to 5,500 feet above sea level. Within the NTE zone shown in the chart below, the engine must meet the NTE

requirements. For testing at a given altitude outside of this zone, NOx and PM emission results may be corrected for temperature. This is shown in Figure 4.

Figure 4

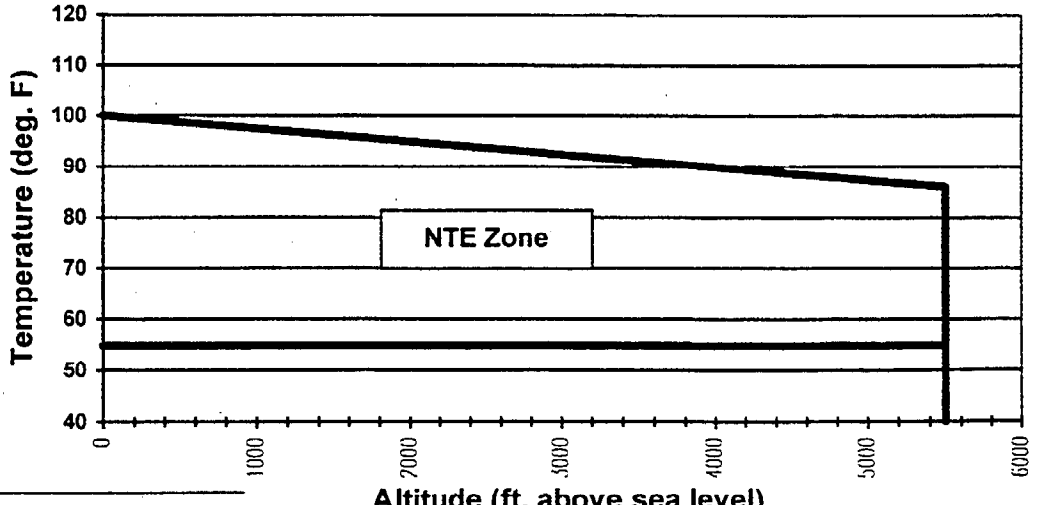
NTE Zone of Option 1



Under option two,[12] manufacturers must comply with the NTE requirements between 55 °F and 100 °F at sea-level and between 55 °F and 86 °F at 5,500 feet above sea-level. The NTE zone described is shown in Figure 5. The maximum temperatures for the corresponding altitudes between those points are determined linearly. At temperatures above the NTE zone, NTE requirements do not apply. In addition, existing requirements, which prohibit defeat devices, apply during operation in the temperatures above the NTE zone.

Figure 5

NTE Zone of Option 2



[12] This option is not contained in the consent decrees, but is contained in the U.S. EPA's Final Rule.

Option one is included in this proposal to ensure consistency between this proposal and the consent decree requirements so that consent decree engines would comply with the proposed test procedure without additional technological changes. However, in 2001 staff may propose that for 2007 and beyond, the NTE zone include ambient temperatures up to 105 °F to ensure control of emissions during virtually all California temperatures during the "ozone season." In California, temperatures over 95 °F are often experienced during periods of ozone non-attainment. Because the ambient conditions substantially contribute to National Ambient Air Quality Standard exceedances, proper emission control is critically needed at the higher ambient temperatures. At this time, however, for consistency with the consent decrees, the proposal includes the option for the same ambient temperature range for NTE control as required in the consent decrees.

Similar to the approach taken in the U.S. EPA's Final Rule, the proposal includes a provision for NTE deficiency in 2005 through 2007 model years. The deficiency provision provides manufacturers additional flexibility through a relief mechanism for failing to comply with some of the NTE requirements. This provision, however, is not contained in the consent decrees. Although the NTE control area and test procedures in the proposed regulation are identical to the NTE requirements in the consent decrees for model years 2003 and 2004, only the settling manufacturers will be in compliance with proposed NTE requirements prior to the implementation date of this proposal. Additionally, the proposal recommends a technology review in 2003, in the event engine manufacturers are unable to demonstrate that they can comply with the proposed test procedures.

2. Euro III European Stationary Cycle Test Procedure

The Euro III European Stationary Cycle (ESC) test cycle, defined in CFR §86.1360-2007 as the "supplemental steady state test", consists of 13 modes at specified speed and power conditions, primarily representing the typical highway cruise operating conditions of heavy-duty diesel vehicles. The ESC test cycle is identical to that in the consent decrees, and also identified as the "Supplemental Steady State Test Cycle" in the U.S. EPA's Final Rule.

During the test cycle, the engine is initially operated at idle, then through a defined sequence of 12 modes at various speeds and engine loads. The test modes are at three different operational engine speeds and at 25%, 50%, 75%, and 100% of maximum load. The engine is operated for two minutes at each mode, except idle. The emission results at each mode are then weighted and averaged. Table 2 details the various modes of operation and associated weighting factors.

Table 2 - Euro III ESC Testing Modes

Mode Number	Operational Engine Speed	Percent Load	Weighting Factor	Mode Length (minutes)
1	Idle	--	0.15	4
2	A	100	0.08	2
3	B	50	0.10	2
4	B	75	0.10	2
5	A	50	0.05	2
6	A	75	0.05	2
7	A	25	0.05	2
8	B	100	0.09	2
9	B	25	0.10	2
10	C	100	0.08	2
11	C	25	0.05	2
12	C	75	0.05	2
13	C	50	0.05	2

The operational engine speeds are calculated for the ESC test by a method that is similar to the NTE control area definition.

$$\text{Operational Engine Speed A} = 25\%\ \text{Operational Engine Speed} = n_{lo} + [\ 0.25 \times (n_{hi} - n_{lo})\ ]$$

Equation 4 : Operational engine speed A

$$\text{Operational Engine Speed B} = 50\%\ \text{Operational Engine Speed} = n_{lo} + [\ 0.50 \times (n_{hi} - n_{lo})\ ]$$

Equation 5 : Operational engine speed B

$$\text{Operational Engine Speed C} = 75\%\ \text{Operational Engine Speed} = n_{lo} + [\ 0.75 \times (n_{hi} - n_{lo})\ ]$$

Equation 6 : Operational engine speed C

Manufacturers would be required to show compliance with the following:

Average Allowable Emission Caps

At each mode of operation of the ESC test, the concentration of the gaseous pollutants is measured. The weighted average emissions for each pollutant, must not be greater than the existing Federal Test Procedure emission standard which is currently 2.5 g/bhp-hr for NMHC plus NOx for 2005 and subsequent model year engines. A single, particulate matter measurement is made of the entire 13 modes at the end of the test.

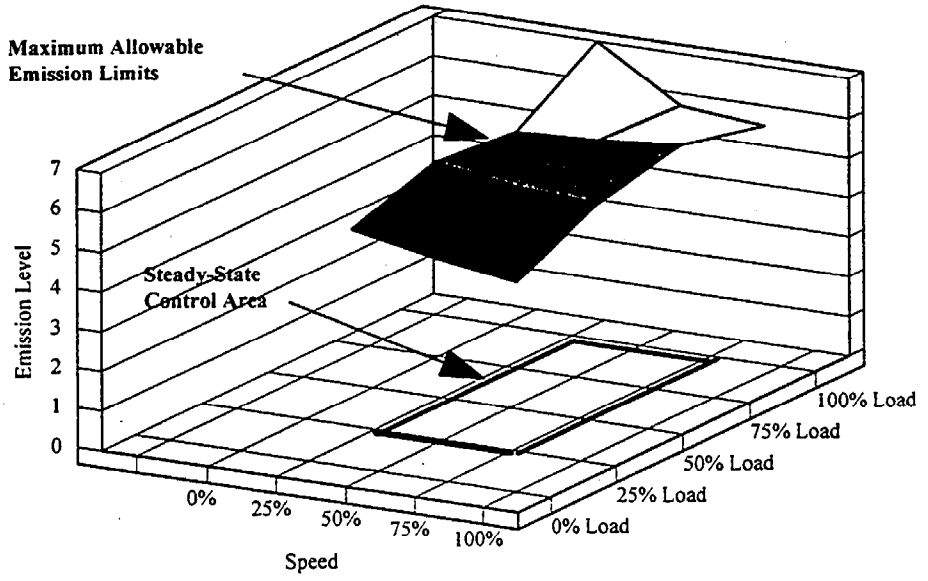
The ARB may select an additional 3 test points between the 12 non-idle test modes. The additional test points are for gaseous pollutants only. Results from each test point are compared to the interpolated emissions from the nearest four test modes. Interpolation is completed using a four-point interpolation procedure. The purpose of these tests is to ensure that the engines are not optimized for the specific test modes.

Maximum Allowable Emission Limits

Maximum allowable emission limits are determined from the 12 non-idle test points of the ESC tests. A 10 percent interpolation allowance is added to the results of each of the 12 test points. The 10 percent allowance is added to provide additional allowance for possible errors in interpolation. This is similar to the U.S. EPA's Final Rule, but differs from the consent decrees, which have a 5 percent interpolation allowance. The maximum allowable emission limit at any set of speed and load conditions between the test points can be determined by using a four-point interpolation procedure. If a test point exceeds the NTE cap, the NTE cap will be used for the point, in addition to determining the map of limit points, described below. Emissions of gaseous pollutants at any point within the maximum allowable emission limit operational zone must not exceed the cap as determined by interpolation. Maximum allowable emission limits only apply to gaseous pollutants and do not apply to particulate matter. The following plot in Figure 6 is a sample of the steady-state control area for a heavy-duty diesel engine. The figure is taken from the U.S. EPA's Final Rule.

Figure 6

Sample Map in the Steady State Control Area for a Heavy-Duty Diesel Engine



3. Measuring Smoke Emissions Within the NTE Zone

Similar to the consent decree requirements, within the NTE control area, an engine must meet either a filter smoke cap or an opacity cap. The filter smoke cap is 1.0 on the Bosch number scale, a measure of smoke opacity. There are two alternatives for the smoke opacity cap. The first opacity cap is 4 percent averaged over 30 seconds using a 5 inch path. This cap is for transient testing. The second opacity cap is also 4 percent, but averaged over 10 seconds using a 5 inch path. This cap is for steady state testing (ESC test). Both caps are at levels where smoke would not be visible to an observer.

D. FLEXIBILITY PROVISIONS – 2003 TECHNOLOGY REVIEW

As mentioned previously, settling manufacturers are required to comply with these requirements by October of 2002 because of the consent decrees. For other engine manufacturers, the proposal provides sufficient time to develop complying engines technologies, if necessary. Many of the approaches to compliance presented in this proposal are identical to those presented by the U.S. EPA in their Final Rule. However, in the event that settling manufacturers have difficulty with full compliance before 2004, staff is proposing a 2003 technology review to determine the state of progress in complying with the proposed supplemental test procedures.

V. DIFFERENCES AND SIMILARITIES BETWEEN FEDERAL AND CALIFORNIA REGULATIONS

The proposed supplemental test procedures are intended to be identical in stringency to the testing provisions in the consent decrees. This would allow a continuation of lower emitting consent decree engines beyond 2004 and to prevent unnecessary, redundant work for settling manufacturers. Additionally, the proposed test procedures prevent the potential excess emissions that would have occurred in model years 2005 and 2006, after the consent decree requirements expire and before the Federal program begins in 2007.

Therefore, most of the requirements in the proposed supplemental tests are identical to those in the consent decrees. The identical requirements between the proposed test procedures and the consent decrees are shown in Table 3. For example, the proposed supplemental steady state test procedure is identical to that in the consent decrees.

Similar to the U.S. EPA's Final Rule, some additional provisions are incorporated in the proposed rule to allow flexibility for manufacturers to comply with the requirements and to increase control of emissions under the typical ambient conditions in California. The differences among the proposed test procedures, the consent decrees, and the U.S. EPA's Final Rule are described below and summarized in Table 4.

1. NTE Deficiency Provision

Recently, settling manufacturers have indicated that under certain temperatures and altitudes it would be difficult to comply with the NTE requirements. Negotiations are underway to determine whether these exemptions are permissible in the consent decrees. In the U.S. EPA's Final Rule, deficiency provisions for NTE were provided in order to allow manufacturers a relief mechanism for some of the NTE requirements if compliance would not be feasible due to the technological difficulties and/or need for more lead time. NTE deficiencies will only be granted on an engine family basis and under limited operating conditions. The proposed supplemental test procedures provide manufacturers the flexibility to apply for NTE deficiencies, as in the U.S. EPA's Final Rule.

Table 3 - Comparison of Consent Decrees, U.S. EPA Final Rule, and ARB Proposal - Identical Consent Decrees and ARB Provisions

Items	Consent Decrees	U.S. EPA 2004 Final Rule	ARB Proposed Test Procedures
NTE Test:			
NTE test procedure	Defined	Identical to consent decrees	Identical to consent decrees
NTE emission cap	1.25 times the standard for each regulated pollutant	Identical to consent decrees	Identical to consent decrees
Temperature and altitude of the NTE control zone (55 °F – 95 °F from sea level and higher)	Defined	Identical to consent decrees (plus 1 additional option)	Identical to consent decrees (plus 1 additional option)
NTE cold temperature exclusion for EGR equipped engines	Not included	Stated	Identical to consent decrees
Euro III ESC Test			
Euro III ESC test procedure	Defined	Identical to consent decrees	Identical to consent decrees
ESC emission cap	1 times the emission standard	Identical to consent decrees	Identical to consent decrees
MAEL test procedure	Defined	Identical to consent decrees	Identical to consent decrees
In-use Compliance			
Calculation of emission threshold for failure	Threshold is equivalent to emission cap plus 0.5 g/bhp-hr.	Threshold is equivalent to emission cap	Identical to consent decrees for 2005 and 2006 MY; otherwise at emission cap.
Option of engine or chassis dynamometer or ROVER	Available	Identical to consent decrees	Identical to consent decrees
Primary set of engines tested	"Population" of engines tested	Typically ten engines	Identical to consent decrees for 2005 and 2006 MY; otherwise 10 engines tested.
Test at least nine more times under same conditions per each exceedance found in original testing "population".	Available	Typically one test per engine	Identical to consent decrees for 2005 and 2006 MY; otherwise one test per engine.
Defeat Device Definition	Defined to cover operation in FTP test cycle	Similar to Consent Decree with additional coverage in NTE and ESC test cycles.	Identical to consent decrees

Table 4 - Comparison of Consent Decrees, U.S. EPA Final Rule, and ARB Proposal - Different Consent Decrees and ARB Provisions

Items	Consent Decrees	U.S. EPA 2004 Final Rule	ARB Proposed Test Procedures
Implementation of NTE/EURO III ESC requirements	2002 through 2004 calendar years	2007 and subsequent model years	2005 and subsequent model years
NTE Test:			
NTE Deficiency Provision	None	Allowed	Identical to U.S. EPA's Final Rule
Apply to altitudes less than or equal to 5,500 ft. at ambient conditions	Not Stated	Stated	Identical to U.S. EPA's Final Rule
Optional temperature and altitude NTE control zone (55 °F – 100 °F @ sea level to 55 °F – 86 °F @ 5,500 ft. elevation).	None	Allowed	Identical to U.S. EPA's Final Rule
MAEL Test. Interpolation calculation allowance to allow for variability between operating modes	5%	10%	Identical to U.S. EPA's Final Rule

2. Temperature and Altitude of the NTE Control Zone

In the consent decrees, the NTE control zone parameters for temperature and altitude are defined as the ambient temperature range of 55 °F to 95 °F, and any altitude above sea level. For testing at a given altitude outside of this temperature zone, NOx and PM emission results may be corrected for temperature.

In addition to the single control range required in the consent decrees, the proposed NTE test procedure allows a second option included in the U.S. EPA's Final Rule. In the second option, the temperature in the NTE control zone ranges 55 °F and 100 °F at sea level and between 55 °F and 86 °F at 5,500 feet above sea level. The maximum temperatures for the corresponding altitudes between those points are determined linearly. At temperatures and altitudes above the NTE zone, NTE requirements do not apply. Flexibility is provided by allowing manufacturers to choose between either option for NTE compliance. Unlike the consent decrees, the proposal has an altitude upper limit of 5,500 feet elevation for which NTE requirements apply.

As with the U.S. EPA's Final Rule, the staff's proposal includes both the consent decree NTE control zone and an optional second ambient temperature and altitude range. The optional second NTE control zone more closely represents the ambient conditions in California and would result in better control of emissions under typical conditions in California.

3. MAEL

Maximum allowable emission limit (MAEL) controls the emission during steady state operation of engines. The limit is calculated based on the collection of emission data from 12 steady state points, the four interpolation points and the margin. The allowed margin for the limit is 5 percent in the consent decrees whereas the allowance is 10 percent in the U.S. EPA's Final Rule. The proposal utilizes the higher margin of 10 percent, similar to the U.S. EPA's Final Rule to allow more flexibility in compliance.

4. EGR Cold Temperature Exclusion

Responding to the U.S. EPA's 2004 Notice of Proposed Rulemaking, manufacturers expressed concern regarding operation of exhaust gas recirculation technologies during cold temperatures. Specifically, sulfuric acid is formed from the mixture of cold ambient air and hot engine exhaust (i.e., a mixture containing small amounts of water vapor and SO2). When this mixture is recirculated through the intake system, corrosion problems reportedly occur. Consequently, in the U.S. EPA's Final Rule, an exclusion is included to allow EGR to be turned off in cold ambient temperature conditions, as shown in Table 3. As in the consent decrees, however, this exclusion is not included in the proposal since manufacturers may use more corrosion resistant materials. Additionally, the proposed NTE deficiency provision will give manufacturers a relief mechanism if the technologies have not developed sufficiently to allow EGR use during cold temperature conditions.

VI. TECHNOLOGICAL FEASIBILITY

A. GENERAL REVIEW

As described in the U.S. EPA's Final Rule, significant technological progress has been made in the last few years to achieve emission reductions from heavy-duty diesel engines. The examples of technologies described below have been demonstrated to effectively lower emissions: advanced fuel injection systems, cooled exhaust gas recirculation, advanced turbocharging systems (such as variable geometry and multiple turbochargers), and advanced electronic control systems. These systems have proven to be technically feasible and effective in numerous demonstrations and have been documented in scientific and engineering publications. These emission control technologies can produce substantial emission reductions in NOx, particulate matter and hydrocarbons, over a broad range of engine operating conditions. Emission reductions of approximately 50 to 90 percent from current generation heavy-duty diesel engines, have been demonstrated by combining these technologies.

In response to U.S. EPA's 1999 Notice of Proposed Rulemaking to adopt supplemental test procedures, several manufacturers provided U.S. EPA and ARB with information and data regarding the testing and development work they have already performed. The data show that under some extreme ambient and operating conditions, some engine technologies are challenged to meet the NTE and ESC requirements without sacrificing performance. Overall, however, under typical operating conditions, the data demonstrate that engines are capable of fully complying with the NTE and ESC requirements. Additionally, the signing manufacturers are required to meet the supplemental test procedures beginning October 1, 2002, pursuant to the consent decrees. Thus, the proposed supplemental test procedures, which mirror those in the consent decrees, will be technically feasible for the 2005 model year, about two years after the first consent decree engines have been manufactured.

Overall, the U.S. EPA's review of technology offers sufficient evidence that the proposed requirements in this report are technologically feasible. The following section will, therefore, briefly discuss some of the likely control strategies. Much of the information listed here is derived from the U.S. EPA's Final Rule and its Regulatory Impact Analysis. It should be noted that in the U.S. EPA's Final Rule, the rule reaffirmed the reduced FTP emission standard from 4.0 g/bhp-hr of NOx to 2.5 g/bhp-hr of NMHC plus NOx (for 2004 and subsequent model year HDDEs), and adopted similar supplemental test procedures (for 2007 and subsequent model year HDDEs). Consequently, the U.S. EPA's Final Rule described the combined technologies required for compliance with both the reduced FTP standard and the supplemental test procedures. In this proposal,

ARB staff is not proposing any change to the existing ARB 2.4/2.5 g/bhp-hr emission standard, but is proposing to adopt similar supplemental test procedures. Therefore, technology requirements and associated costs to comply with only the supplemental test procedures are expected to be significantly less than the costs presented by the U.S. EPA. Additionally, as mentioned previously in Section IV, staff is proposing a 2003 Technology Review to determine the state of technological progress to achieve compliance with the proposed supplemental test procedures.

B. EXAMPLES OF TECHNOLOGY

1. *Exhaust Gas Recirculation*

Exhaust gas recirculation (EGR) reduces peak combustion chamber temperatures by feeding exhaust gas back into the cylinder. This slows reaction rates and absorbs some of the heat, resulting in lower NOx emissions. Unfortunately, EGR also tends to negatively impact combustion efficiency, which tends to increase PM. However, PM increases can be minimized by reducing the amount of EGR during high-load operation. Another concern is that soot from the exhaust is added to the intake air, which could increase engine wear, damage a turbocharger or reduce the efficiency of an aftercooler. Researchers are evaluating ways to reduce the soot fed back into the engine.

2. *Turbocharging and Aftercooling*

Turbocharging is used to generate increased power from a given engine displacement. A turbocharger uses the waste energy in the exhaust gas to drive a turbine, which then boosts the pressure of the incoming air charge. By forcing more air into the combustion chamber, more fuel can be added, resulting in higher power while still inhibiting large particulate formation. Increasing power from a given engine, increases the denominator in the grams per brake horsepower-hour calculation, thereby reducing the emissions per unit of engine work.

Aftercooling was initially developed to improve the specific power output of an engine by increasing the density of air entering the combustion chamber, but aftercooling also reduces NOx emissions, by reducing the temperature of the charge air after it has been heated during compression. There are two kinds of aftercooling strategies: air-to-water, which releases the absorbed heat to the engine coolant system; and air-to-air, which releases the heat directly to the ambient air.

3. *Timing Retard*

Retarding the timing when fuel is injected into the engine cylinder, reduces NOx emissions by shortening the time available for combustion and lowering cylinder temperature and pressure. Conversely, timing retard increases HC, CO, PM, and fuel consumption, for the same reasons. In most cases, timing retard will be used in conjunction with other strategies to counteract any emission increases.

4. *Advanced Fuel Injection Controls*

Improved fuel injection is a major part of virtually any approach to reduce emissions from compression-ignition engines. High injection pressures offer better fuel atomization and mixing of the fuel and air, achieving more complete combustion. Timing retard can be used in conjunction with this strategy to inhibit NOx formation, resulting in overall reductions in NOx, HC, and PM simultaneously. Fuel injection rate shaping is another technique that helps reduce NOx. In a rate shaping system, the fuel is injected in several different injection events. Especially with electronic controls, this results in more carefully-controlled combustion. Thus, rapid increases in temperature and pressure can be minimized, reducing NOx formation. Staff expects most manufacturers can achieve significant NOx reductions by optimizing injection.

5. *Aftertreatment*

Aftertreatment strategies are not expected to be necessary to comply with the supplemental test procedures being proposed. However, aftertreatment remains a likely option for the future. Further reductions in emissions from diesel exhaust sources will be needed, particularly since diesel PM has been identified as a toxic air contaminant.

There are a number of aftertreatment technologies being researched for use on diesel-fueled vehicles and equipment that show a potential to control greater than 75 percent of engine-out NOx emissions. Some of these include DeNOx or "Lean-NOx" catalysts, NOx Adsorbers or NOx "traps," selective catalytic reduction (SCR) technology, and non-thermal plasma. For advanced particulate emissions control, diesel particulate filters have been applied commercially in Europe and to provide reductions in excess of 85 percent for PM, HC, and CO emissions. These technologies are strong candidates for both new engines and retrofit applications.

All catalyst-based technologies are sensitive, to some extent, to the sulfur content in fuels. Sulfur impacts the emissions reduction capability of the aftertreatment device by attaching to the chemical sites that are needed for the

catalytic reaction that reduces the emissions. NOx reduction catalysts are very susceptible to sulfur poisoning. Similarly, for catalyzed particulate traps, a high sulfur content directly leads to high levels of sulfate-based PM, rendering very low PM levels infeasible with high-sulfur fuel. Therefore, it is desirable to use the lowest sulfur diesel fuel available. Currently, California limits the sulfur level of diesel fuel used on-road to 500 parts per million (ppm). Actual sulfur levels are about 120 ppm, well below the maximum limit. The U.S. EPA also limits sulfur levels of diesel fuel for on-road vehicles to 500 ppm; in-use sulfur levels average 350 ppm. In order for manufacturers to take advantage of the emissions reduction potential of these advanced aftertreatment technologies, adoption of a nationwide sulfur limit of 15 ppm or less will be necessary.

VII. REMAINING ISSUES

Although the proposed supplemental test procedures were first required in 1998, through the consent decrees, and adopted in July 2000 by the U.S. EPA, several issues remain. These remaining issues are the technical feasibility of the proposed test procedures and concerns regarding ARB's authority to adopt the test procedures.

In early 2000, manufacturers raised several technological concerns with achieving full compliance with NTE test procedures. The concerns include the performance of emission control components at high ambient operating conditions (e.g., high ambient temperatures and high altitudes) and the durability of available materials for components. Manufacturers argue that without turning off emission control devices under these conditions, the engine turbochargers would overheat.

The NTE test procedure's range of applicability is restricted in the consent decrees, with respect to the engine operating map, humidity, and temperature. The restrictions were designed to ensure that the requirements would be feasible, and we anticipate that settling manufacturers will be able to meet these limits in 2002. If NTE compliance at these operating conditions continues to pose a problem, a solution is to limit power generated by the engines under these conditions of concern. While manufacturers do not favor this option, it is certainly feasible. In addition, staff has included an NTE deficiency allowance in the proposal to provide relief for technical problems that are of a limited nature. Finally, to ensure that manufacturers can comply with the proposed test procedures, staff is proposing a 2003 technology review to determine the state of technological progress to achieve compliance with the proposed supplemental test procedures.

In addition, manufacturers have expressed concern with the proposal to implement the NTE and ESC test procedures in 2005 and subsequent model years. The final federal rulemaking for the NTE and ESC test procedures (65 FR 59896, October 6, 2000), delayed the implementation of the test procedures to 2007. The delay was attributed to timing constraints imposed on the U.S. EPA by the federal Clean Air Act Amendments of 1990 (CAA; Public Law 101-549; Title 42, United States Code, § 7401 et seq.). Some believe that California's proposed implementation of the supplemental test procedures should be similarly delayed. The federal timing constraints, however, do not apply to California's rulemaking: California has authority to adopt a separate state program of emission controls for new motor vehicles and new motor vehicle engines under CAA § 209(b). California's authority includes the authority to adopt test procedures that ensure that new motor vehicles and new motor vehicle engines meet California's state emission control standards.

VIII. REGULATORY ALTERNATIVES

The staff evaluated various alternatives to the proposed amendments. A brief description of the alternatives and the staff's reasoning for rejecting them follows.

A. DO NOT AMEND CURRENT CALIFORNIA REGULATIONS

One alternative to this proposal would be to continue to use the current on-road heavy-duty diesel test procedures for 2005 and subsequent model years. The current certification method uses the FTP test cycle. However, this test cycle does not completely represent actual, in-use driving. As a result, engine manufacturers may employ less efficient emission control strategies in order to achieve higher fuel efficiency during driving patterns not represented on the FTP test cycle.

Additionally, many engine manufacturers are required to satisfy the proposed NTE and ESC requirements for a two-year period beginning in October 2002. If the proposed amendments are not approved, the marketplace in 2005 may prompt the settling manufacturers to use less efficient emission control strategies to boost fuel economy. If this occurs, the potential resulting emissions in California from HDDEs are in excess of 20 tons per day of NOx in 2006 and 18 tons per day of NOx in 2010. Because of these potential excess emissions, and because the technologies needed to achieve the reductions will be in use by the time the proposed regulations are implemented, staff rejected this alternative.

B. ADOPT MORE STRINGENT TESTING STANDARDS

The staff recognizes that more stringent standards for the control of emissions from heavy-duty diesel engines will be necessary to cover all types of driving and attain federal ambient air quality standard for ozone. Emission benefits of this proposal are discussed in Section X. For 2007 and subsequent model year HDDEs, both the U.S. EPA and ARB are examining further emission reductions through more stringent testing standards. At this time, however, the staff is not recommending more stringent requirements compared to those required for the settling manufacturers in the consent decrees.

IX. ECONOMIC IMPACTS

The proposed amendments fill the regulatory gap between consent decree requirements for the settling manufacturers and the federal regulations for 2007 and subsequent model year heavy-duty diesel engines. Adoption of the proposed test procedures would not impose additional costs above the costs to comply with the requirements set forth in the consent decrees for the settling manufacturers.

Only those engine manufacturers who are not subject to consent decree requirements are expected to incur additional costs for engine design modifications. Currently, the non-settling engine manufacturers and settling manufacturers who are not required to comply with the supplemental test requirements of the consent decrees account for approximately 40 percent of engine sales. Under the proposed regulations, the non-settling manufacturers are required to satisfy the NTE and ESC requirements two years earlier than they would under the U.S. EPA's Final Rule. Staff believes that the proposed supplemental test procedures will not impose significant costs on these manufacturers given that they will nonetheless have to meet the NTE and ESC requirements in 2007. The proposed adoption of the supplemental test procedures is expected to have no noticeable impact on California business competitiveness, employment, or on business creation, elimination, and expansion for 2005 and 2006. A detailed discussion of the potential cost and economic impacts of the proposed amendments follows; it is primarily based on the U.S. EPA's Final Rule.

A. LEGAL REQUIREMENT

Sections 11346.3 and 11346.5 of the Government Code require State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. The assessment includes 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.

State agencies are required to estimate the cost or savings to any state or local agency, and school districts. The estimate is to include any non-discretionary cost or savings to local agencies and the cost or savings in federal funding to the State.

B. AFFECTED BUSINESSES

Any business that is involved in manufacturing on-road heavy-duty diesel engines may be affected by the proposed supplemental test procedures. ARB has identified 21 major engine manufacturers worldwide. Based on California's emission inventory model, EMFAC2000 Version 2.0, a projected total of 300,000 on-road heavy-duty diesel engines will be operating in California in 2005 and 2006. Projections indicate that 36,000 new, heavy-duty diesel vehicles may be affected during this two-year period.

The proposed supplemental test procedures may require additional or upgraded engine accessories. As a result, the HDDEs may be more costly to manufacture, and hence heavy-duty vehicles may cost more. Due to the potential price increase for HDDEs, transportation companies may be affected. The baseline average costs for a heavy-duty diesel engine, vehicle, and the operating costs based on a 30-year lifetime are shown in Table 5, with potential increases shown in Table 6.

Table 5 - Baseline Heavy-Duty Engine and Vehicle Costs

Heavy-Duty Class	Engine Cost	Vehicle Cost	Operating Cost
Medium Heavy-Duty	$ 13,938.00	$ 51,852.00	$ 35,116.00
Heavy Heavy-Duty	$ 24,391.00	$108,455.00	$121,422.00

Source: U.S. EPA's Final Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines, July 2000. Costs are in year 2000 dollars.

Table 6 - Potential Cost Increases for Transportation Businesses

Heavy-Duty Class	Increased Engine and Vehicle Cost (2005)	Increased Annual Operating Cost	Total Annualized Cost (20 year)
Medium Heavy-Duty	$ 674.00	$ 4.03	$ 67.65
Heavy Heavy-Duty	$ 824.00	$ 8.62	$ 86.40

Source: U.S. EPA's Final Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines, July 2000. Costs are in year 2000 dollars.

The net impact of increasing vehicle and operating costs may be greater competition from transportation companies that register their vehicles outside of California. Medium heavy-duty vehicles are assumed (from the EMFAC 2000 emissions inventory model) to only operate within the State. Therefore, only businesses that use heavy heavy-duty vehicles may encounter increased competition. Since the emissions inventory model that assumes only 24.6% of heavy heavy-duty vehicle activity is not registered in California, and the annualized increased costs are less than 1% of total annualized vehicle and operating costs, the detrimental effects of this proposal are expected to be minimal.

C. ESTIMATED COSTS TO ENGINE MANUFACTURERS

The costs of the proposed supplemental test procedures have been estimated and are based on U.S. EPA's analysis for their Final Rule. The U.S. EPA's analysis not only includes costs to comply with similar supplemental test procedures, but also costs to reduce NOx emissions from 4.0 g/bhp-hr to NOx plus NMHC emissions of 2.5 g/bhp-hr. Because U.S. EPA's analysis includes costs for requirements in addition to the supplemental test procedures, the costs are considered a conservative, worst case estimate and actual costs for compliance with the supplemental test procedures will be markedly less. All engine manufacturers are assumed to utilize multiple technologies to satisfy the test procedure requirements for 2005 and subsequent model year medium and heavy heavy-duty engines. To estimate the incremental effect of the federal FTP standards and supplemental test procedures on engine costs, the U.S. EPA determined the most likely combination of technologies necessary to meet the requirements. The technologies which are expected to be used, include combustion optimization, electronic controls, improved fuel injection, cooled exhaust gas recirculation, and variable and multiple geometry turbochargers. The only non-emission parameters affected were engine performance, fuel consumption, and life of the engine. The net result of the non-emission benefits was a slight increase in annual costs associated with these effects. Assuming that engine manufacturers pass on the entire costs of the new test procedures to the end users, the incremental increase in per-engine price and overall lifetime operating costs have been estimated. These cost estimates are presented in Table 7 and are identical to those determined by the U.S. EPA.

Table 7 - Projected Unit Costs per Engine

Medium Heavy-Duty (14,001 – 33,000 lbs. GVWR)		
Item	Fixed Cost	Variable Cost
Cooled EGR (high-flow)	$106.00	$249.00
EGR durability	$ 28.00	$ 0.00
Combustion optimization	$ 57.00	$ 0.00
Improved fuel injection	$ 10.00	$ 65.00
Variable geometry turbochargers	$ 18.00	$127.00
Emission map testing	$ 5.00	$ 0.00
Certification	$ 9.00	$ 0.00
TOTAL	**$233.00**	**$441.00**

*(Table 7 continues on next page)

Heavy Heavy-Duty (33,000 lbs. and greater GVWR)		
Item	Fixed Cost	Variable Cost
Cooled EGR (high-flow)	$106.00	$345.00
EGR durability	$28.00	$0.00
Combustion optimization	$57.00	$0.00
Improved fuel injection	$10.00	$72.00
Variable geometry turbochargers	$18.00	$174.00
Emission map testing	$5.00	$0.00
Certification	$9.00	$0.00
TOTAL	**$233.00**	**$591.00**

Source: U.S. EPA's Final Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines, July 2000. Costs are in year 2000 dollars.

The estimated costs are separated into incremental engine purchase price and annual operating costs. The incremental engine purchase price for new engines includes the fixed and variable costs. Fixed costs are costs associated with research and development, retooling, and certification. Variable costs are costs associated with hardware and assembly. Annual operating costs include any expected increases in maintenance and/or fuel consumption. U.S. EPA relied on a study of the economic impacts on heavy-duty highway engines by Accurex Environmental Corporation.[13] All costs in the Accurex study were presented in year 1995 dollars, although the costs shown in the table above are in year 2000 dollars.

Although hardware costs generally decline over time, the proposed test procedures will only affect model year 2005 and 2006 engines. Therefore, the resulting costs per engine per model year are as detailed in Table 8.

Table 8 - Projected Lifetime Net Present Value Cost per Engine

	Lifetime NPV Cost	
Medium Heavy-Duty	$	716.69
Heavy Heavy-Duty	$	915.35
Weighted Average of All Heavy-Duty	*$*	*797.04*

Additionally, many of the settling manufacturers are required to comply with the supplemental test procedures for the two-year period beginning in 2002. Since this accounts for approximately 60 percent of the current engines sold, the fixed costs associated with the supplemental test procedures will not be realized by the settling manufacturers, or HDDE purchasers, for model years 2005 and 2006.

[13] "Benefits of Reducing Mobile Source NOx Emissions," prepared by Accurex Environmental Corporation for U.S. EPA, March 31, 1997. The Acurex Environmental Corporation has since changed its name to Arcadis Geraghty & Miller.

D. POTENTIAL COSTS TO VEHICLE MANUFACTURERS

In addition to the costs directly associated with the manufacturing of engines which comply with the proposed test procedures, there may be costs associated with the re-design of vehicle chassis. However, in the U.S. EPA's Final Rule, no increased cost was attributed to vehicle manufacturers.

E. POTENTIAL IMPACTS ON BUSINESS

There are no potential impacts on businesses other than the additional costs for the engines and the additional annual operating costs, both described above. These costs summarized by vehicle class and model year are detailed in Table 9.

Table 9 - Estimated Prices for New On-Road Diesel Vehicles (per vehicle)

	2005 MY	2006 MY	Operating Costs NPV (20 yr)	Annualized Total Cost
Medium Heavy-Duty	$ 674.00	$ 441.00	$ 42.69	$ 67.65
Heavy Heavy-Duty	$ 824.00	$ 591.00	$ 91.35	$ 86.40
Weighted Average of All Heavy-Duty	*$ 734.05*	*$ 502.28*	*$ 62.37*	*$ 75.23*

Based on: U.S. EPA's Final Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines, July 2000. Costs are in year 2000 dollars.

There are only two model years that would expect an increased cost due to the proposed supplemental test procedures since similar requirements have been finalized by the U.S. EPA for 2007 and subsequent model year heavy-duty diesel engines. The difference in vehicle prices for 2005 and 2006 model years is due to the assumption that fixed costs are only applied to the 2005 model year.

F. POTENTIAL IMPACT ON BUSINESS COMPETITIVENESS

The proposed amendments would have no significant impact on the ability of California businesses to compete with businesses in other states. This is because all manufacturers that manufacture diesel engines for sale in California are subject to the proposed amendments regardless of where they are located. Most manufacturers of diesel engine have no major manufacturing facilities in California although they have some presence here. In addition, California's adoption of the proposed amendments would not impose additional costs above the costs to comply with the requirements set forth in the consent decrees for the signing manufacturers. These manufacturers supply approximately 60 percent of diesel engines used in California.

California trucking companies who use heavy-duty diesel engines may experience a slight increase in the price of a new truck relative to those in other states. We estimated the proposed amendments would increase the price of a new truck by about 1 to 2 percent compared to the estimated vehicle price of $52,000 for a medium heavy-duty vehicle and $108,000 for a heavy heavy-duty vehicle. This is not expected to significantly dampen the demand for heavy-duty trucks in California. In addition, this price disadvantage would last only for two years until the U.S. EPA's Final Rule became effective in 2007. If other states will adopt the supplemental test procedures pursuant to their authority to adopt California test procedures, California trucking companies would not have any increased costs for new heavy-duty diesel vehicles compared to costs in other states.

G. POTENTIAL IMPACT ON EMPLOYMENT

California accounts only for a small share of manufacturing employment for diesel engine production. According to the U.S. Department of Commerce, California employment in the internal combustion engines industry (NAICS 333618), which includes manufacturers of diesel engines, was 1,635 persons in 1998 or less than 0.1 percent of total manufacturing jobs in California. These employees work in 28 businesses across the state. One business employed over 500 people, two employed between 100 and 500, and the rest had less than 100 employees. Employment in these businesses is unlikely to be affected adversely because a small price increase is not expected to dampen the demand for diesel engines in California. Thus, the proposed regulations are not expected to cause a noticeable adverse impact on the California employment. However, some jobs may be created in research and development to enhance the design of current engine models. Some jobs may also be created in businesses manufacturing and distributing parts.

H. POTENTIAL IMPACT ON BUSINESS CREATION, ELIMINATION OR EXPANSION

The proposed amendments would have no noticeable impact on the status of California businesses. The amendments would not impose additional costs on major HDDE manufacturers that supply approximately 60 percent of engines. Non-consent decree manufacturers may experience a small increase in their manufacturing costs two years earlier than required in the U.S. EPA's Final Rule. We estimate the cost increase would range from about $674 to $824 per engine in 2005 model year and $441 to $591 per engine in 2006 model year. As noted above, the difference in vehicle prices for the 2005 and 2006 model years is due to the assumption that fixed costs are only applied to the 2005 model year. A

cost increase of this magnitude is not expected to significantly alter the status of California businesses.

I. POTENTIAL COSTS TO LOCAL AND STATE AGENCIES

There would be no additional costs for local and state agencies associated with adopting the proposed test procedures. There may be a net health benefit as heavy-duty diesel engines must certify using more stringent test procedures. Health benefits, however, were not quantifiable in monetary terms.

X. ENVIRONMENTAL IMPACTS AND COST-EFFECTIVENESS

The air quality benefits and the cost-effectiveness of the proposed supplemental test procedures are presented in this section. The analysis, though based on U.S. EPA's Regulatory Impact Analysis, is adjusted to reflect costs in California and excess emissions reduced in California. The U.S. EPA's analysis includes increases in costs due to the costs of technologies needed to reduce engine emissions from 4.0 g/bhp-hr of NOx to 2.5 g/bhp-hr of NMHC plus NOx (for 2004 and subsequent model year HDDEs), as well as the costs associated with similar supplemental test procedures (for 2007 and subsequent model year HDDEs). Because of these premises, the presented cost-effectiveness for the proposed supplemental test procedures is very conservative. Yet, because the proposed supplemental test procedures would apply statewide, they would provide significant cost-effective emission reductions throughout California.

A. AIR QUALITY BENEFITS

1. Statewide Benefits

Using the methodology described below, Table 10 shows the statewide excess NOx emissions reduced by the staff's proposal for the 2005, 2006, and 2010 calendar years. Over the lifetime of the vehicles from the 2005 and 2006 model years, the amount of excess NOx emissions reduced is 0.6 tons per medium heavy-duty vehicle and 5.1 tons per heavy heavy-duty vehicle.

Table 10 - 2005, 2006, and 2010 Statewide Excess NOx Emissions Reduced by the Proposal (in tons per day)

	CY 2005	CY 2006	CY 2010
California Registered Vehicles Only	8.4	17.3	13.8
California and Out-of-State Registered Vehicles	10.8	22.2	18.3

In the adoption of the 2.5 g/bhp-hr NMHC plus NOx standard (SIP Measure M6), it was assumed that the 50 percent reduction of the federal NOx standard would also result in a 50 percent reduction in emissions for all driving. The ARB's emission inventory reflected this assumption. When the HDDE certification violations in the 1990s were discovered, it was found that operation outside the scope of the FTP test cycle could result in significant emission increases. The proposed supplemental test procedures ensure that the original emission benefit assumptions under SIP Measure M6 are valid.

The 1994 Ozone SIP is California's plan for achieving the federal ozone standard in all areas of the state by the federally required date. The 1994 Ozone SIP includes state measures to control motor vehicles and pesticides, local measures for stationary and area sources, and federal measures for sources under exclusive or practical federal control. The U.S. EPA approved the 1994 Ozone SIP in September 1996 (62 Federal Register 1150, January 8, 1997).

The proposed test procedures will not affect the SIP since the excess emissions are not included in the inventory. Reductions from this proposal are not valid for SIP purposes. However, failure to adopt these test procedures could increase the NOx emission inventory and thus require further control in a future SIP. At this point, no further SIP analysis is necessary. Table 11 shows excess emissions that would be eliminated in several California air basins which have not yet achieved National Ambient Air Quality Standards. The excess emissions are calculated for California registered vehicles only.

Table 11 - Excess Emissions Eliminated by Air Basin in 2005, 2006 and 2010 (tons per day)

	2005	2006	2010
Sacramento Air Basin	0.8	1.6	1.3
San Joaquin Valley Air Basin	1.6	3.4	2.8
South Coast Air Basin	3.4	7.0	6.0
Statewide	8.4	17.3	14.3

2. Methodology to Calculate Excess Emissions

The equation used to calculate the excess NOx emissions, if the NTE and ESC standards were not required, for the 2005 and 2006 model years is as follows:

$$\text{Excess Emissions (tons/day)} = \frac{\text{EF} \times \text{CF} \times (\text{Daily\_VMT}) \times (\text{Percent\_steady\_state})}{909{,}091}$$

Equation 7 : Excess Emissions Formula

Where:

EF = The incremental NOx emission factor in grams per brake horsepower-hour (2.5 g/bhp-hr). This number was obtained by subtracting the FTP standard from the emission rate at steady-state mode. The emission rate at steady-state was provided, by one manufacturer of heavy-duty engines, as confidential information.

CF = The conversion factor from gram per bhp-hr to grams per mile
= 2.3 for medium heavy-duty diesel engines or
= 2.6 for heavy heavy-duty diesel engines
(both are from California's previous Motor Vehicle Emission Factor Model – MVEI7G).

Daily VMT = Total daily vehicle miles traveled (from EMFAC2000)

Percent_steady_state
= The percent of VMT under steady-state mode. The split between the steady-state mode and the urban or transient mode of driving were obtained from two sources. One source of steady state driving mode information is based on confidential information from an engine manufacturer. The second source is the U.S. EPA's Defeat Device Spreadsheet model. Estimation from this model resulted in a 72% steady-state mode for heavy-heavy duty vehicles and 25% steady-state mode for medium-heavy duty vehicles. In this rulemaking, results from the Defeat Device spreadsheet model were used to calculate the excess emissions since the data in the model were derived from individual engine family defeat device response data provided to the U.S. EPA by engine manufacturers as a confidential and proprietary information and thus would be more representative than data obtained from a single manufacturer.

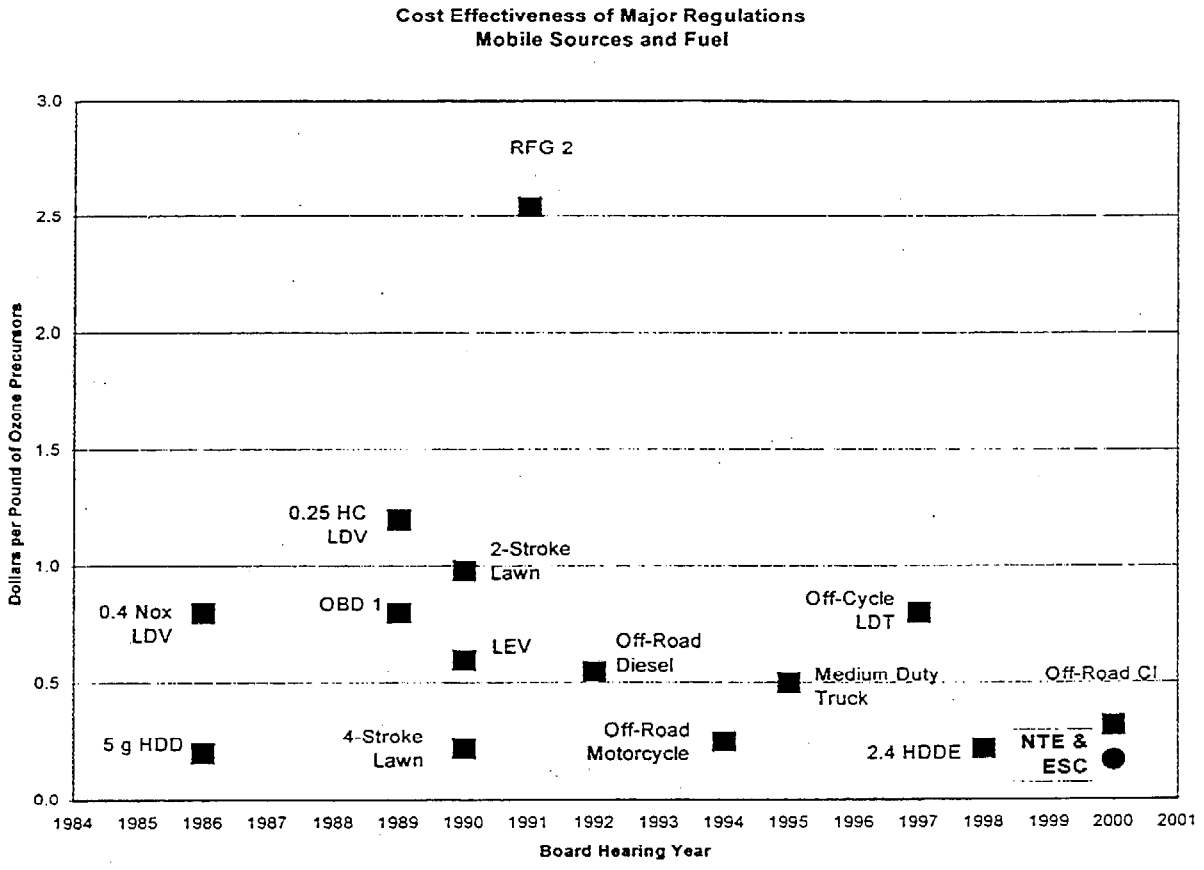
909,091 = Conversion factor from grams per day to tons per day

B. COST-EFFECTIVENESS

This proposal contains the most conservative cost estimates, as described in the sections above. The estimated cost of complying with the test procedures will vary depending on the gross vehicle weight rating class.

As shown in Figure 7, the cost-effectiveness of California mobile source and motor vehicle fuels regulations adopted over the past decade range from $0.17 to $2.55 per pound of ozone precursors reduced. The cost-effectiveness of the proposed test procedures by weight class is $0.63 per pound of NOx reduced for medium heavy-duty vehicles and $0.09 per pound of NOx reduced for heavy heavy-duty vehicles. Combining the cost-effectiveness for all heavy-duty vehicles based on predicted sales, results in $0.17 per pound of NOx reduced for all heavy-duty vehicles (identified with a round marker on Figure 7).

Figure 7


Cost Effectiveness of Major Regulations
Mobile Sources and Fuel
Dollars per Pound of Ozone Precursors
3.0
2.5
2.0
1.5
1.0
0.5
0.0
RFG 2
0.25 HC LDV
2-Stroke Lawn
0.4 Nox LDV
OBD 1
LEV
Off-Road Diesel
Off-Cycle LDT
Medium Duty Truck
Off-Road CI
5 g HDD
4-Stroke Lawn
Off-Road Motorcycle
2.4 HDDE
NTE & ESC
1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001
Board Hearing Year

XI. SUMMARY AND STAFF RECOMMENDATION

The supplemental test procedures included in the proposed amendments are essential to ensure in-use compliance with ARB's standards over various operation conditions. These supplemental test procedures will be effective measures to prevent excess emissions that are not detected when certifying only to the FTP test cycle. Since these emissions were not included in the SIP, they are "excess". However, due to their potential negative effects on human health, reduction of these excess emissions is important.

When the consent decree requirements expire in 2004, the engines produced by the settling manufacturers will likely revert to engine control strategies that are more fuel efficient, but also emit more NOx during in-use driving, to enhance competitiveness in the marketplace. Adopting the proposed test procedures will require settling manufacturers to continue producing clean engines during the 2005 and 2006 calendar year period, and require non-settling manufacturers to produce similarly clean engines beginning in 2005.

The technologies that would allow manufacturers to comply with the proposed test procedures are available. Furthermore, the HDDE settling manufacturers will start producing engines that are compliant with the proposed test procedures by October 1, 2002 under the consent decrees. These engine manufacturers will have at least two years of experience with the various technologies by 2005. Therefore, it will be technologically feasible for model year 2005 heavy-duty diesel engines to comply with the supplemental test procedures.

Estimates of statewide reductions of excess emissions resulting from the proposal are 8 tons per day and 17 tons per day of NOx in 2005 and 2006, respectively, for California registered vehicles (i.e., not including out-of-state vehicles). However, if enough States adopt California's requirements, under the authority granted in section 177 of the federal Clean Air Act, engine manufacturers will decide to produce clean heavy-duty diesel engines on a national basis. Consequently, the reduction of excess emissions (including emissions from out-of-state vehicles) would be 11 tons per day and 22 tons per day of NOx in 2005 and 2006, respectively. The additional emission reductions would be realized from "clean" out-of-state vehicles travelling in California. This makes the support, and adoption, of the proposed test procedures by other states an important component in maximizing the success and effectiveness of the proposal.

The estimated California cost-effectiveness with adoption of the staff's proposal ranges from approximately $0.09 to $0.63 per pound of NOx reduced. The staff recommends that the Board adopt the proposed supplemental test procedures.

XII. REFERENCES

ARB, 2000. Mailout #MSC-00-20, Consideration of Amendments to Adopt Not-to-Exceed and Euro III European Stationary Cycle Emission Standards and Test Procedures for the 2005 and Subsequent Model Year Heavy-Duty Engines and Vehicles, September 15, 2000.

ARB, 2000. Public Hearing to Consider Amendments to Off-Road Compression-Ignition Engine Regulations: 2000 and Later Emission Standards, Compliance Requirements and Test Procedures. December 10, 1999

ARB, 1994. The California State Implementation Plan for Ozone, Volume II, November 15, 1994.

ARB, 1998. Proposed Amendments to Heavy-Duty Vehicle Regulations: 2004 Emission Standards; Averaging, Banking and Trading; Optional Reduced Emission Standards; Certification Test Fuel; Labeling; Maintenance Requirements and Warranties, March 6, 1998 (Staff Report).

U.S. EPA, 2000. Notice of Final Rulemaking, Control of Emissions of Air Pollution From 2004 and Later Model Year Heavy-Duty Highway Engines and Vehicles; Revision of Light-Duty On-Board Diagnostics Requirements, Signed by Carol Browner, United States Environmental Protection Agency Administrator, July 31, 2000; 65 Federal Register 59896, October 6, 2000.

U.S. EPA, 2000. Regulatory Impact Analysis: Control of Emissions of Air Pollution from Highway Heavy-Duty Engines, July 2000 (EPA420-R-00-010).

APPENDIX A – PROPOSED AMENDMENTS TO TITLE 13, CALIFORNIA CODE OF REGULATIONS, CHAPTER 1, ARTICLE 2; EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1985 AND SUBSEQUENT MODEL YEAR HEAVY-DUTY ENGINES AND VEHICLES.

APPENDIX A

PROPOSED REGULATION ORDER

I. Amend the following section of Title 13, California Code of Regulations, to read as set forth in the following pages:

Section 1956.8	Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Year Heavy-Duty Engines and Vehicles

II. Adopt the following article and section within Chapter 2 of Division 3 of Title 13, California Code of Regulations, to read as set forth in the following pages:

Article 1.5	Enforcement of Vehicle Emission Standards and Surveillance Testing for 2005 and Subsequent Model Year Heavy-Duty Engines and Vehicles

Section 2065	Applicability of Chapter 2 to 2005 and Subsequent Model Year Heavy-Duty Engines and Vehicles

Notes:

a) The regulatory language does not include any amendments that have not been finalized (i.e., Transit Bus Rule amendments and the proposed medium-duty low emission vehicle (LEV) and heavy-duty otto-cycle (gasoline) engine amendments). Where these changes would appear is indicated by "[No change in this rulemaking.]"

b) The proposed regulatory amendments are shown in <u>underline</u> to indicate additions to the text and ~~strikeout~~ to indicate deletions.

Amend Title 13, California Code of Regulations, section 1956.8, to read:

1956.8. Exhaust Emission Standards and Test Procedures - 1985 and Subsequent Model Heavy-Duty Engines and Vehicles.

(a)(1) [No Change]

(2), (3) [No Change]

(4) [No change in this rulemaking.]

(b) The test procedures for determining compliance with standards applicable to 1985 and subsequent heavy-duty diesel engines and vehicles and the requirements for participation in the averaging, banking and trading programs, are set forth in the "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" adopted April 8, 1985, as last amended ~~April 15, 1999~~ [insert date of finalized amendment], which is incorporated herein by reference.

(c) [No change in this rulemaking.]

(d) [No change in this rulemaking.]

(e) [No change in this rulemaking.]

(f) [No Change]

(g) [No change in this rulemaking.]

(h) The exhaust emissions from new 1992 and subsequent model-year engines used in incomplete medium-duty low-emission vehicles, ultra-low-emission vehicles, and super-ultra-low-emission vehicles, and for diesel engines used in medium-duty low-emission vehicles, ultra-low-emission vehicles and super-ultra-low-emission vehicles shall not exceed:

Exhaust Emission Standards for Engines Used in Incomplete Otto-Cycle Medium-Duty Low-Emission Vehicles, Ultra-Low-Emission Vehicles, and Super Ultra-Low-Emission Vehicles, and for Diesel Engines Used in Medium-Duty Low-Emission Vehicles, Ultra-Low-Emission Vehicles, and Super Ultra-Low-Emission Vehicles[A,F]

(grams per brake horsepower-hour)

Model Year	Vehicle Emissions Category[B]	Carbon Monoxide	Non-Methane Hydrocarbons and Oxides of Nitrogen[C]	Formaldehyde	Particulates[D]
1992[E] - 2001	LEV	14.4	3.5 [K]	0.050	0.10 [K]
2002-2003[E]	LEV	14.4	3.0 [K]	0.050	0.10 [K]
1992-2003[E,HG]	ULEV	14.4	2.5 [K]	0.050	0.10 [K]
2004 and subsequent	ULEV - Opt A.	14.4	2.5 [G,I,J,K]	0.050	0.10 [J,K]
2004 and subsequent	ULEV - Opt. B	14.4	2.4 [G,I,J,K]	0.050	0.10 [J,K]
1992 and subsequent	SULEV	7.2	2.0 [K]	0.025	0.05 [K]

[A] This set of standards is optional. Manufacturers of engines used in incomplete medium-duty vehicles or diesel engines used in medium-duty vehicles from 8501-14,000 pounds gross vehicle weight rating may choose to comply with these standards as an alternative to the primary emission standards and test procedures specified in section 1960.1, Title 13, California Code of Regulations. Manufacturers that choose to comply with these optional heavy-duty standards and test procedures shall specify, in the application for certification, an in-use compliance test procedure, as provided in section 2139(c), Title 13, California Code of Regulations.

[B] "LEV" means low-emission vehicle.
"ULEV" means ultra-low-emission vehicle.
"SULEV" means super ultra-low-emission vehicle.

[C] This standard is the sum of the individual non-methane hydrocarbon emissions and oxides of nitrogen emissions. For methanol-fueled engines, non-methane hydrocarbons shall mean organic material hydrocarbon equivalent ("OMHCE").

[D] This standard shall only apply to diesel engines and vehicles.

E Manufacturers may certify engines used in incomplete medium-duty vehicles or diesel engines used in medium-duty vehicles to these standards to meet the requirements of section ~~1965.8(g)~~ 1956.8(g), Title 13, California Code of Regulations.

F In-use compliance testing shall be limited to vehicles or engines with fewer than 90,000 miles.

G ~~[The U.S. EPA is considering the adoption of amendments to the federal emission standards for engines used in incomplete medium duty vehicles or diesel engines used in medium duty vehicles as they existed June 24, 1996. If the U.S. EPA promulgates amendments to the emission standards for this category, the ARB will hold a noticed public hearing within one year of such promulgation to consider the adoption of similar or identical standards in California.]~~ [Reserved]

H For engines certified to the 3.5 grams per brake horsepower-hour (g/bhp-hr) LEV standards, the in-use compliance standard shall be 3.7 g/bhp-hr for the first two model years of introduction. For engines certified to the 2002 and 2003 model year LEV standards, the in-use compliance standard shall be 3.2 g/bhp-hr. For engines certified to the 1992 through 2003 model year ULEV standards, the in-use compliance standard shall be 2.7 g/bhp-hr for the first two model years of introduction. For engines certified to the 1992 and subsequent SULEV standards, the in-use compliance standard shall be 2.2 g/bhp-hr for the first two model years of introduction.

I Manufacturers have the option of certifying to either option A or B. Manufacturers electing to certify to Option A must demonstrate that the NMHC emissions do not exceed 0.5 g/bhp-hr.

J Emissions averaging may be used to meet these standards for diesel engines, using the requirements for participation in averaging, banking and trading programs, as set forth in the "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles", ~~adopted April 8, 1985,~~ as ~~last amended April 15, 1999,~~ incorporated by reference in paragraph (b), above.

K Engines of 1998 and subsequent model years may be eligible to generate averaging, banking and trading credits based on these standards according to the requirements of the averaging, banking and trading programs described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles", ~~adopted April 8, 1985,~~ as ~~last amended April 15, 1999,~~ incorporated by reference in paragraph (b), above.

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NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, ~~43103,~~ 43104 and 43806, Health and Safety Code; and Section 28114, Vehicle Code. Reference: Sections 39002, 39003, 43000, 43013, 43018, 43100, 43101, 43101.5, 43102, ~~43103,~~ 43104, 43106, 43204 and 43806, Health and Safety Code.

Adopt article 1.5 and section 2065, within chapter 2, division 3, title 13, California Code of Regulations, to read:

Article 1.5. Enforcement of Vehicle Emission Standards and Surveillance Testing for 2005 and Subsequent Model Year Heavy-Duty Engines and Vehicles

2065. Applicability of Chapter 2 to 2005 and Subsequent Model Year Heavy-Duty Engines and Vehicles

The requirements of chapter 2, division 3, title 13, California Code of Regulations apply to 2005 and subsequent model year heavy-duty engines and vehicles except as specifically modified by the provisions of the "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" adopted April 8, 1985, as last amended [insert date of finalized amendment], which are incorporated herein by reference.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43101, 43104, 43105, 43210, and 43806, Health and Safety Code. Reference: Sections 39002, 39003, 39500, 43000, 43012, 43013, 43018, 43100, 43101, 43101.5, 43102, 43104, 43106, 43202, 43203, 43204, 43210-43213, and 43806, Health and Safety Code; and Section 28114, Vehicle Code.

APPENDIX B — PROPOSED AMENDMENTS TO CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1985 AND SUBSEQUENT MODEL HEAVY-DUTY DIESEL ENGINES AND VEHICLES

APPENDIX B

PROPOSED AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1985 AND SUBSEQUENT MODEL HEAVY-DUTY DIESEL ENGINES AND VEHICLES

State of California
AIR RESOURCES BOARD

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1985 AND SUBSEQUENT MODEL HEAVY-DUTY DIESEL-ENGINES AND VEHICLES

Adopted: April 8, 1985
Amended: July 29, 1986
Amended: January 22, 1990
Amended: May 15, 1990
Amended: December 26, 1990
Amended: July 12, 1991
Amended: October 23, 1992
Amended: October 22, 1993
Amended: March 24, 1994
Amended: September 22, 1994
Amended: June 29, 1995
Amended: June 4, 1997
Amended: February 26, 1999 ~~April 15, 1999~~
Amended: To Be Finalized (Board approved on February 24, 2000)
Amended: (insert date of finalized amendment)

NOTES: This document incorporates by reference various sections of the Code of Federal Regulations (CFR), some with modifications. Modifications to portions of paragraphs in the Federal language are indicated by underline for additions and ~~strikeout~~ for deletions. Larger portions of Federal language for a specific section which is not to be included in these procedures are denoted by the "DELETE" and larger portions of new California language are indicated by "REPLACE WITH" or "INSERT". The symbols "*****" and "....." mean that the reminder of the federal text for a specific section, which is not shown in these procedures, has been included by reference, with only the printed text changed. The symbol "~~#####~~" means that the remainder of the text of these procedures, which is not shown in this amendment document, has not been changed.

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1985 AND SUBSEQUENT MODEL HEAVY-DUTY DIESEL ENGINES AND VEHICLES

The following provisions of Subparts A, I, and N, Title 40, Code of Federal Regulations, as adopted or amended by the U. S. Environmental Protection Agency on the date listed, and only to the extent they pertain to the testing and compliance of exhaust emissions from heavy-duty diesel-engines and vehicles, are adopted and incorporated herein by this reference as the California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel-Engines and Vehicles, except as altered or replaced by the provisions set forth below.

The federal regulations contained in the Subparts identified above which pertain to oxides of nitrogen emission averaging shall not be applicable to these procedures except for diesel engines and vehicles produced in the 1998 and subsequent model years. The federal regulations contained in the Subparts identified above which pertain to particulate emission averaging shall not be applicable to these procedures for 1996 and subsequent model years. The smoke exhaust test procedures shall be applicable to California petroleum-fueled, liquefied-petroleum gas-fueled, and compressed-natural gas fueled heavy-duty diesel engines and vehicles for 1988 and later model years.

The federal regulations contained in the subparts identified above which pertain to nonconformance penalty shall not be applicable.

The federal regulations contained in the subparts identified above which pertain to evaporative emission shall not be applicable to these procedures. Applicable regulations pertaining to evaporative emissions are contained in "California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles," as incorporated in Title 13, California Code of Regulations, Section 1976.

Starting with the 1990 model year, these regulations shall be applicable to all heavy-duty diesel natural-gas-fueled and liquefied-petroleum gas-fueled engines (and vehicles) including those engines derived from existing diesel engines. For any engine which is not a distinctly diesel engine nor derived from such, the Executive Officer shall determine whether the engine shall be subject to these regulations or alternatively to the heavy-duty Otto-cycle engine regulations, in consideration of the relative similarity of the engine's torque-speed characteristics and vehicle applications with those of diesel and Otto-cycle engines.

The regulations concerning the certification of methanol-fueled urban bus engines are not applicable in California until 1991 and subsequent model years. The regulations concerning the certification of all other methanol-fueled diesel engines and vehicles are not applicable in California until 1993 and subsequent model years.

Regulations concerning the certification of incomplete medium-duty diesel low-emission vehicles and engines and ultra-low-emission vehicles and engines operating on any fuel are applicable for the 1992 and subsequent model years.

All references to the "Administrator" in the federal regulations contained in the subparts identified above shall be replaced with the "Executive Officer".

Subpart A, General Provisions for Emission Regulations for 1977 and Later Model Year New Light-Duty Vehicles, Light-Duty Trucks, and Heavy-Duty Engines, and for 1985 and later Model Year New Gasoline-Fuel and Methanol Fueled Heavy-Duty Vehicles.

Amend § 86.004-21, Title 40, Code of Federal Regulations, to read:

§ 86.004-21 Application for certification. ~~October 21, 1997.~~ October 6, 2000.

* * * * *

(b)(2) DELETE
REPLACE WITH:

(b)(2) For 1992 and subsequent model-year low-emission and ultra-low-emission vehicles and engines not powered exclusively by diesel, projected California sales data and fuel economy estimates two years prior to certification, and projected California sales data for all vehicles and engines, regardless of operating fuel or vehicle emission category, sufficient to enable the Executive Officer to select a test fleet representative of the vehicles (or engines) for which certification is requested at the time of certification.

* * * * *

(m) DELETE ~~For model years 2004 through 2007, within 180 days after submission of the application for certification of a heavy-duty diesel engine, the manufacturer must provide emission test results from the Load Response Test conducted according to § 86.1380, including, at a minimum, test results conducted at each of the speeds identified in § 86.1380. Load Response Test data submissions are not necessary for carry-over engine families for which Load Response Test data has been previously submitted. In addition, upon approval of the Administrator, manufacturers may carry Load Response Test data across from one engine family to other engine families, provided that the carry-across engine families use similar emission control technology hardware which would be expected to result in the generation of similar emission data when run over the Load Response Test.~~

(n) Upon request from ARB ~~EPA~~, a manufacturer must provide to ARB ~~EPA~~ any hardware (including scan tools), passwords, and/or documentation necessary for ARB ~~EPA~~ to read, interpret, and store (in engineering units if applicable) any information broadcast by an engine's on-board computers and electronic control modules which relates in anyway to emission control devices and auxiliary emission control devices, provided that such hardware, passwords, or documentation exists and is not otherwise commercially available. Passwords include any information necessary to enable generic scan tools or personal computers access to proprietary emission related information broadcast by an engine's on-board computer, if such passwords exist. This requirement includes access by ARB ~~EPA~~ to any proprietary code information which may be broadcast by an engine's on-board computer and electronic control modules. Information which is confidential business information must be marked as such. Engineering units refers to the ability to read, interpret, and store information in commonly understood engineering units, for example, engine speed in revolutions per minute or per second, injection timing parameters such as start of injection in degree's before top-dead center, fueling rates in cubic centimeters per stroke, vehicle speed in

miles per hour or kilometers per hour. This paragraph (n) does not restrict ARB ~~EPA~~ authority to take any action authorized by Section 208 of the Clean Air Act.

Adopt and amend § 86.007-21, Title 40, Code of Federal Regulations, to read:

§ 86.007-21 Application for certification. October 6, 2000.

Section 86.007-21 includes text that specifies requirements that differ from § 86.004-21. Where a paragraph in § 86.004-21 is identical and applicable to § 86.007-21, this may be indicated by specifying the corresponding paragraph and the statement "[Reserved]. For guidance see § 86.004-21.".

(a) through (n) [Reserved]. For guidance see § 86.004-21.

(o) For 2005 and subsequent model year ~~diesel~~ heavy-duty diesel engines, the manufacturer must provide the following additional information pertaining to the supplemental steady-state test conducted under § 86.1360-2007:

(1) Weighted brake-specific emissions data (i.e., in units of g/bhp-hr), calculated according to § 86.1360-2007(e)(5), for all pollutants for which an emission standard is established in § 86.004-11(a);

(2) Brake specific gaseous emission data for each of the 13 test points (identified under § 86.1360-2007(b)(1)) and the 3 ARB ~~EPA~~-selected test points (identified under § 86.1360-2007(b)(2));

(3) Concentrations and mass flow rates of all regulated gaseous emissions plus carbon dioxide;

(4) Values of all emission-related engine control variables at each test point;

(5) Weighted break-specific particulate matter (i.e., in units of g/bhp-hr);

(6) A statement that the test results corresponds to the maximum NOx producing condition specified in § 86.1360-2007(e)(4). The manufacturer also must maintain records at the manufacturer's facility which contain all test data, engineering analyses, and other information which provides the basis for this statement, where such information exists. The manufacturer must provide such information to the Executive Officer ~~Administrator~~ upon request;

(7) A statement that the engines will comply with the weighted average emissions cap ~~standard~~ and interpolated values comply with the ~~Maximum Allowable Emission Limits~~ emission testing caps specified in §86.1360-2007(j) ~~§ 86.007-11(a)(3)~~ for the useful life of the engine. The manufacturer also must maintain records at the manufacturer's facility which contain a detailed description of all test data, engineering analyses, and other information which provides the basis for this statement, where such information exists. The manufacturer must provide such information to the Executive Officer ~~Administrator~~ upon request.

(p)(1) The manufacturer must provide a statement in the application for certification that the diesel heavy-duty engine for which certification is being requested will comply with the applicable Not-To-Exceed Limits specified in §86.1370-2007(d) ~~§86.007-11(a)(4)~~ when operated under all conditions which may reasonably be expected to be encountered in normal vehicle operation and use. The manufacturer also must maintain records at the manufacturer's facility which contain all test data, engineering analyses, and other information which provides the basis for this statement, where such information exists. The manufacturer must provide such information to the Executive Officer ~~Administrator~~ upon request.

(2) For engines equipped with exhaust gas recirculation, the manufacturer must provide a detailed description of the control system the engine will use to comply with the requirements of ~~§ 86.007-11(a)(4)(iii) and~~ § 86.1370-2007(f) for NTE cold temperature operating exclusion, including but not limited to the method the manufacturer will use to access this exclusion during normal vehicle operation.

(3) For each engine model and/or horsepower rating within an engine family for which a manufacturer is applying for ~~an~~ NTE deficiency(ies) under the provisions of §86.1370-2007(i) ~~§86.007-11(a)(4)(iv)~~, the manufacturer's application for an NTE deficiency(ies) must include a complete description of the deficiency, including but not limited to: the specific description of the deficiency; what pollutant the deficiency is being applied for, all engineering efforts the manufacturer has made to overcome the deficiency, what specific operating conditions the deficiency is being requested for (i.e., temperature ranges, humidity ranges, altitude ranges, etc.), a full description of the auxiliary emission control device(s) which will be used to maintain emissions to the lowest practical level; and what the lowest practical emission level will be.

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Subpart N, Emission Regulations for New Otto-Cycle and Diesel Heavy-Duty Engines; Gaseous and Particulate Exhaust Test Procedures

Amend §86.1313-90, Title 40, Code of Federal Regulations, to read:

§86.1313-90 Fuel Specifications. April 11, 1989.

* * * * *

(b) Diesel test fuel. (1) The petroleum fuels for testing diesel engines ... pour depressant, dye, dispersant, and biocide. Fuels specified for emissions testing are intended to be representative of commercially available in-use fuels.

(2) Except as noted below, petroleum fuel for diesel engines ... shall be used. For 1993 and subsequent model-year diesel-fueled engines, the petroleum fuel used in exhaust emissions testing may meet the specifications in Table N98-2 ~~N94-2~~ of 40 Code of Federal Regulations section 86.1313-98(b)(2) ~~86.1313-94(b)(2)~~, as adopted September 5, 1997 ~~August 21, 1990~~, or substantially equivalent specifications approved by the Executive Officer as an option to the specifications in Table N90-2. For 1995 through 2003 model-year medium-duty diesel-fueled engines, and for 1996 and 1997 model-year urban bus engines only, the petroleum fuel used in exhaust emissions testing may meet the specifications listed below, or substantially equivalent specifications approved by the Executive Officer, as an option to the specifications in Table N90-2. Where a manufacturer elects pursuant to this subparagraph to conduct exhaust emission testing using the specifications in Table N98-2 ~~N94-2~~, or the specifications listed below, the Executive Officer shall conduct exhaust emission testing with the diesel fuel meeting the specifications elected by the manufacturer. The manufacturer shall submit evidence to the Executive Officer demonstrating to the Executive Officer's satisfaction that the test fuel will be the predominant in-use fuel. Such evidence could include such things as copies of signed contracts from customers indicating the intent to purchase and use the test fuel as the primary fuel for use in the engines or other evidence acceptable to the Executive Officer.

Fuel Property	Limit	Test Method [a]
Natural Cetane Number	47-55	D613-86
Distillation Range, °F		Title 13 CCR, §2282(g)(3)
IBP	340-420	
10% point	400-490	
50% point	470-560	
90% point	550-610	
EP	580-660	
API Gravity, degrees	33-39	D287-82
Total Sulfur, wt. %	0.01-0.05	Title 13 CCR, §2282(g)(3)
Nitrogen Content, ppmw	100-500	Title 13 CCR, §2282(g)(3)
Total Aromatic Hydrocarbons, vol.%	8-12	Title 13 CCR, §2282(g)(3)
Polycyclic Aromatic Hydrocarbons, wt. % (max.)	1.4	Title 13 CCR, §2282(g)(3)

Flashpoint, °F (max)	130	D 93-80
Viscosity @ 40°F, centistokes	2.0-4.1	D 445-83

[a] ASTM specifications unless otherwise noted. A reference to a subsection of Title 13, CCR, §2282 means the test method identified in that subsection for the particular property. A test method other than that specified may be used following a determination by the Executive Officer that the other method produces results equivalent to the results of the specified method.

(3) Except as noted below, petroleum fuel for diesel engines meeting the specifications in Table N90-3, or substantially equivalent specifications approved by the Executive Officer ~~Administrator~~, shall be used in service accumulation. The grade of petroleum fuel recommended by the engine manufacturer, commercially designated as "Type 2-D" grade diesel fuel, shall be used. For 1993 and subsequent model-year diesel-fueled engines, excluding the 1995 through 2003 model-year medium-duty diesel-fueled engines referenced below, the petroleum fuel used in service accumulation may meet the specifications in Table N94-3 of 40 Code of Federal Regulations section 86.1313-94(b)(3), as adopted August 21, 1990, or substantially equivalent specifications approved by the Executive Officer as an option to the specifications in Table N90-3. For 1995 through 2003 model-year medium-duty diesel-fueled engines, and for 1996 and 1997 model-year urban bus engines only, diesel fuel representative of commercial diesel fuel which will be generally available through retail outlets shall be used in service accumulation. The manufacturer shall submit evidence to the Executive Officer demonstrating to the Executive Officer's satisfaction that the test fuel will be the predominant in-use fuel. Such evidence could include such things as copies of signed contracts from customers indicating the intent to purchase and use the test fuel as the primary fuel for use in the engines or other evidence acceptable to the Executive Officer.

#####

Adopt §86.1342-94, Title 40, Code of Federal Regulations, to read:

§86.1342-94 Calculations; exhaust emissions. September 5, 1997.

#####

Adopt and amend § 86.1360-2007, Title 40, Code of Federal Regulations, to read:

§ 86.1360-2007 Supplemental steady-state test; test cycle and procedures. October 6, 2000.

(a) Applicability. This section applies to 2005 ~~2007~~ and subsequent model year ~~later diesel~~ heavy duty diesel engines.

(b) Test cycle.

(1) The following 13-mode cycle must be followed in dynamometer operation on the test engine:

Mode Number	Engine Speed	Percent Load	Weighting Factor	Mode Length (minutes)
1	Idle	–	0.15	4
2	A	100	0.08	2
3	B	50	0.10	2
4	B	75	0.10	2
5	A	50	0.05	2
6	A	75	0.05	2
7	A	25	0.05	2
8	B	100	0.09	2
9	B	25	0.10	2
10	C	100	0.08	2
11	C	25	0.05	2
12	C	75	0.05	2
13	C	50	0.05	2

(2) In addition to the 13 test points identified in paragraph (b)(1) of this section, ARB ~~EPA~~ may select, and require the manufacturer to conduct the test using, up to 3 additional test points within the control area (as defined in paragraph (d) of this section). ARB ~~EPA~~ will notify the manufacturer of these supplemental test points in writing in a timely manner before the test. Emissions sampling for the additional test modes must include all regulated gaseous pollutants. Particulate matter does not need to be measured.

(c) Determining engine speeds. (1) The engine speeds A, B, ~~and~~ C, D, and E, referenced in the table in paragraph (b)(1) of this section~~, and speeds D and E, referenced in § 86.1380,~~ must be determined as follows:

Speed A = n_{lo} + 0.25 x (n_{hi}-n_{lo})
Speed B = n_{lo}+ 0.50 x (n_{hi}-n_{lo})
Speed C = n_{lo} + 0.75 x (n_{hi}-n_{lo})
Speed D = n_{hi}
Speed E = n_{lo} + 0.15 x (n_{hi}-n_{lo})

Where:

n_{hi} = High speed as determined by calculating 70% of the maximum power. The highest engine speed where this power value occurs on the power curve is defined as n_{hi}.

n_{lo} = Low speed as determined by calculating 50% of the maximum power. The lowest engine speed where this power value occurs on the power curve is defined as n_{lo}.

Maximum Power = the maximum observed power calculated according to the engine mapping procedures defined in § 86.1332-90.

(d) Determining the control area. The control area extends from the engine speed A to C, as defined in paragraph (c) of this section, and extends from 25 to 100 percent load.

(e) Test requirements. (1) Engine warm-up. Prior to beginning the test sequence, the engine must be warmed-up according to the procedures in § 86.1332-90(d)(3)(i) through (iv).

(2) Test sequence. The test must be performed in the order of the mode numbers in paragraph (b)(1) of this section. The ARB ~~EPA~~-selected test points identified under paragraph (b)(2) of this section must be performed immediately upon completion of mode 13. The engine must be operated for the prescribed time in each mode, completing engine speed and load changes in the first 20 seconds of each mode. The specified speed must be held to within ~~<plus-minus>~~ plus or minus (+/-) 50 rpm and the specified torque must be held to within plus or minus two percent of the maximum torque at the test speed.

(3) Particulate sampling. One pair of filters (primary and back-up) shall be used for sampling PM over the 13-mode test procedure. The modal weighting factors specified in paragraph (b)(1) of this section shall be taken into account by taking a sample proportional to the exhaust mass flow during each individual mode of the cycle. This can be achieved by adjusting sample flow rate, sampling time, and/or dilution ratio, accordingly, so that the criterion for the effective weighting factors is met. The sampling time per mode must be at least 4 seconds per 0.01 weighting factor. Sampling must be conducted as late as possible within each

mode. Particulate sampling shall be completed no earlier than 5 seconds before the end of each mode.

(4) The test must be conducted with all emission-related engine control variables in the highest brake-specific NOx emissions state which could be encountered for a 30 second or longer averaging period at the given test point and for the conditions under which the engine is being tested.

(5) Exhaust emissions measurements and calculations. Manufacturers must follow the exhaust emissions sample analysis procedures under § 86.1340-90, and the calculation formulas and procedures under § 86.1342-94, for the 13-mode cycle and the 3 ARB ~~EPA~~-selected test points as applicable for steady-state testing, including the NOx correction factor for humidity.

(6) Calculating the weighted average emissions. (i) For each regulated gaseous pollutant, the weighted average emissions must be calculated as follows:

$$A_{WA} = \frac{\sum_{i=1}^{n} [A_{Mi} \times WF_i]}{\sum_{i=2}^{n} [A_{Pi} \times WF_i]}$$

Where:

A_{WA} = Weighted average emissions for each regulated gaseous pollutant, in grams per brake horsepower hour.

A_M = Modal average mass emissions level, in grams per hour. Mass emissions must be calculated as described in § 86.1342-94.

A_P = Modal average power, in brake horse-power. Any power measured during the idle mode (mode 1) is not included in this calculation.

W_F = Weighting factor corresponding to each mode of the steady-state test cycle, as defined in paragraph (b)(1) of this section.

i = The modes of the steady-state test cycle, as defined in paragraph (b)(1) of this section.

n = 13, corresponding to the 13 modes of the steady-state test cycle, as defined in paragraph (b)(1) of this section.

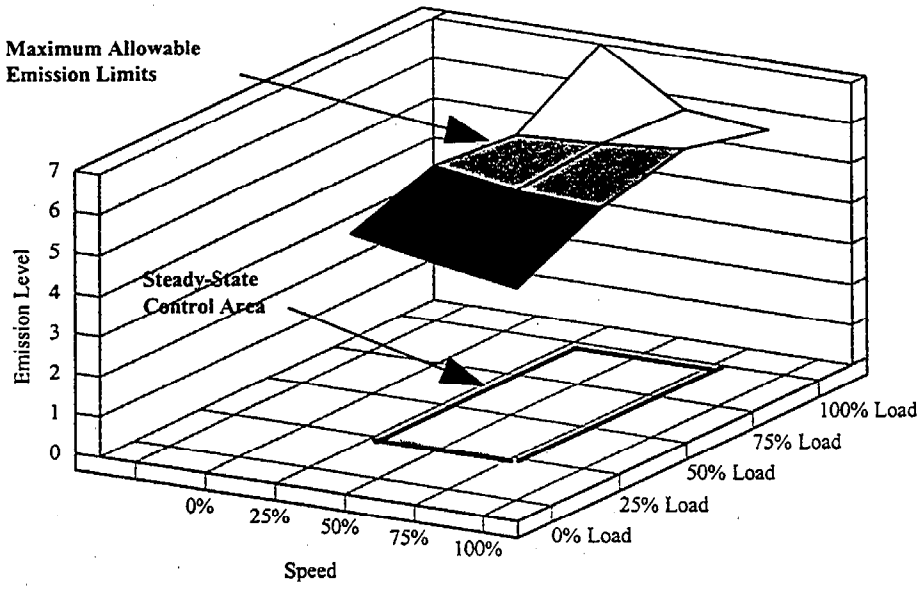
(ii) For PM measurements, a single pair of filters must be used to measure PM over the 13 modes. The brake-specific PM emission level for the test must be calculated as described for a transient hot start test in § 86.1343-88. Only the power measured during the sampling period shall be used in the calculation.

(f) Maximum allowable emission limits. (1) For gaseous emissions, the 12 non-idle test point results and the four-point linear interpolation procedure specified in paragraph (g) of this section for intermediate conditions, shall define Maximum Allowable Emission Limits for purposes of paragraph (j) of this section ~~§ 86.007-11(a)(3)~~ except as modified under paragraph (f)(3) of this section. Each engine shall have its own Maximum Allowable Emission Limits generated from the 12 non-idle supplemental steady state test points from that engine. The control area extends from the 25% to the 75% engine speeds, at engine loads of 25% to 100%, as defined in paragraph (d) of this section. Figure 1 of this paragraph (f)(1) depicts a sample Maximum Allowable Emission Limit curve, for illustration purposes only, as follows:

Figure 1

Maximum Allowable Emission Limits

Sample - For Illustration Only



(2) If the weighted average emissions, calculated according to paragraph (e)(6) of this section, for any gaseous pollutant is equal to or lower than required by paragraph (j) of this section ~~§ 86.007-11(a)(3)~~, each of the 13 test values for that pollutant shall first be multiplied by the ratio of the applicable emission standard (under paragraph (j) of this section ~~§ 86.00711(a)(3)~~) to the weighted average emissions value, and then by 1.10 for interpolation allowance, before determining the Maximum Allowable Emission Limits under paragraph(g)(2) of this section.

(3) If the Maximum Allowable Emission Limit for any point, as calculated under paragraphs (f)(1) and (2) of this section, is greater than the applicable Not-to-Exceed limit (if within the Not-to-Exceed control area defined in § 86.1370-2007(b)), then the Maximum Allowable Emission Limit for that point shall be defined as the applicable Not-to-Exceed limit.

(g) Calculating intermediate test points. (1) For the three test points selected by ARB ~~EPA~~ under paragraph (b)(2) of this section, the emissions must be measured and calculated as described in paragraph (e)(6)(i) of this section (except that n = 1 and WF = 1). The measured values then must be compared to the interpolated values according to paragraph (g)(3) of this section. The interpolated values are determined from the modes of the test cycle closest to the respective test point according to paragraph (g)(2) of this section.

(2) Interpolating emission values from the test cycle. The gaseous emissions for each regulated pollutant for each of the control points (Z) must be interpolated from the four closest modes of the test cycle that envelop the selected control point Z as shown in Figure 2 of this paragraph (g)(2).

(i) For these modes (R, S, T, U), the following definitions apply:

Speed (R) = Speed(T) = n_{RT}
Speed (S) = Speed(U) = n_{SU}
Percent load (R) = Percent load (S)
Percent load (T) = Percent load (U)

(ii) The interpolated value of the brake specific gaseous emissions of the selected control point Z(EZ) must be calculated as follows:

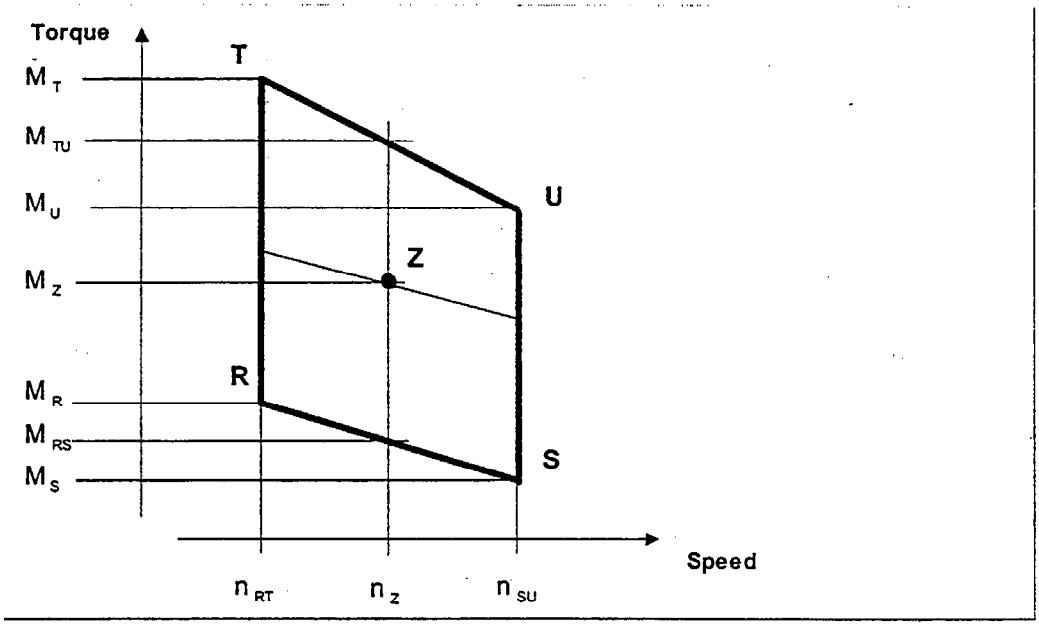
$E_Z = E_{RS} + (E_{TU} - E_{RS}) * (M_Z - M_{RS}) / (M_{TU} - M_{RS})$
$E_{TU} = E_T + (E_U - E_T) * (n_Z - n_{RT}) / (n_{SU} - n_{RT})$
$E_{RS} = E_R + (E_S - E_R) * (n_Z - n_{RT}) / (n_{SU} - n_{RT})$
$M_{TU} = M_T + (M_U - M_T) * (n_Z - n_{RT}) / (n_{SU} - n_{RT})$
$M_{RS} = M_R + (M_S - M_R) * (n_Z - n_{RT}) / (n_{SU} - n_{RT})$

Where:

E_R, E_S, E_T, E_U	= for each regulated pollutant, brake specific gaseous emissions of the enveloping modes adjusted according to the factors in (f)(2).
M_R, M_S, M_T, M_U	= engine torque of the enveloping modes.
M_Z	= engine torque of the selected control point Z.
n_Z	= engine speed of the selected control point Z.

(iii) Figure 2 follows:

Figure 2
Four-Point Linear Interpolation



(3) Comparing calculated and interpolated emission values. The measured brake specific gaseous emissions of the control point Z (X_Z) must be less than or equal to the interpolated value (E_Z).

(h) Test fuel specifications. The test fuel used for supplemental steady-state testing under this section must meet the requirements of § 86.1313-90.

(i) General requirements. Ambient conditions, charge cooling specifications, and intake and exhaust restrictions for supplemental steady-state testing and maximum allowable emission limit testing under this section must meet the requirements of § 86.1330-90.

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(j) Emission testing caps. (1) The weighted average exhaust emissions, as determined under paragraph (e)(5) of this section pertaining to the supplemental steady-state test cycle, for each regulated pollutant shall not exceed 1.0 times the applicable emission standards specified in California Code of Regulations, title 13, §1956.8 (a)(1).

(2) Gaseous exhaust emissions shall not exceed the steady-state interpolated values determined by the Maximum Allowable Emission Limits (for the corresponding speed and load), as determined under paragraph (g) of this section, when the engine is operated in the steady-state control area defined under paragraph (d) of this section, during steady-state engine operation.

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(k) In-Use Compliance. The procedures for in-use voluntary and influenced recall for heavy-duty diesel engines under this section are described in California Code of Regulations, title 13, sections 2111 through 2140, except as modified by this paragraph for 2005 and 2006 model year engines. In evaluating the scope of the affected population for the purposes of this section, there shall be a rebuttable presumption that the affected population is the engine family to which the tested engines belong. No engine may be used to establish the existence of an emissions exceedance if the engine or vehicle in which it was installed was subject to abuse or improper maintenance or operation, or if the engine was improperly installed, and such acts or omissions caused the exceedance.

(1) For the purposes of this section, an exceedance of the emission testing caps occurs when the average emissions of the test vehicles or engines, pursuant to California Code of Regulations, Title 13, Section 2139, for any pollutant exceed the emission threshold. For the purposes of this section, emission threshold is defined as:

(i) for a test using vehicle test equipment (e.g., an over-the-road mobile monitoring device such as "ROVER", or a chassis dynamometer), the applicable maximum NOx emissions limit plus the greater of 0.5 g/bhp-hr or one standard deviation of the data set established pursuant to paragraph (k)(2) of this section; or

(ii) for a test using an engine dynamometer, the applicable maximum NOx emissions limit plus 0.5 g/bph-hr.

(2) Where an engine dynamometer or vehicle test shows an apparent exceedance of the emissions threshold, the party conducting the original test shall repeat such test under the same conditions at least nine times. The mean of the tests shall be used for the averaging of the test vehicle emissions in determining compliance.

(3) If the average emissions of the test vehicles exceed the emissions threshold, the Executive Officer shall notify the manufacturer in writing of the test results. The manufacturer has the option to submit an influenced recall plan in accordance with California Code of Regulations, title 13, sections 2113 through 2121 within 45 days or to proceed with performing the engineering analysis and/or conducting further testing in accordance with paragraphs (k)(4) and/or (k)(5) of this section. Upon the completion of testing conducted in paragraph(s) (k)(4) and/or (k)(5), if the test results indicate that the average emissions of the test vehicles exceeds the emissions threshold, the Executive Officer shall notify the manufacturer in writing of the test results and upon receipt of the notification, the manufacturer shall have 45 days to submit an influenced recall plan in accordance with California Code of Regulations, title 13, sections 2113 through 2121.

(4) If the testing conducted under paragraph (k)(1) and California Code of Regulations, title 13, section 2139 was performed using vehicle test equipment, then the engine manufacturer may elect to conduct additional tests of that engine using an engine dynamometer, provided that all environmental and engine operating conditions present during vehicle testing under paragraph (k)(1) and California Code of Regulations, title 13, section 2139 can be reproduced or corrected consistent with paragraph (k)(6) of this section. If the engine manufacturer elects to conduct such additional engine dynamometer tests, it shall provide ARB with at least three business days notice prior to commencement of such testing. If based on such additional tests the engine exceeds the emission threshold, the engine manufacturer may conduct further testing in accordance with paragraph (k)(5) of this section and/or perform an engineering analysis to determine the percentage of the affected population that exceeds the emissions threshold and the emission levels of the exceeding engines. However, the manufacturer may not determine the percentage of the affected population or the emission levels solely on the basis of an engineering analysis unless it demonstrates to the Executive Officer's satifaction that such analysis alone is sufficient under the circumstances.

(5) Within 60 days of receiving notice of an exceedance under paragraph (k)(2) of this section, the manufacturer may commence testing of not less than ten additional in-service engines. The manufacturer may conduct these tests using vehicle testing equipment, or using an engine dynamometer, at the manufacturer's option.

(6) The testing of additional engines under paragraphs (k)(4) and (k)(5) of this section shall be conducted under conditions that are no less stringent than the initial test in terms of those parameters that may affect the result, and, at the manufacturer's option, may be limited to those emission limits and conditions for which apparent exceedances have been identified. Such parameters typically, but not necessarily, include relevant ambient conditions, operating conditions, service history, and age of the vehicle. Prior to conducting any testing, the manufacturer shall submit a test plan to ARB for its review and approval. Within 30 days following ARB's proposed modifications, the manufacturer shall incorporate the proposed modifications and implement the test plan as approved. Special conditioning of test engines shall not be permitted. Where the manufacturer elects to conduct the additional testing utilizing an engine dynamometer, it shall reproduce relevant engine operating and environmental conditions associated with the initial exceedance, provided, however, that correction factors may be used to reproduce temperature, humidity or altitude conditions that cannot be simulated in the laboratory. Regardless of the testing equipment utilized, the test results shall be adjusted to reflect documented test systems error and/or variability in accordance with good engineering practices.

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(l) Exemptions.

(1) The requirements set forth in this section do not apply to "ultra-small volume manufacturers" for model years 2005 and 2006. For the purposes of this section, an "ultra-small volume manufacturer" means any manufacturer with California sales less than or equal to 300 new passenger cars, light-duty trucks, medium-duty vehicles, heavy-duty vehicles, and heavy-duty engines per model year based on the average number of vehicles and engines sold by the manufacturer in the previous three consecutive model years.

(2) The requirements set forth in this section do not apply to "urban buses", as defined in Title 13, California Code of Regulations, Section 1956.2, for model years 2005 and 2006.

Adopt and amend § 86.1370-2007, Title 40, Code of Federal Regulations, to read:

§ 86.1370-2007 Not-To-Exceed (NTE) test procedures. October 6, 2000.

(a) General. The purpose of this test procedure is to measure in-use emissions of 2005 and subsequent model year heavy-duty diesel engines while operating within a broad range of speed and load points (the Not-To-Exceed Control Area) and under conditions which can reasonably be expected to be encountered in normal vehicle operation and use. Emission results from this test procedure are to be compared to the Not-To-Exceed Limits specified in paragraph (d)(1) of this section ~~§ 86.007-11(a)(4)~~.

(b) Not-to-exceed control area for ~~diesel~~ heavy-duty diesel engines. The Not-To-Exceed Control Area for ~~diesel~~ heavy-duty diesel engines consists of the following engine speed and load points:

(1) All operating speeds greater than the speed calculated using the following formula, where n_{hi} and n_{lo} are determined according to the provisions in § 86.1360-2007(c):

$n_{lo} + 0.15 \times (n_{hi} - n_{lo})$

(2) All engine load points greater than or equal to 30% or more of the maximum torque value produced by the engine.

(3) Notwithstanding the provisions of paragraphs (b)(1) and (b)(2) of this section, all operating speed and load points with brake specific fuel consumption (BSFC) values within 5% of the minimum BSFC value of the engine. For the purposes of this requirement, BFSC must be calculated under the general test cell conditions specified in § 86.1330-90. The manufacturer may petition the Executive Officer ~~Administrator~~ at certification to exclude such points if the manufacturer can demonstrate that the engine is not expected to operate at such points in normal vehicle operation and use. Engines equipped with drivelines with multi-speed manual transmissions or automatic transmissions with a finite number of gears are not subject to the requirements of this paragraph (b)(3).

(4) Notwithstanding the provisions of paragraphs (b)(1) through (b)(3) of this section, speed and load points below 30% of the maximum power value produced by the engine shall be excluded from the Not-To-Exceed Control Area for all emissions.

(5) For particulate matter only, speed and load points determined by one of the following methods, whichever is applicable, shall be excluded from the Not-To-Exceed Control Area. B and C engine speeds shall be determined according to the provisions of § 86.1360-2007(c):

(i) If the C speed is below 2400 rpm, the speed and load points to the right of or below the line formed by connecting the following two points:

(A) 30% of maximum torque or 30% of maximum power, whichever is greater, at the B speed;

(B) 70% of maximum power at 100% speed (n_{hi});

(ii) If the C speed is above 2400 rpm, the speed and load points to the right of the line formed by connecting the two points in paragraphs (b)(5)(ii)(A) and (B) of this section and below the line formed by connecting the two points in paragraphs (b)(5)(ii)(B) and (C) of this section:

(A) 30% of maximum torque or 30% of maximum power, whichever is greater, at the B speed;

(B) 50% of maximum power at 2400 rpm;

(C) 70% of maximum power at 100% speed (n_{hi}).

(6) For natural gas and other non-diesel fueled diesel cycle engines, the manufacturer may petition the Executive Officer ~~Administrator~~ at certification to exclude operating points from the Not-to-Exceed Control Area defined in ~~§ 86.1370~~ paragraph (b)(1) through (5) of this section if the manufacturer can demonstrate that the engine is not expected to operate at such points in normal vehicle operation and use.

(c) [Reserved]

(d) Not-to-exceed control area caps ~~limits~~. (1) When operated within the Not-To-Exceed Control Area defined in paragraph (b) of this section, diesel engine brake-specific exhaust emissions in grams/bhp-hr (as determined under paragraphs (b) and (c) of this section), for each regulated pollutant, shall not exceed 1.25 times the applicable emission standards ~~Not To Exceed Limits~~ specified in ~~§ 86.007-11(a)(4)~~ California Code of Regulations, Title 13, §1956.8 (a)(1) during engine and vehicle operation specified in paragraph (e)(1) of this section, except as noted in paragraph (e)(2) of this section, when averaged over any period of time greater than or equal to 30 seconds.

(2) [Reserved]

(3) For 2005 and subsequent model year heavy-duty engines, operation within the Not-to-Exceed control area (defined in paragraph (b) of this section) must also comply with the following:

(i) A filter smoke number of 1.0 under steady-state operation, or the following alternate opacity limits:

(A) A 30 second transient test average opacity limit of 4% for a 5 inch path; and

(B) A 10 second steady state test average opacity limit of 4% for a 5 inch path.

(ii) The limits set forth in paragraph (d)(3)(i) of this section refer to exhaust smoke emissions generated under the conditions set forth in paragraphs (b) and (e) of this section and calculated in accordance with the procedures set forth in §86.1372-2007.

(e) Ambient corrections. The measured data shall be corrected based on the ambient conditions under which it was taken, as specified in this section.

(1) For engines operating within the ambient conditions specified in paragraph (g)(1)(i) of this section ~~§86.007-11(a)(4)(ii)(a);~~

(i) NOx emissions shall be corrected for ambient air humidity to a standard humidity level of 50 grains (7.14 g/kg) if the humidity of the intake air was below 50 grains, or to 75 grains (10.71 g/kg) if above 75 grains.

(ii) NOx and PM emissions shall be corrected for ambient air temperature to a temperature of 55 degrees F (12.8 degrees C) for ambient air temperatures below 55 degrees F or to 95 degrees F (35.0 degrees C) if the ambient air temperature is above 95 degrees F.

(iii) No ambient air temperature or humidity correction factors shall be used within the ranges of 50-75 grains or 55-95 degrees F.

(iv) Where test conditions require such correction factors, the manufacturer must use good engineering judgement and generally accepted engineering practice to determine the appropriate correction factors, subject to ARB ~~EPA~~ review.

(2) For engines operating within the ambient conditions specified in paragraph (g)(1)(ii) of this section ~~§86.007-11(a)(4)(ii)(b);~~

(i) NOx emissions shall be corrected for ambient air humidity to a standard humidity level of 50 grains (7.14 g/kg) if the humidity of the intake air was below 50 grains, or to 75 grains (10.71 g/kg) if above 75 grains.

(ii) NOx and PM emissions shall be corrected for ambient air temperature to a temperature of 55 degrees F (12.8 degrees C) for ambient air temperatures below 55 degrees F.

(iii) No ambient air temperature or humidity correction factors shall be used within the ranges of 50-75 grains or for temperatures greater than or equal to 55 degrees F.

(iv) Where test conditions require such correction factors, the manufacturer must use good engineering judgement and generally accepted engineering practice to determine the appropriate correction factors, subject to ARB ~~EPA~~ review.

(f) DELETE ~~NTE cold temperature operating exclusion. Engines equipped with exhaust gas recirculation (EGR) whose operation within the NTE control area specified in §86.1370(b) when operating during cold temperature conditions as specified in paragraph (f)(1) of this section are not subject to the NTE emission limits during the specified cold temperature operation conditions.~~

~~(1) Cold temperature operation is defined as engine operating conditions meeting either of the following two criteria:~~

~~(i) Intake manifold temperature (IMT) less than or equal to the temperature defined by the following relationship between IMT and absolute intake manifold pressure (IMP) for the corresponding IMP.~~

~~$P = 0.0875 \times IMT - 7.75$ Equation (1)~~

~~Where;~~

~~P = absolute intake manifold pressure in bars~~
~~IMT = intake manifold temperature in degrees Fahrenheit~~

~~(ii) Engine coolant temperature (ECT) less than or equal to the temperature defined by the following relationship between ECT and absolute intake manifold pressure (IMP) for the corresponding IMP.~~

~~$P = 0.0778 \times ECT - 9.8889$ Equation (2)~~

~~Where;~~

~~P = absolute intake manifold pressure in bars~~
~~ECT = engine coolant temperature in degrees Fahrenheit~~

~~(2) [Reserved]~~

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(g) Ambient operating regions. For each engine family, the not-to-exceed emission limits must apply during one of the following two ambient operating regions;

(1) The not-to-exceed emission limits apply for all altitudes less than or equal to 5,500 feet above sea-level, during all ambient conditions (temperature and humidity). Temperature and humidity ranges for which correction factors are allowed are specified in paragraph (e) of this section; or

(2) The not-to-exceed emission limits apply at all altitudes less than or equal to 5,500 feet above sea-level, for temperatures less than or equal to the temperature determined by the following equation at the specified altitude;

$$T = -0.00254 \times A + 100$$

Where:

T = ambient air temperature in degrees Fahrenheit

A = altitude in feet above sea-level (A is negative for altitudes below sea-level)

Temperature and humidity ranges for which correction factors are allowed are specified in section (e).

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(h) In-Use Compliance. The procedures for in-use voluntary and influenced recall for heavy-duty diesel engines under this section are described in California Code of Regulations, title 13, sections 2111 through 2140, except as modified by this paragraph for 2005 and 2006 model year engines. In evaluating the scope of the affected population for the purposes of this section, there shall be a rebuttable presumption that the affected population is the engine family to which the tested engines belong. No engine may be used to establish the existence of an emissions exceedance if the engine or vehicle in which it was installed was subject to abuse or improper maintenance or operation, or if the engine was improperly installed, and such acts or omissions caused the exceedance.

(1) For the purposes of this section, an exceedance of the emission testing caps occurs when the average emissions of the test vehicles or engines, pursuant to California Code of Regulations, title 13, section 2139, for any pollutant exceed the emission threshold. For the purposes of this section, emission threshold is defined as:

(i) for a test using vehicle test equipment (e.g., an over-the-road mobile monitoring device such as "ROVER", or a chassis dynamometer), the applicable maximum NOx emissions limit plus the greater of 0.5 g/bhp-hr or one standard deviation of the data set established pursuant to paragraph (h)(2) of this section; or

(ii) for a test using an engine dynamometer, the applicable maximum NOx emissions limit plus 0.5 g/bph-hr.

(2) Where an engine dynamometer or vehicle test shows an apparent exceedance of the emissions threshold, the party conducting the original test shall repeat such test under the same conditions at least nine times. The mean of the tests shall be used for the averaging of the test vehicle emissions in determining compliance.

(3) If the average emissions of the test vehicles exceed the emissions threshold, the Executive Officer shall notify the manufacturer in writing of the test results. The manufacturer has the option to submit an influenced recall plan in accordance with California Code of Regulations, title 13, sections 2113 through 2121 within 45 days or to proceed with performing the engineering analysis and/or conducting further testing in accordance with paragraphs (h)(4) and/or (h)(5) of this section. Upon the completion of testing conducted in paragraph(s) (h)(4) and/or (h)(5), if the test results indicate that the average emissions of the test vehicles exceeds the emissions threshold, the Executive Officer shall notify the manufacturer in writing of the test results and upon receipt of the notification, the manufacturer shall have 45 days to submit an influenced recall plan in accordance with California Code of Regulations, title 13, sections 2113 through 2121.

(4) If the testing conducted under paragraph (h)(1) and California Code of Regulations, title 13, section 2139 was performed using vehicle test equipment, then the engine manufacturer may elect to conduct additional tests of that engine using an engine dynamometer, provided that all environmental and engine operating conditions present during vehicle testing under paragraph (h)(1) and California Code of Regulations, title 13, section 2139 can be reproduced or corrected consistent with paragraph (h)(6) of this section. If the engine manufacturer elects to conduct such additional engine dynamometer tests, it shall provide ARB with at least three business days notice prior to commencement of such testing. If based on such additional tests the engine exceeds the emission threshold, the engine manufacturer may conduct further testing in accordance with paragraph (h)(5) of this section and/or perform an engineering analysis to determine the percentage of the affected population that exceeds the emissions threshold and the emission levels of the exceeding engines. However, the manufacturer may not determine the percentage of the affected population or the emission levels solely on the basis of an engineering analysis unless it demonstrates to the Executive Officer's satifaction that such analysis alone is sufficient under the circumstances.

(5) Within 60 days of receiving notice of an exceedance under paragraph (h)(2) of this section, the manufacturer may commence testing of not less than ten additional in-service engines. The manufacturer may conduct these tests using vehicle testing equipment, or using an engine dynamometer, at the manufacturer's option.

(6) The testing of additional engines under paragraphs (h)(4) and (h)(5) of this section shall be conducted under conditions that are no less stringent than the initial test in terms of those parameters that may affect the result, and, at the manufacturer's option, may be limited to those emission limits and conditions for which apparent exceedances have been identified. Such parameters typically, but not necessarily, include relevant ambient conditions, operating conditions, service history, and age of the vehicle. Prior to conducting any testing, the

manufacturer shall submit a test plan to ARB for its review and approval. Within 30 days following ARB's proposed modifications, if any, the manufacturer shall incorporate the proposed modifications and implement the test plan as approved. Special conditioning of test engines shall not be permitted. Where the manufacturer elects to conduct the additional testing utilizing an engine dynamometer, it shall reproduce relevant engine operating and environmental conditions associated with the initial exceedance, provided, however, that correction factors may be used to reproduce temperature, humidity or altitude conditions that cannot be simulated in the laboratory. Regardless of the testing equipment utilized, the test results shall be adjusted to reflect documented test systems error and/or variability in accordance with good engineering practices.

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(i) Deficiencies for NTE emission standards. (1) For model years 2005 through 2007, upon application by the manufacturer, the Executive Officer may accept a HDDE as compliant with the NTE standards even though specific requirements are not fully met. Such compliances without meeting specific requirements, or deficiencies, will be granted only if compliance would be infeasible or unreasonable considering such factors as, but not limited to: technical feasibility of the given hardware and lead time and production cycles including phase-in or phase-out of engines or vehicle designs and programmed upgrades of computers. Deficiencies will be approved on a engine model and/or horsepower rating basis within an engine family, and each approval is applicable for a single model year. A manufacturer's application must include a description of the auxiliary emission control device(s) which will be used to maintain emissions to the lowest practical level, considering the deficiency being requested, if applicable. An application for a deficiency must be made during the certification process; no deficiency will be granted to retroactively cover engines already certified.

(2) Unmet requirements should not be carried over from the previous model year except where unreasonable hardware or software modifications would be necessary to correct the deficiency, and the manufacturer has demonstrated an acceptable level of effort toward compliance as determined by the Executive Officer. The NTE deficiency should only be seen as an allowance for minor deviations from the NTE requirements. The NTE deficiency provisions allow a manufacturer to apply for relief from the NTE emission requirements under limited conditions. ARB expects that manufacturers should have the necessary functioning emission control hardware in place to comply with the NTE.

INSERT

(j) Exemptions.

(1) The requirements set forth in this section do not apply to "ultra-small volume manufacturers" for model years 2005 and 2006. For the purposes of this section, an "ultra-small volume manufacturer" means any manufacturer with California sales less than or equal to 300 new passenger cars, light-duty trucks, medium-duty vehicles, heavy-duty vehicles, and heavy-duty engines per model year based on the average number of vehicles and engines sold by the manufacturer in the previous three consecutive model years.

(2) The requirements set forth in this section do not apply to "urban buses", as defined in Title 13, California Code of Regulations, Section 1956.2, for model years 2005 and 2006.

Adopt and amend § 86.1372-2007, Title 40, Code of Federal Regulations, to read:

§ 86.1372-2007 Measuring smoke emissions within the NTE zone. October 6, 2000.

This section contains the measurement techniques to be used for determining compliance with the filter smoke limit or opacity limits in §86.1370-2007 (d)(3)(i) ~~§ 86.007-11(b)(1)(iv)~~.

(a) For steady-state or transient smoke testing using full-flow opacimeters, equipment meeting the requirements of subpart I of this part or ISO/DIS-11614 "Reciprocating internal combustion compression-ignition engines--Apparatus for measurement of the opacity and for determination of the light absorption coefficient of exhaust gas" is required. This document is incorporated by reference ~~(see § 86.1)~~.

(1) All full-flow opacimeter measurements shall be reported as the equivalent percent opacity for a five inch effective optical path length using the Beer-Lambert relationship.

(2) Zero and full-scale (100 percent opacity) span shall be adjusted prior to testing.

(3) Post test zero and full scale span checks shall be performed. For valid tests, zero and span drift between the pre-test and post-test checks shall be less than two percent of full-scale.

(4) Opacimeter calibration and linearity checks shall be performed using manufacturer's recommendations or good engineering practice.

(b) For steady-state testing using a filter-type smokemeter, equipment meeting the requirements of ISO/FDIS-10054 "Internal combustion compression-ignition engines--Measurement apparatus for smoke from engines operating under steady-state conditions--Filter-type smokemeter" is recommended. Other equipment may be used provided it is approved in advance by the Executive Officer ~~Administrator~~.

(1) All filter-type smokemeter results shall be reported as a filter smoke number (FSN) that is similar to the Bosch smoke number (BSN) scale.

(2) Filter-type smokemeters shall be calibrated every 90 days using manufacturer's recommended practices or good engineering practice.

(c) For steady-state testing using a partial-flow opacimeter, equipment meeting the requirements of ISO-8178-3 and ISO/DIS-11614 is recommended. Other equipment may be used provided it is approved in advance by the Executive Officer ~~Administrator~~.

(1) All partial-flow opacimeter measurements shall be reported as the equivalent percent opacity for a five inch effective optical path length using the Beer-Lambert relationship.

(2) Zero and full scale (100 percent opacity) span shall be adjusted prior to testing.

(3) Post-test zero and full scale span checks shall be performed. For valid tests, zero and span drift between the pre-test and post-test checks shall be less than two percent of full scale.

(4) Opacimeter calibration and linearity checks shall be performed using manufacturer's recommendations or good engineering practice.

(d) Replicate smoke tests may be run to improve confidence in a single test or stabilization. If replicate tests are run, three additional tests which confirm to this section shall be run, and the final reported test results must be the average of all the valid tests.

(e) A minimum of thirty seconds sampling time shall be used for average transient smoke measurements. The opacity values used for this averaging must be collected at a minimum rate of 1 data point per second, and all data points used in the averaging must be equally spaced in time.