State of California
California Environmental Protection Agency

AIR RESOURCES BOARD

UPDATE TO THE STAFF'S PROPOSAL

Public Hearing to Consider Adoption of Amendments to the Certification Procedures for All On-Road Motor Vehicle Retrofits and to Consider Adoption of Optional Retrofit Emission Standards for Heavy-Duty Engines and Vehicles

Board Hearing: July 27, 1995

The purpose of this document is to inform interested parties of updates to the staff's proposal as presented in the staff report released June 9, 1995. There are three updates:

1) Propose that all vehicle classes be included in the alternate durability test plan.
2) Propose that kit manufacturers be allowed two years to validate deterioration factors under the alternate durability test plan.
3) Update the retrofit procedures with language allowing manufacturers to disable specific on-board diagnostic (OBD) monitoring strategies if justified. This language was approved by the Office of Administrative Law on June 8, 1995, and must be incorporated.

These updates apply to the "California Certification and Installation Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years", adopted March 11, 1993, and incorporated by reference in Title 13 California Code of Regulations (CCR) sections 2030 and 2031. These requirements are referred to herein as the "new retrofit procedures." The new retrofit procedures with proposed changes and updates are attached.

Background

On May 14, 1992, the ARB adopted amendments to the regulations regarding the certification and compliance procedures for motor vehicle retrofit systems. The amended regulations require manufacturers to demonstrate the durability of their systems over the useful life of each retrofitted vehicle for every engine family seeking certification. The new retrofit procedures require deterioration factors to be determined by either accumulating actual mileage on a durability vehicle of by bench aging retrofit system components. Currently, durability testing under the new procedures is done prior to certification.

Light- and medium-duty vehicles currently have OBD devices which monitor emissions-related operations and equipment. Retrofit kit manufacturers must design their systems to work with the OBD system, to maintain the integrity of the emissions monitoring systems, and ensure that differences in operation due to the vehicle retrofit do not cause the OBD system to log errors. Beginning with the 1996 model year, more sophisticated monitoring systems, known as OBDII, are required.

Changes to the New Procedures Proposed in the Staff Report

On June 9, 1995, the ARB released a staff report presenting proposed changes to the retrofit certification procedures. The proposed changes will be presented at the Board hearing today. The staff report proposes the use of an alternate test plan for heavy-duty vehicles and those medium-duty vehicles originally certified on an engine dynamometer. This alternate test plan would allow manufacturers to derive an appropriate deterioration factor (DF), certify the retrofit kit, and then complete durability testing to validate the derived DFs. Durability testing could be completed on an in-use vehicle, with a test vehicle on a test track, or through bench aging. If durability testing shows that deterioration is greater than expected based on the derived DFs, the manufacturers would be subject to recall of the retrofit kits.

Updates to the Staff Proposal

1) Propose that all vehicle classes be included in the alternate durability test plan.

   At a meeting with light- and medium-duty retrofit kit manufacturers on May 30, 1994, the ARB staff agreed to expand the proposed alternate test plan to include all light- and medium-duty vehicles. As the staff report was already final at that time, the ARB staff were unable to incorporate the proposal to allow the alternate test plan for all light- and medium-duty vehicles. The staff proposal presented at the Board hearing today will include an allowance for an alternate test plan for all classes of vehicle retrofits.

2) Propose that kit manufacturers be allowed two years to validate deterioration factors under the alternate durability test plan.

   The staff report proposed that manufacturers submit a test plan describing the procedures that will be used to validate the derived deterioration factors within two years. The new proposed language states explicitly that the manufacturer must submit test data to verify the derived deterioration factors within two years of certification of the retrofit system.

3) Update the retrofit procedures with language allowing manufacturers to disable specific on-board diagnostic (OBD) monitoring strategies if justified. This language was approved by the Office of Administrative Law on June 8, 1995, and must be incorporated.

Retrofit kit manufacturers are very concerned that designing kits around the new OBDII systems will be difficult, and could adversely affect their businesses. On December 8, 1994, the Board approved language allowing manufacturers to submit a request that would allow them to disable specific OBD strategies. They would need to submit test data and/or an engineering evaluation justifying their request. The allowance would be valid for kits up to and including the 1998 model year. This OBD allowance language was approved by the Office of Administrative Law on June 8, 1994, and is hereby incorporated.

PROPOSED

State of California
AIR RESOURCES BOARD

CALIFORNIA CERTIFICATION AND INSTALLATION PROCEDURES FOR ALTERNATIVE FUEL RETROFIT SYSTEMS FOR MOTOR VEHICLES CERTIFIED FOR 1994 AND SUBSEQUENT MODEL YEARS AND FOR ALL MODEL YEAR MOTOR VEHICLE RETROFIT SYSTEMS CERTIFIED FOR EMISSION REDUCTION CREDIT

Note: Changes proposed in the staff report are indicated by strike-out (deletion) and underline (addition). Changes proposed since the staff report are shown in bold strikeout and bold underline. A change related to on-board diagnostics (OBD) is shown in italics, and is incorporated into the regulation. The OBD change is not under consideration today, as it was already adopted by the Board, and was recently approved by the Office of Administrative Law.

Adopted March 11, 1993
Amended: June 8, 1995
Amended: xxxxxxx

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California Certification and Installation Procedures
for Alternative Fuel Retrofit Systems for Motor Vehicles
Certified for 1994 and Subsequent Model Years
and for all Model Year Motor Vehicle Retrofit Systems
Certified for Emission Reduction Credit

1. APPLICABILITY

(a) "Certification and Installation Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years and Retrofit Procedures for Emission Reduction Credit for all Model Years" ("these Procedures") apply to alternative fuel retrofit systems designed for installation on gasoline- or diesel-fueled light-, medium-, and heavy-duty motor vehicles for 1994 and subsequent model years, and alternative fuel and conventional fuel retrofit systems for emission reduction credits for all model years.

(b) Only these procedures shall be used to certify a retrofit system for the purpose of generating emission reduction credits. Each retrofit system manufacturer shall certify all engine family systems to be used for generating emission reduction credits regardless of model year (MY) or fuel used.

(c) Only these Procedures shall be used to certify a retrofit system for installation on a transitional low-emission vehicle ("TLEV"), low-emission vehicle ("LEV"), or ultra-low-emission vehicle ("ULEV") or to certify a retrofit system designed to convert a vehicle to TLEV, LEV, or ULEV emission standards (as defined in Section 1960.1, Title 13, CCR).

(d) Each manufacturer shall certify a minimum of 15 percent of 1994, 55 percent of 1995, 55 percent of 1996, and 100 percent of 19967 and subsequent model year engine family retrofit systems according to the requirements of these Procedures except as provided in paragraph 1.(b). "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels," (for certifying liquefied petroleum gas or natural gas retrofit systems) and "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels" (for certifying alcohol and alcohol/gasoline retrofit systems) shall be used to certify the remaining percentage of 1994, 1995, and 19956 model year engine family systems and 1993 and prior model year engine family systems, except as provided in paragraph 1.(b) and 1.(e) The percentages shall be determined from the total number of retrofit systems certified and shall be met prior to the end of the next respective calendar year.

~~(b)~~
(e) A retrofit system manufacturer may as an option use these Procedures to certify non-credit generating alternative fuel retrofit systems designed for installation on pre-1994 model year gasoline- or diesel-fueled light-, medium-, and heavy-duty motor vehicles, with the following addition: the Executive Officer may order 25,000 mile durability vehicle testing for alternative fuel retrofit systems designed for installation on pre-1994 model year vehicles which include hardware or components other than the fuel conversion system as part of the overall retrofit system.

~~(c)~~
(f) A certification for an alternative fuel retrofit system issued pursuant to these Procedures shall have the effect of a certification of an alternative fuel retrofit system pursuant to Health and Safety Code Section 43006~~,~~. A certification for retrofit equipment utilizing any fuel, issued pursuant to these regulations, and~~shall also~~have the effect of an exemption issued pursuant to Vehicle Code Sections #27156 and 38395.

2. DEFINITIONS

"Alternative fuel" refers to liquefied petroleum gas, natural gas, alcohol and alcohol/gasoline fuels.

An "alternative fuel retrofit system" ~~or "retrofit system"~~is a package of fuel, ignition, emission control, and engine components that are modified, removed, or added during the process of modifying a motor vehicle to operate on an alternative fuel. Such systems can be optionally certified to generate credits.

"Conventional fuel" means gasoline or diesel fuel.

"Credit-generating conventional fuel retrofit system" is a retrofit system that is certified to generate credits and that operates exclusively on the fuel for which the engine family was originally certified.

"Credits" refers to mobile source emission reduction credits.

"Driveability" of a vehicle refers to the smooth delivery of power, as demanded by the driver. Typical causes of driveability degradation are rough idling, misfiring, surging, hesitation, or insufficient power. Conversion from gasoline to gaseous fuels usually entails a loss of volumetric efficiency, resulting in some power loss. Normal power loss shall not be considered to be driveability degradation.

"Dual fuel" refers to a retrofit system which utilizes both an alternative fuel and a conventional fuel without further hardware changeover required.

"Installer" refers to a person who installs alternative fuel or credit-generating conventional fuel retrofit systems on motor vehicles.

"Retrofit system" is a package of fuel, ignition, emission control, and engine components that are modified, removed, or added during the process of modifying an engine to operate at an emission rate lower than the rate to which the engine family was originally certified.

"Retrofit system manufacturer" or "manufacturer" refers to a person who manufactures or assembles an alternative fuel or credit-generating conventional fuel retrofit system for sale in California and requests or is granted the Executive Order certifying the alternative fuel or credit-generating conventional fuel retrofit system.

"Tier 1" refers to the emission standards applicable to 1995 and subsequent model year light-duty vehicles, not considered as TLEV's, ULEV'S or LEV'S, and as described in Section 1960.1, Title 13, California Code of Regulations.

For purposes of these Procedures "useful life" is the duration, expressed in miles, of the longest durability period for the new vehicle or engine emission standards to which the vehicle or engine family was certified. (This is typically 50,000 miles for light-duty vehicles. However, as of the 1993 model year, a phase-in of new, more stringent, light-duty standards with 100,000 mile useful life requirements will begin.)

3. GENERAL REQUIREMENTS

(a) Product Specifications:

In addition to all other standards or requirements imposed, the following general requirements shall apply to all alternative fuel or credit-generating conventional fuel retrofit systems to be certified for installation on California-certified gasoline or diesel-fueled motor vehicles:

(i) Alternative fuel retrofit systems for gaseous fuels shall be equipped with a lockoff valve, actuated by an electrical or vacuum signal, preventing delivery of fuel to the carburetor, or fuel injection system, while the engine is shut down.

(ii) The driveability of a vehicle equipped with a retrofit system shall not be degraded in such a way as to encourage consumer tampering. To verify that the driveability of a retrofitted vehicle is acceptable, the Executive Officer may require that an independent laboratory evaluate driveability. The Executive Officer's determination that driveability must be evaluated shall be based on an engineering evaluation of the retrofit system described in the application for certification or on reports or observations that retrofit systems similar in design to the system for which certification is sought have caused driveability degradation. The cost of this evaluation shall be borne by the applicant.

(iii) If the vehicle to be retrofitted was certified with an on-board diagnostic (OBD) system pursuant to Section 1968 or 1968.1, Title 13, California Code of Regulations (CCR), the proper

function of the on-board diagnostic system shall not be impaired as a result of the installation and operation of the alternative fuel or credit-generating conventional fuel retrofit system. This requirement may necessitate modification of the OBD system to prevent it from storing erroneous trouble codes (e.g., storing a code signifying faulty operation of the evaporative canister purge valve because the evaporative emission control system has been removed). All modifications to OBD components, programming or wiring, must be fully specified as parts of the retrofit system. If the retrofit system includes modifications to the OBD system, the applicant must submit an analysis showing that these modifications will not adversely affect OBD performance. *Notwithstanding, for 1998 and previous model year vehicles, retrofit system manufacturers may request Executive Officer aproval to disable specific on-board diagnostic monitoring strategies for which monitoring may not be reliable with respect to the use of alternative fuels (e.g., oxygen sensor response rate checks). The manufacturer shall submit data and/or an engineering evaluation to justify the request.*

(iv) With the exception of idle speed control and throttle position control, no component or calibration of the fuel system that could affect emission performance shall be adjustable by the system installer or the vehicle's user.

(b) Emission Control Labels:

"California Motor Vehicle Emission Control Label Specifications," incorporated by reference in Title 13, CCR, Section 1965, shall apply to installations of alternative fuel or credit-generating conventional fuel retrofit systems, with the following additions:

(i) The retrofit system manufacturer shall provide a supplemental Emission Control Information label, which shall be affixed in a permanent manner to each retrofitted vehicle, in a location adjacent to the original Emission Control Information Label. If the supplemental label cannot be placed adjacent to the original label, it shall be placed in a location where it can be seen by a person viewing the original label.

(ii) The supplemental label ~~shall clearly state that the vehicle has been equipped with an alternative fuel retrofit system designed to allow it to operate on a fuel other than gasoline or diesel, and shall identify the fuel(s) which the vehicle is designed to use. The label~~ shall show the vehicle model year; the Executive Order number certifying the retrofit system; the retrofit system manufacturer's name, address, and telephone number; and shall state that the retrofitted vehicle complies with California emission requirements. If the retrofit system has been certified as being capable of converting the vehicle into a Tier 1, TLEV, LEV, or ULEV, the label shall prominently display the title, "Tier 1 Vehicle," "Transitional Low-Emission Vehicle," "Low-Emission Vehicle," or "Ultra-Low-Emission Vehicle," as appropriate. If the retrofit system has been certified for credit-generation use on a heavy-duty vehicle, the label will

state the applicable credit standards, as defined in Section 1956.9, Title 13, California Code of Regulations. The label shall also list any original parts that were removed during installation of the retrofit system, as well as any changes in tune-up specifications required for the retrofit system. In addition, the label shall show the installer's name, address, and telephone number; the date on which the retrofit system was installed; and the mileage (retrofitted vehicle odometer reading) and date at which the retrofit system warranty expires. It is not necessary for emission control labels installed with retrofit systems to be machine readable. The supplemental label for an alternative fuel retrofit vehicle shall clearly state that the vehicle has been equipped with an alternative fuel retrofit system designed to allow it to operate on a fuel other than gasoline or diesel, and shall identify the fuel(s) that the vehicle is designed to use.

(iii) The retrofit system manufacturer shall provide a vacuum hose routing diagram for each alternative fuel retrofit system sold, and for any other retrofit that includes changes to the vacuum hose routing. The vacuum hose routing diagram shall be placed underhood in a permanent manner at a visible and accessible location and shall show modifications to the original vacuum system.

(c) Owner's Manuals:

Each retrofit system installed shall include an owner's manual containing at least the following information:

(i) a brief description of the retrofit system, including major components and their theory of operation;

(ii) the correct refueling procedure for alternative fuel retrofits;

(iii) a listing of necessary service and service intervals, as well as tune-up data, which differ from the service requirements specified by the vehicle's or engine's original manufacturer;

(iv) the name, address, and phone number of the installer, as well as a list of the names, addresses, and phone numbers of the major dealers in California who supply parts for, or service, the retrofit system; and

(v) warranty information.

(d) Manufacturer Recordkeeping Requirement:

Manufacturers of retrofit systems shall maintain a record of the vehicle identification numbers and California license plate numbers of those vehicles on which their product has been installed. As part of this record, manufacturers shall identify the installation date and the certification number of those systems installed on each vehicle and shall identify the vehicles' owners at the time of installation, including the owners' current addresses and phone numbers at the time of installation. The retrofit system

manufacturer shall supply a copy of all installation information to the Executive Officer upon request.

(e) Installer Recordkeeping Requirement:

Installers of retrofit systems shall maintain a record as specified in paragraph 3(d) and shall provide this information to retrofit system manufacturers upon request.

4. REQUEST FOR CERTIFICATION

(a) A request for certification of an alternative fuel or credit-generating conventional fuel retrofit system may be submitted by an authorized representative of the retrofit system manufacturer intending to offer the retrofit system for sale or installation in the State of California.

(b) A separate request shall be required for each model year, even though the emission standards for certifying new vehicles may be the same for consecutive model years. The request shall include all test data and other information required pursuant to these Procedures, except where other provisions of these Procedures allow carry-over or carry-across of test data from an engine family to the engine family(ies) for which certification is sought. Procedures governing carry-over and carry-across are discussed under paragraph 6, "Approval."

(c) The request for certification shall be submitted in writing, signed by an authorized representative of the retrofit system manufacturer, and shall include the following:

(i) Identification and description of the engine families for which the retrofit system to be certified is designed; the emission standards applicable to those engine families; and if applicable, a statement that the retrofit system is designed [A] to convert conventional vehicles into either TLEVs, LEVs or ULEVs, [B] to convert a TLEV into either an LEV or ULEV, or [C] to convert an LEV into a ULEV, [D] to convert 1994 or earlier model year vehicles into Tier 1 Vehicles, or [E] to convert heavy-duty vehicles for emission reduction credit. For [E] include the credit standard(s) proposed for certification from the "Optional Exhaust Emission Standards for Retrofitted Heavy-Duty Engines", as contained in Section 1956.9, Title 13, California Code of Regulations.

(ii) A complete description of the alternative fuel retrofit system, including details of the carburetor, mixer, regulator, vaporizer, or fuel injection system; the feedback mixture control system (if applicable), part number(s), calibration data, hose routing, specifications for the fuel tank, and pressure regulator; a sample of the emission control label as specified in 3.(b); a sample of the warranty statement as specified in 9(a) and (b); and all necessary modifications to the engine, emission control system, or other parts of the vehicle.

(iii) Procedures for installing and maintaining the retrofit system, including tune-up specifications and discussion of any special tools or techniques required for proper installation, maintenance, or operation.

(iv) An agreement to supply the Air Resources Board, within 45 calendar days of the Executive Officer's request, with any one or more of the vehicles used for certification testing, or to provide Air Resources Board personnel with the equipment to inspect and test such vehicles at the applicant's facility, if requested by the Executive Officer.

(v) For retrofit systems being certified for credit-generation, the manufacturer shall provide, in writing, the name(s) and address(es) of the fabrication, assembly line(s), and test facility(ies) where the retrofit kit is manufactured and tested.

(vi) For retrofit systems being certified for credit-generation, the manufacturer shall provide an engineering analysis upon request from the Executive Officer. Such analysis shall describe the detailed operating theory of the retrofit system based on accepted scientific and engineering principles. Final certification will require ARB acceptance and approval of the analysis.

(vii) For conventional fuel retrofits for credit-generation, the manufacturer shall provide a complete description of the major components of the retrofit system and part number(s).

5. TEST PROCEDURES

(a) Description of Vehicle Categories:

For the purposes of these certification Procedures, the motor vehicle fleet is divided into three major categories:

I. Passenger cars, light-duty trucks, and medium-duty vehicles as defined in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" (as incorporated by reference in Section 1960.1, Title 13, CCR), which were certified to an exhaust emission standard based on a chassis-dynamometer test procedure;

II. Vehicles with gross vehicle weight ratings less than or equal to 14,000 lbs and not originally certified to a chassis dynamometer-based exhaust emission standard; and

III. Vehicles with gross vehicle weight ratings greater than 14,000 lbs.

(b) Test Procedures for Vehicles in Category I:

Vehicles in Category I may certify under these provisions, or under the alternate test procedures given in 5(g).

For vehicles in Category I, the emission standards and test procedures set forth in the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" also apply to the certification of alternative fuel or credit-generating conventional fuel retrofit systems, with the following exceptions:

(i) The applicable emission standards shall be at least as stringent as the emission standards applicable to the engine families for which the retrofit systems to be certified are designed. For credit-generation, the applicable emission standards shall be the Tier 1 and LEV program standards. Dual-fuel vehicles must be certified on each of the two fuels. For dual-fuel vehicles certified for credit, the certification standards for the two fuels shall be no more than one tier apart. In addition, vehicles retrofitted to operate on a given alternative fuel shall also be subject to any additional emission standards applicable to new motor vehicles that are designed to operate on the alternative fuel, and that are of the model year and vehicle class for which certification is sought. A maximum of one emission-data vehicle per engine family for which certification is sought shall be required. Where durability testing is required, a bench-test vehicle may be substituted for a durability vehicle and may also be considered an emission-data vehicle. Prior to the commencement of testing, the choice of durability vehicle or bench-test vehicle, emission-data vehicle(s) and engine(s) must be approved by the Executive Officer as being representative of the range of engine families for which certification is sought.

(ii) For the purpose of applying the provisions of the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" to certification testing of alternative fuel or credit-generating conventional fuel retrofit systems, test vehicles equipped with an alternative fuel or credit-generating conventional fuel retrofit system shall be assumed to have zero miles of mileage accumulation at the time that the retrofit system is installed. Mileage may be subsequently accumulated by driving the vehicle on the road, following a typical suburban route, or on a chassis dynamometer using the Automobile Manufacturer's Association mileage accumulation cycle (40 C.F.R., Part 86, Appendix IV, as adopted January 28, 1977).

(iii) Vehicle mileage accumulation on a durability vehicle or bench aging of retrofit system components shall be conducted to determine deterioration factors. Prior to the commencement of any emission or bench aging, the applicant's test plan must be approved by the Executive Officer. Approval of the test plan shall be contingent upon a demonstration by the applicant that bench aging produces deterioration factors at least as great as durability vehicle testing.

(iv) Bench aging conducted in lieu of vehicle mileage accumulation shall be conducted for a period of time such that the resulting

deterioration of the retrofit system is equivalent to that which would occur during durability vehicle mileage accumulation over a mileage equal to the useful life of the vehicle.

(v) Vehicle mileage accumulation on a durability vehicle shall be performed in conjunction with emission testing. Before beginning vehicle mileage accumulation of the retrofit system, the system shall be installed on the durability vehicle, the vehicle shall be driven 4,000 + 100 miles and then tested. An alternative fuel retrofit the vehicle shall be tested using the alternative fuel. A dual-fuel retrofit system shall be emission tested using each fuel that it is capable of operating on. At the conclusion of vehicle mileage accumulation, a second emission test or series of tests shall be performed.

Alternatively, if bench aging is used to determine deterioration factors, then bench aging shall be performed in conjunction with emission testing of a bench-test vehicle. Before beginning bench aging of the retrofit system, it shall be installed on the bench-test vehicle, the vehicle shall be driven for 4,000 + 100 miles, and the vehicle shall then be emission tested. Alternative fuel retrofits shall be tested using the alternative fuel. A dual-fuel retrofit system shall be emission tested using each fuel that it is capable of operating on. After the emission tests are completed, the retrofit system shall be removed from the vehicle and subjected to bench aging. At the conclusion of bench aging, the retrofit system shall be reinstalled on the bench-test vehicle, and a second emission test or series of tests shall be performed.

(vi) For exhaust emissions of each regulated pollutant measured during the vehicle mileage accumulation or bench-test procedure, a deterioration factor shall be calculated by dividing the emission rate obtained during the second emission test by that obtained during the first. If the resulting quotient is less than one, the deterioration factor shall be assigned a value of one. The deterioration constant for evaporative emissions shall be calculated by subtracting the evaporative emissions found during the first emission test from those found during the second test. If the resulting difference is less than zero, the deterioration constant shall be assigned a value of zero.

(vii) Choices of vehicle models, engines, and transmissions for use in emission-data vehicles shall be approved by the Executive Officer as being representative of the engine families for which certification is sought, prior to the commencement of testing. Following installation of the retrofit system, the emission-data vehicle shall be driven 4,000 + 100 miles to stabilize emission rates. After the specified mileage has been accumulated, the emission-data vehicles' exhaust and evaporative emissions, where applicable, shall be tested, using the appropriate procedure as set forth in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty

Vehicles." Dual fuel vehicles shall be emission tested using each fuel that the vehicle is capable of operating on.

(viii) The deteriorated emissions of emission-data vehicles shall be calculated using the deterioration factors and constants found during vehicle mileage accumulation or bench testing. The useful life exhaust emission values are defined as the product of each emission value at 4,000 miles times the corresponding deterioration factor. For evaporative emissions, the certification emission value is equal to the sum of the emissions measured at, or extrapolated to 4,000 miles, plus the deterioration constant. The durability vehicle, bench-test vehicle, and all emission-data vehicles shall meet the applicable new vehicle useful life emission standards, as well as all applicable emission standards for intermediate mileage levels, for the vehicles' model year and fuel type(s).

(c) Test Procedures for Vehicles in Category II Not Being Certified for Credit-Generation Purposes:

Vehicles in Category II not being certified for credit may certify under these provisions, or under the alternate test procedures given in 5(g).

For durability, bench-test and emission-data vehicles in Category II, test vehicles shall have accumulated a total mileage greater than 4,000 miles and less than 10,000 miles with the original fuel system, prior to emission testing. If the manufacturer chooses to use the option as described in 1~~(b)~~ (e) for pre-1994 model year vehicles, then the 10,000 mile limit shall not be applicable. A test vehicle's engine and emission control system shall be equipped and calibrated as certified. The vehicle shall then be tested for exhaust and, if applicable, evaporative emissions using the test procedures set forth in the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles". The inertia weight setting shall be equal to the average of the vehicle's curb weight and gross vehicle weight rating and road load horsepower based on the frontal area of the vehicle without modifications, as determined in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," Section 9.b. The test results shall be defined as the baseline emission rates. After the baseline emission rates have been measured, the retrofit system shall be installed.

(i) The procedures outlined in paragraphs 5(b)(iii) through 5(b)(vi) shall be used with the following modifications: "useful life" shall equal 120,000 miles for vehicles in Category II; the durability or bench-test vehicle's emission rates of regulated pollutants measured at 4,000 ± 100 miles after the installation of the retrofit system shall not exceed 1.10 times the baseline rates; the deteriorated exhaust emissions of regulated pollutants projected to 120,000 miles shall not exceed 1.3 times the baseline emissions; and the deteriorated evaporative emissions of regulated pollutants

projected to 120,000 miles shall not exceed the baseline emissions plus 0.5 grams.

(ii) When the Executive Officer determines that deterioration factors determined in paragraph 5(c)(i) may be carried across or carried over to other engine families in Category II, the representative emission-data vehicles shall be tested as specified in paragraph 5(b)(vii). Emission rates measured at 4,000 ± 100 miles after installation of the retrofit system shall not exceed 1.10 times the vehicles' baseline rates.

(d) Test Procedures for Vehicles in Category III Not Being Certified for Credit-Generation Purposes:

Vehicles in Category III not being certified for credit may certify under these provisions, or under the alternate test procedures given in 5(g).

Applicants requesting certification for retrofit systems for use in Category III vehicles shall submit a test plan ~~utilizing eight mode chassis dynamometer testing,~~ subject to the Executive Officer's approval, to verify that the retrofit system will not cause excess emissions from engine families for which certification is sought. Test vehicles shall have accumulated a total mileage greater than 4,000 miles ~~and less than 10,000 miles~~ with the original fuel system prior to emission testing. ~~If the manufacturer chooses to use the option as described in 1(b) for pre-1994 model year vehicles, then the 10,000 mile limit shall not be applicable.~~ A test vehicle's engine and emission control system shall be equipped and calibrated as certified. The vehicle shall then be tested for exhaust emissions ~~using the eight mode chassis dynamometer test~~ as specified in the test plan. The test result shall be defined as the baseline emission rate. After the baseline emission rate has been measured, the retrofit system shall be installed. Emission rates shall then be measured at 4,000 ± 100 miles after installation of the retrofit system ~~using the eight mode chassis dynamometer~~ test specified in the test plan.

~~(i) Subject to the Executive Officer's approval of the applicant's test plan prior to commencing testing, testing utilizing procedures other than the eight mode chassis dynamometer test shall be allowed.~~

(ii) Emission testing shall be conducted to determine exhaust emission rates of carbon monoxide and the sum of non-methane hydrocarbons plus nitrogen oxides. Emissions shall not exceed 1.10 times the baseline rates.

(iii) The procedures outlined in paragraphs 5(b)(iii) through 5(b)(vi) shall be used with the following modifications: "useful life" shall equal 180,000 miles for vehicles in Category III; the durability or bench-test vehicle's emission rates of CO, and the sum of non-methane hydrocarbons plus NOx measured at 4,000 ± 100 miles shall not exceed 1.10 times the baseline rates; the deteriorated exhaust emissions projected to 180,000 miles shall not exceed 1.3 times the baseline

emissions; and, the deteriorated evaporative emissions projected to 180,000 miles shall not exceed baseline emissions plus 0.5 grams. For the purposes of this section, the evaporative baseline emissions shall be estimated by the manufacturer based on good engineering principles and judgment. The manufacturer's test plan shall specify the evaporative baseline emissions estimate and describe how this estimate was derived.

(~~iv~~iii) The Executive Officer may allow carry-across of durability data from certification bench testing of retrofit systems designed for vehicles in Categories I or II to Category III retrofit system applications, if the Executive Officer determines that the carry-across durability data will adequately represent the durability performance of the retrofit system to be certified.

(iv) Applicants requesting certification for retrofit systems designed to allow Category III vehicles to operate on an alternative fuel in addition to diesel fuel shall conduct smoke opacity testing on the emission-data vehicle(s) utilizing the peak smoke opacity standards and procedures set forth in "Heavy-Duty Diesel Vehicle Smoke Opacity Test Procedure," as incorporated by reference in Title 13, CCR, Section 2182. Smoke opacity testing shall be conducted using each fuel that the retrofitted vehicle is designed to operate on. The applicable peak smoke opacity standard shall be that set for the model year for which certification is sought.

(v~~i~~) The selection of duty cycle(s) and all other aspects of the test procedure shall be subject to approval by the Executive Officer, and emission testing shall commence only after the Executive Officer has approved the test plan. The Executive Order shall be issued following review of the test data and determination that they meet the criteria specified in the test plan.

(e) Test Procedures for Vehicles in Category II Certified for Emission Reduction Credit

Vehicles in Category II certified for emission reduction credit may use these provisions, or the alternate test plan as given in 5(h).

The procedures outlined in paragraphs 5(c)(i) and (ii) shall be used with the following modifications:

(i) Certification for credit-generation purposes shall be conducted on the retrofitted engine system, utilizing an engine dynamometer, and not on the engine and vehicle combination. The test procedure used shall be the same procedure used to certify the engine family when new.

(ii) Emissions for any pollutant shall not exceed the baseline rate by more than a factor of 1.10. Baseline emissions for pre- and post-retrofit comparison purposes will be the certification emission levels determined during the original engine family certification, except:

[A] The baseline for particulate matter (PM) emissions for diesel engines whose PM emission levels were not determined during the new engine family certification process shall be 0.6 gram/bhp-hr.

[B] Formaldehyde emissions from any 1993 and earlier model year engine operating on methanol- or ethanol-based fuel shall be at or below the 1993 model year standard. Formaldehyde emissions from any 1994 or subsequent model year engine operating on methanol- or ethanol-based fuel shall be at or below the formaldehyde standard for that model year.

[C] For diesel engines, baseline carbon monoxide and hydrocarbon emissions shall be the original emission certification value for the engine's model year.

[D] For engine families originally certified to a combined HC plus NOx standard, the baseline HC and NOx standards will be the combined standard pro-rated by the HC and NOx portions, respectively, of the original emission certification levels. If the original emission certification levels are not available, the HC and NOx baseline standards will be pro-rated by the HC and NOx certification standards of the next later model year with separate HC and NOx standards.

(iii) The "useful life" shall be 120,000 miles for vehicles in Category II, and 180,000 miles for vehicles in Category III. Deteriorated exhaust emissions projected to the useful life shall not exceed the baseline rate by more than a factor of 1.30, except for the pollutant(s) for which credits will be generated, which will not exceed the credit standard declared on the certification application as required under 4(c)(i). The deteriorated evaporative emissions, if any, projected to the useful life shall not exceed baseline emissions.

(f) Test Procedures for Vehicles in Category III Certified for Emission Reduction Credit

Vehicles in Category III certified for emission reduction credit may use these provisions, or the alternate test plan as given in 5(h).

The procedures outlined in paragraphs 5(d)(i) through (v) shall be used with the modifications listed in 5(e)(i) through 5(e)(iii).

(g) Alternate Test Procedure for Vehicles in Category I, or for Vehicles in Categories II, or ~~Category~~ III Not Being Certified for Credit Generation Purposes

The manufacturer shall submit data from durability testing conducted using the test procedures used in ~~the~~ new vehicle or engine certification. The deteriorated useful life emission levels shall meet the applicable emission standards for vehicles or engines of that model year and fuel type. The Executive Officer may certify the retrofit system based on review of the durability

test data. If durability test data are not available, the manufacturer shall use the following procedures:

(i) The retrofit manufacturer shall submit derived deterioration factors, ~~and~~ **The manufacturer shall submit** test data that shows similar performance characteristics between the retrofitted **vehicle or** engine and the original equipment manufacturer **vehicle or** engine. The manufacturer shall submit test data showing component durability of the retrofit system. The manufacturer shall also submit a test plan describing the procedures that will be used to validate the derived deterioration factors within two years. The manufacturer derived deterioration factors and the test plan must be reviewed and approved by the Executive Officer.

(ii) The retrofit system shall be installed on the test **vehicle or** engine. Certification shall be conducted on the retrofitted **vehicle or** engine ~~system~~, using the same test procedure used to certify the engine family when new. Deteriorated useful life emissions based on manufacturer derived deterioration factors shall meet the applicable new engine emission standards.

(iii) Following retrofit system certification, the manufacturer will conduct engine aging, either in-use or on ~~an engine~~ dynamometer, according to the specified test plan. Emissions testing shall be conducted on the aged retrofit **vehicle or** engine system using the same test procedure used to certify the engine family when new. Deteriorated useful life emissions based on durability testing shall meet the applicable new **vehicle or** engine emission standards for that vehicle model. **The manufacturer shall submit test data to verify the derived deterioration factors within two years of certification of the retrofit system.**

(iv) Vehicles in Category III must meet the requirements of 5(d)(iii) and 5(d)(iv).

(h) Alternate Test Procedure for Vehicles in Category II or Category III Certified for Credit Generation Purposes

The procedures outlined in 5(g) shall be used, with the following modifications:

(i) The manufacturer shall also meet the requirements in 5(e)(i) and 5(e)(ii).

(ii) Deteriorated useful life emissions based on durability testing shall not exceed the original equipment manufacturer engine certification emissions level by more than a factor of 1.30, except for the pollutant(s) for which credits will be generated, which will not exceed the credit standard declared on the certification application

as required under 4(c)(i). The deteriorated evaporative emissions, if any, projected to the useful life, shall not exceed baseline emissions.

6. APPROVAL

(a) Issuance of Executive Orders:

If, after reviewing the test data and other information submitted by the retrofit system manufacturer, the Executive Officer determines that the retrofit system meets the applicable emission standards or the criteria of an approved test plan, as applicable, an Executive Order shall be issued certifying the retrofit system for sale and installation on vehicles in the engine families specified in the application. The Executive Order shall specify, if applicable, that the retrofit system is certified as [A] converting a conventional motor vehicle into a TLEV, LEV or ULEV, [B] converting a TLEV into a LEV or ULEV, ~~or~~[C] converting a LEV into a ULEV or [D] for heavy-duty credit conversions, the applicable credit standard(s).

(b) Carry-Over and Carry-Across:

(i) Carry-over of emission test data from the previous model year to the following model year will be allowed, if the Executive Officer determines that the carry-over data will adequately represent the emissions performance of the retrofit system to be certified.Carry-across to similar engine families will also be allowed.

(ii) An original equipment manufacturer (OEM) that produces retrofit hardware which upgrades an old engine to the identical configuration of a newer engine family that the manufacturer also produces, may carry-across the newer engine family certification test data for the retrofit hardware certification process. (For these purposes, the term "identical" means that all engine parts on the retrofitted engine which affect emissions, such as pistons, cylinder heads, etc., must be of the same design and construction as those on the newer engine family. Engine calibration, including injection timing must also be identical.)

(iii) Applications for carry-over and carry-across must be accompanied by an engineering analysis demonstrating that the emissions and durability of the retrofit system and engine family for which certification is being sought will be adequately represented by a certified retrofit system/engine family application.

(iv) Applications for carry-over and carry-across will be evaluated according to the the criteria contained in EPA Advisory Circular 17F, which is incorporated herein by reference, and paragraph 4.~~b~~.4 c.5 of the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and

Medium-Duty Vehicles." These include, but are not limited to, similarity of catalyst location and configuration, similarity of fuel metering system, similarity of emission control system logic and design, and similarity of any other features that may affect the durability of the retrofit system's emission performance.

7. INSTALLATION REQUIREMENTS

(a) Prior to releasing a converted vehicle to the consumer, the installer of an alternative fuel or credit-generating conventional fuel retrofit system shall submit the converted vehicle to a Bureau of Automotive Repair Referee Smog Check Station for inspection and testing except as provided in 7 (b).

(i) The installer of an alternative fuel or credit-generating conventional fuel retrofit system shall keep a copy of the certificate of compliance, issued by the Bureau of Automotive Repair Referee Smog Check Station, as part of the record specified in paragraph 3(e). The certificate of compliance shall contain, but need not be limited to, the following: the vehicle's identification number, the vehicle's model year and make, the date of installation, and the emissions category to which the retrofitted system is certified (i.e., conventional vehicle, TLEV, LEV, or ULEV) or, for heavy-duty vehicles, the credit standard to which the system is certified. The original certificate of compliance shall be submitted to the vehicle owner upon the vehicle's release.

(ii) The installer of an alternative fuel or credit-generating conventional fuel retrofit system shall not release the converted vehicle to the consumer without the issuance of a certificate of compliance for the vehicle by a Bureau of Automotive Repair Referee Smog Check Station.

(iii) The installer of an alternative fuel or credit-generating conventional fuel retrofit system shall also meet the requirements of paragraph 9(c).

(b) The retrofit system installer may request Air Resources Board approval to use the alternative inspection schedule for fleet installation of the same retrofit kit on more than 10 vehicles with engines from similar engine families. If approval is granted, the installer shall submit ten vehicles with engines from similar engine families, retrofitted with the same kit, to a Bureau of Automotive Repair Station as provided in 7 (a)(i) and 7 (a)(ii).

(i) If all ten vehicles receive a certificate of compliance, for subsequent applications of the same type, the installer need only submit every tenth retrofitted vehicle to the Bureau of Automotive Repair pursuant to 7 (a)(i) and 7 (a)(ii). For the remaining vehicles included in the alternative inspection schedule that are not submitted to the Bureau of Automotive Repair, the installer shall maintain a record of the vehicle's identification number, the vehicle's model year and make, the engine size, the manufacturer and fuel type of the retrofit

kit, the date of installation, and the emissions category to which the retrofitted system is certified (i.e., conventional vehicle, TLEV, LEV, or ULEV), or for heavy-duty vehicles, the credit standard to which the system is certified. The Air Resources Board may require random inspection of any vehicles subject to the alternative inspection schedule.

(ii) If any of the ten vehicles fail to pass inspection, the next set of ten retrofitted vehicles shall be subject to inspection at the Bureau of Automotive Repair, until an entire group of 10 passes.

8. IN-USE ENFORCEMENT TEST REQUIREMENTS

(a) Manufacturers of alternative fuel or credit-generating conventional fuel retrofit systems shall, upon order by the Executive Officer, perform in-use enforcement emission testing of their products. The Executive Officer may order in-use enforcement emission testing of not more than 20 percent of a manufacturer's certified retrofit systems/engine family applications per year. If 20 percent constitutes less than one of a manufacturer's certified systems, the Executive Officer may order in-use enforcement emission testing of not more than one certified system/engine family application per year. Manufacturers shall be required to perform emission testing of not less than ten vehicles per certified retrofit system/engine family application selected by the Executive Officer for in-use enforcement emission testing. Upon order by the Executive Officer, manufacturers shall perform the applicable emission tests pursuant to the following:

(i) No vehicle shall be accepted by the manufacturer as a representative vehicle for enforcement testing unless the following criteria are met:

(1) California certified and registered.

(2) Odometer indication of less than certified useful-life mileage and vehicle age within useful-life time period.

(3) No indication of abuse (e.g., racing, overloading, misfueling, or other misuse), neglect, improper maintenance or other factors that would have an effect on emission performance.

(4) No major repair to engine or major repair of vehicle resulting from collision.

(5) Lead content of fuel sample from the vehicle tank meets applicable standards.

(6) No indication of any problem that might jeopardize the safety of laboratory personnel.

(ii) The manufacturer shall, under ARB supervision, perform diagnosis or restorative maintenance on those vehicles selected

for in-use enforcement testing. The manufacturer or a laboratory approved by the Executive Officer shall (1) identify part numbers of all essential emission control system components; (2) check air filter, all drive belts, all fluid levels, radiator cap, all vacuum hoses and electrical wiring related to emission control for integrity; check fuel metering and emission control system components for maladjustments and/or tampering, and record all discrepancies; (3) check ignition system with oscilloscope and replace any defective components; i.e., spark plugs, wires, etc.; (4) check compression; (5) check and adjust engine parameters to manufacturer's specifications; and (6) perform maintenance if the vehicle is within 500 miles of scheduled maintenance service.

(iii) For vehicles in Category I, the manufacturer or a laboratory approved by the Executive Officer shall perform the applicable emission test procedures set forth in the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles." The applicable emission standards shall be the vehicle's useful life standards as well as any intermediate emission standards, as stated in the Executive Order.

(iv) For vehicles in Category II not certified for credit generation, in-use enforcement exhaust and, if applicable, evaporative emissions shall be performed using the test procedures set forth in the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles". The inertia weight setting shall be equal to the average of the vehicle's curb weight and gross vehicle weight rating and road load horsepower based on the frontal area of the vehicle without modifications, as determined in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," Section 9.b. For vehicles in Category III not certified for credit generation, in-use enforcement exhaust emission tests shall be performed in accordance with the test plan approved by the Executive Officer prior to certification testing of the engine family applications specified for in-use enforcement testing. For vehicles in Categories II and III which are certified for credit generation, in-use enforcement testing will consist of repeating the procedures and requirements of paragraphs 5(e) and 5(f), respectively, except as provided for in paragraph 8(a)(viii), below.

(v) The applicable exhaust emission standards for vehicles in Categories II and III shall be the baseline emission rates established during certification testing of the engine family applications specified for in-use enforcement testing times 1.3 except as provided in paragraphs 5(e) and 5(f) for credit generating systems. The applicable evaporative emission standards for vehicles in Categories II and III shall be the baseline emission rates established during certification testing of the engine family applications specified for in-use

enforcement testing plus 0.5 grams except as provided in paragraphs 5(e) and 5(f) for credit generating systems.

(vi) Manufacturers shall complete in-use enforcement testing within 6 months of the issuance of the in-use compliance testing order and shall submit all test data to the Executive Officer within 30 calendar days following completion of testing.

(vii) Following review of manufacturer in-use enforcement test data, the Executive Officer may conduct confirmatory in-use enforcement testing.

(viii) OEM upgrade systems certified for credit-generation use as described in paragraph 6(b), shall be subject to the new engine family in-use testing requirements for the engine family on which the system is originally certified. Such systems will not be subject to the in-use enforcement testing requirements of these Procedures.

(b) If the results of the in-use vehicle emission tests conducted pursuant to paragraphs 8(a)(i) through 8(a)(viii) indicate that the average emissions of the test vehicles for any pollutant exceed the applicable emission standards or specified limits for credit generation certification, the entire vehicle population so represented shall be deemed to exceed such standards. Upon order by the Executive Officer, the manufacturer shall have 45 days to submit an influenced recall plan in accordance with Sections 2111 through 2121, Title 13, CCR. If no such recall plan is submitted, the Executive Officer may order corrective action including recall of the affected vehicles in accordance with Sections 2122 through 2135, Title 13, CCR. For the purpose of these Procedures, the term "manufacturer," as referenced in Sections 2111 through 2135, Title 13, CCR, shall mean "retrofit system manufacturer."

9. WARRANTY REQUIREMENTS

(a) Requirements of Manufacturers:

The manufacturer of an alternative fuel or credit-generating conventional fuel retrofit system shall warrant to the person having the vehicle retrofitted and to each subsequent purchaser of the vehicle that the alternative fuel or credit-generating conventional fuel retrofit system is designed and manufactured to conform with the applicable requirements of these Procedures and is free from defects in materials and workmanship which cause the alternative fuel or credit-generating conventional fuel retrofit system to fail to conform with the applicable requirements of these Procedures or cause damage to any part on the retrofitted vehicle. This warranty shall be effective for three years or 50,000 miles, whichever first occurs, of customer service, and shall cover the full repair or replacement costs including the costs of diagnosis, labor, and parts (including any part on the retrofitted vehicle that is damaged due to a defect in the alternative fuel or credit-generating conventional fuel retrofit system).

(b) Extended Warranty Requirements:

Each manufacturer of an alternative fuel or credit-generating conventional fuel retrofit system shall identify in its application for certification the warranted parts whose individual replacement cost, at the time of certification, exceeds the cost limit defined in paragraph 9(b)(i). The replacement cost shall include the cost of the diagnosis, parts, and labor. The costs shall be those of the highest cost metropolitan area of California. Each manufacturer shall warrant to the person having the vehicle retrofitted and to each subsequent purchaser of the vehicle that those parts identified in its application for certification as exceeding the cost limit defined in paragraph 9(b)(i) are free from defects in materials and workmanship which cause the alternative fuel or credit-generating conventional fuel retrofit system to fail to conform with the requirements of these Procedures or cause damage to any part on the retrofitted vehicle, for seven years or 70,000 miles, whichever first occurs.

(i) The cost limit shall be calculated using the following equation:

$$\text{Cost limit}_n = \$300 \times (\text{CPI}_{n-2}/121.9)$$

where:
Cost limit_n is the cost limit for the year in which the alternative fuel or credit-generating conventional fuel retrofit system is to be certified.

n is the year in which the alternative fuel or credit-generating conventional fuel retrofit system is to be certified.

CPI is the annual average consumer price index for California published by the United States Bureau of Labor Statistics.

(ii) The cost limit shall be revised annually by the Executive Officer. The highest cost metropolitan area in California shall be identified by the Executive Officer.

(iii) Each manufacturer shall submit to the Executive Officer the documentation used to identify the warranted parts required in this subsection. The documentation shall include the estimated retail parts costs, labor rates in dollars per hour, and the labor hours necessary to replace the parts.

(c) Requirements of Installers:

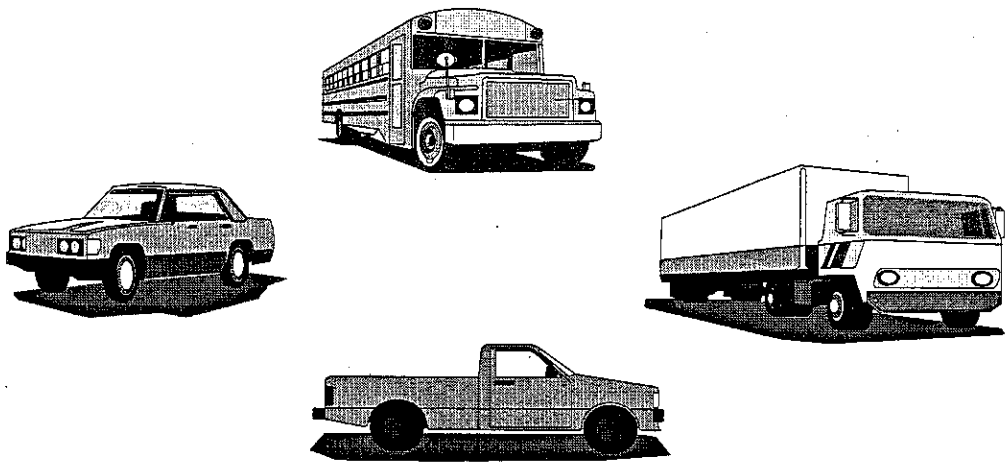
Each installer of an alternative fuel or credit-generating conventional fuel retrofit system shall warrant to the person having the vehicle retrofitted and to each subsequent purchaser of the vehicle that the alternative fuel or credit-generating conventional fuel retrofit system will not fail to conform with the applicable requirements of these Procedures due to incorrect installation, and that no part on the retrofitted vehicle will be damaged due to incorrect installation. Installers of alternative

fuel or credit-generating conventional fuel retrofit systems shall install only those systems of a certified configuration and shall agree to indemnify the person having the vehicle retrofitted and to each subsequent purchaser of the vehicle for the cost of repair of any vehicle upon which a noncertified configuration was installed. In addition, the installer shall agree to indemnify the person having the vehicle retrofitted and to each subsequent purchaser of the vehicle for any tampering fines that may be imposed as a result of improper installation of the alternative fuel or credit-generating conventional fuel retrofit system. The warranties and agreements to indemnify shall be effective for three years or 50,000 miles, whichever first occurs, of customer service, and shall cover the full repair or replacement costs including the costs of diagnosis, labor, and parts (including any part on the retrofitted vehicle that is damaged due to incorrect installation of the alternative fuel or credit-generating conventional fuel retrofit system).

Before an installer installs an alternative fuel or credit-generating conventional fuel retrofit system, he or she shall have submitted to the ARB a sample of the warranty statement to be provided by the installer in accordance with this paragraph.

Staff Report

Proposed Amendments to the Certification Procedures for All On-Road Motor Vehicle Retrofits and Proposed Optional Retrofit Emission Standards for Heavy-Duty Engines and Vehicles



Date of Release: June 9, 1995

California Environmental Protection Agency

Air Resources Board

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER:

I. ADOPTION OF NEW OPTIONAL RETROFIT EMISSION STANDARDS FOR HEAVY-DUTY ENGINES AND VEHICLES

II. AMENDMENTS TO THE CALIFORNIA CERTIFICATION AND INSTALLATION PROCEDURES FOR ALTERNATIVE FUEL RETROFIT SYSTEMS FOR MOTOR VEHICLES CERTIFIED FOR 1994 AND SUBSEQUENT MODEL YEARS

III. AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES CERTIFIED FOR 1993 AND EARLIER MODEL YEARS TO USE LIQUEFIED PETROLEUM GAS OR NATURAL GAS FUELS

IV. AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES CERTIFIED FOR 1993 AND EARLIER MODEL YEARS TO USE ALCOHOL OR ALCOHOL/GASOLINE FUELS

V. AMENDMENTS TO PROCEDURES FOR APPROVAL OF SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES TO USE FUELS OTHER THAN THE ORIGINAL CERTIFICATION FUEL

The Air Resources Board (the "Board" or "ARB") will conduct a public hearing at the time and place noted below to consider the adoption of optional retrofit emission standards for heavy-duty engines and vehicles. The Board will also consider amendments to the existing California Certification and Installation Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years, amendments to the California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels, amendments to the California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels, and amendments to Procedures for Approval of Systems Designed to Convert Motor Vehicles to Use Fuels other than the Original Certification Fuel.

DATE: July 27, 1995

TIME: 9:30 a.m.

PLACE: Air Resources Board
Board Hearing Room, Lower Level
2020 L Street
Sacramento, California, 95814

This item will be considered at a two-day meeting of the Board, which will commence at 9:30 a.m., July 27, 1995, and will

continue at 8:30 a.m., July 28, 1995. This item may not be considered until July 28, 1995. Please consult the agenda for the meeting, which will be available at least 10 days before July 27, 1995, to determine the day on which this item will be considered.

INFORMATIVE DIGEST OF PROPOSED ACTION

Proposed Actions and Sections Affected:

I. The proposed adoption of new optional retrofit emission standards for heavy-duty engines and vehicles -- new Section 1956.9, Title 13, California Code of Regulations (CCR).

Health and Safety Code sections 43701 (b) and (c) provide that the ARB shall require control equipment and adopt emission standards and procedures to qualify equipment used to reduce emissions from existing heavy-duty diesel motor vehicles.

The proposed optional retrofit emission standards would establish emission standards that could be met through retrofitting existing heavy-duty engines. These standards would form the basis for determining emission reduction credits ("credits") that could be earned through retrofitting existing engines. These credits would be used in mobile source emission reduction credit programs developed by the air pollution control districts and air quality management districts.

The proposed retrofit emission standards are optional emission standards for heavy-duty engines that have been retrofitted for credit. Operators of certain heavy-duty vehicles may find it attractive, because of circumstances such as the availability of an alternative fuel terminal or the type of service that the vehicles are engaged in, to retrofit their vehicles to obtain mobile source emission reduction credits.

The optional emission standards for heavy-duty diesel engines would apply to the following pollutants: a) total hydrocarbons (THC), or non-methane hydrocarbons (NMHC) if the engine were originally certified to the optional NMHC standard; b) carbon monoxide (CO); c) oxides of nitrogen (NOx); and d) particulate matter (PM). The optional emission standards for heavy-duty gasoline engines would be the same as for heavy-duty diesel engines for all pollutants except PM. Emissions of PM from gasoline engines are very small, and are not considered eligible for emission reduction credit.

The amount of emission reduction credit that could be generated from heavy-duty vehicle retrofits would be equal to the difference between the pre-conversion certification level (the "ceiling standard"), and the post-conversion certification level (the "credit standard"). The ceiling standard for determining

the emission reduction would generally be the emission certification standard applicable to that model year engine when new. The optional emission standards also include many levels of credit standards to which the engine can be certified after conversion. The first level credit standard is based on 75 percent of the ceiling standard, and other credit standards are set at fixed increments (depending on the pollutant) below the first level.

For some specific pollutants and model years, heavy-duty engines had no original engine certification level. In other cases, the original certification level would not be appropriate for a ceiling standard because
it was either a) negligible, or b) much higher than actual emissions. The proposed changes would define the needed ceiling standards. Ceiling standards are proposed for the following cases:

1. THC (or NMHC as applicable) and CO emissions from heavy-duty diesel engines;

2. PM from pre-1987 model year heavy-duty diesels; formaldehyde emissions; and

3. hydrocarbon (HC) and NOx emissions for engines originally certified to a combined HC plus NOx standard.

II. AMENDMENTS TO THE CALIFORNIA CERTIFICATION AND INSTALLATION PROCEDURES FOR ALTERNATIVE FUEL RETROFIT SYSTEMS FOR MOTOR VEHICLES CERTIFIED FOR 1994 AND SUBSEQUENT MODEL YEARS

Health and Safety Code section 43004 provides that the exhaust emission standards applicable to gasoline-powered motor vehicles shall also apply to gasoline- or diesel-powered vehicles converted to use fuels other than the fuel for which the vehicles were certified. Health and Safety Code section 43006 authorizes the Board to certify these alternative fuel systems if they meet the standards specified in section 43004. In addition, Health and Safety Code section 43018(a) directs the Board to endeavor to achieve the maximum degree of emission reduction possible from vehicular and other mobile sources in order to accomplish the attainment of the state standards at the earliest practicable date. Section 43018(c) provides that in carrying out 43018(a), the Board is to adopt standards and regulations that will result in the most cost-effective combination of controls to achieve reductions in motor vehicle exhaust and evaporative emissions.

Furthermore, Vehicle Code section 27156 provides that no person shall advertise, sell, or install any device or system intended for use with, or as part of, any required motor vehicle pollution control system which modifies its original design or performance.

In addition, Vehicle Code section 27156 authorizes the ARB to allow a device or system to be sold if it satisfies either of the following conditions: a) the device or system does not reduce the effectiveness of any required emission control device; or b) the modified vehicle complies with the applicable emission standards for the model year in which it was produced.

The proposed changes to the California Certification and Installation Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years would enable heavy-duty vehicle retrofits to generate emission reduction credits. The proposed changes would also facilitate durability testing and certification. The credit-related changes would define the ceiling standards, and no retrofit system that would cause an increase in emissions to 110 percent or more of the ceiling standard would be allowed to generate emission reduction credits. To facilitate durability testing and certification, the proposed amendments would a) extend the phase-in period for the procedures by one year; b) allow kit manufacturers until the end of the following calendar year to complete durability testing; and c) allow installers to use an alternative inspection schedule for high volume (fleet) conversions. The proposed amendments also include an alternate test plan for heavy-duty vehicles, and those medium-duty vehicles originally certified on an engine dynamometer. The alternate test plan would allow retrofit kit manufacturers to complete durability testing after certification, and includes further changes to the durability testing provisions.

III. AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES CERTIFIED FOR 1993 AND EARLIER MODEL YEARS TO USE LIQUEFIED PETROLEUM GAS OR NATURAL GAS FUELS

Health and Safety Code Section 43006 provides that the Board may certify the fuel system of any motor vehicle which meets the standards specified by Section 43004 and adopt test procedures for such certification for motor vehicles powered by a fuel other than gasoline or diesel.

The proposed amendments would reflect the proposed new title and phase-in schedule for the 1994 and later model year retrofit procedures, and would allow an alternative inspection schedule for high volume conversions.

IV. AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES CERTIFIED FOR 1993 AND EARLIER MODEL YEARS TO USE ALCOHOL OR ALCOHOL/GASOLINE FUELS

Health and Safety Code Section 43006 provides that the Board may certify the fuel system of any motor vehicle which meets the

standards specified by Section 43004 and adopt test procedures for such certification for motor vehicles powered by a fuel other than gasoline or diesel.

The proposed amendments would reflect the proposed new title and phase-in schedule for the 1994 and later model year retrofit procedures, and would allow an alternative inspection schedule for high volume conversions.

V. AMENDMENTS TO PROCEDURES FOR APPROVAL OF SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES TO USE FUELS OTHER THAN THE ORIGINAL CERTIFICATION FUEL

Health and Safety Code Section 43006 provides that the Board may certify the fuel system of any motor vehicle which meets the standards specified by Section 43004 and adopt test procedures for such certification for motor vehicles powered by a fuel other than gasoline or diesel.

Article 5, Chapter 1, Division 3, Title 13, of the California Code of Regulations is titled "Approval of Systems Designed to Convert Motor Vehicles to Use Fuels Other Than the Original Certification Fuel." There are two sections of Article 5 that contain references to "The California Certification And Installation Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years" ("the procedures"). These sections are Section 2030, "Liquefied Petroleum Gas or Natural Gas Retrofit Systems," and Section 2031, "Alcohol or Alcohol/Gasoline Fuels Retrofit Systems." Because of the proposed change in the title of the procedures to reflect their applicability to performing retrofits to meet optional credit standards, non-substantive amendments are being proposed to Article 5 and Sections 2030 and 2031 of Article 5 to reflect the change in the title of the procedures.

AVAILABILITY OF DOCUMENTS AND CONTACT PERSON

The Board staff has prepared a Staff Report which includes the initial statement of reasons for the proposed action and a summary of the environmental impacts of the proposal, if any. 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 contact person identified immediately below.

The ARB has determined that it is not feasible to draft the regulations in plain English due to the technical nature of the regulations. However, a plain English summary of the regulations

is available from the agency contact person named in this notice, and is also presented above in this notice for the regulatory action in the updated informative digest.

Further inquiries regarding this matter should be directed to Renee Kemena, Regulatory Strategy Section, Mobile Source Division, at (916) 327-2938.

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 nondiscretionary 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.

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action will not affect the creation or elimination of jobs within the State of California, the creation of new business or elimination of existing businesses within California, or the expansion of businesses currently doing business within California. An assessment of the economic impacts of the proposed regulatory action can be found in the Staff Report.

The Board's Executive Officer has also determined, pursuant to Government Code section 11346.5 (a)(3)(B), that the proposed action will not have an affect on small businesses because the changes will not significantly affect their cost of doing business.

Finally, the Executive Officer has determined that there will be no, or an insignificant, potential cost impact, as defined in Government Code section 11346.5(a)(9), on private persons or businesses directly affected resulting from the proposed action.

In addition, 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 Board Secretary, Air Resources Board, P. O. Box 2815, Sacramento, CA 95812, no later than 12:00 noon, July 26, 1995, or received by the Board Secretary at the hearing.

The Board requests but does not require that 20 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 AND HEARING PROCEDURES

This regulatory action is proposed under that authority granted in Health and Safety Code sections 39515, 39600, 39601, 43006, 43013, 43018, 43103, and 43104, and Vehicle Code section 27156. This action is proposed to implement, interpret and make specific Health and Safety Code sections 39002, 39003, 43000, 43004, 43006, 43008.6, 43013, 43018, 43100, 43101.5, 43102, 43103, 43104, 43106, and 43204, and Vehicle Code section 27156.

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 nonsubstantial 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

James D. Boyd
Executive Officer

Date: May 30, 1995

State of California
California Environmental Protection Agency

AIR RESOURCES BOARD

Staff Report: Initial Statement of Reasons for Proposed Rulemaking

Public Hearing to Consider Adoption of Amendments to the Certification Procedures for All On-Road Motor Vehicle Retrofits and to Consider Adoption of Optional Retrofit Emission Standards for Heavy-Duty Engines and Vehicles

Prepared by

Mobile Source Division

Date of Release: June 9, 1995
Scheduled for Consideration: July 27, 1995

EXECUTIVE SUMMARY

The Air Resources Board (ARB) staff is proposing credit standards for optional heavy-duty vehicle retrofits, and amendments to the procedures for certifying vehicle retrofits. Vehicle retrofits can include conversions to alternative fuel, or the addition of emission control hardware.

Vehicle retrofits can reduce emissions. If the retrofit reduces emissions beyond what is required under federal or state laws, the resulting emission reductions could generate emission reduction credits. To be eligible for credit, a retrofitted vehicle or engine kit would have to be certified to a low-emission standard. There are already low-emission standards for light- and medium-duty vehicles, but not for heavy-duty vehicles. This proposal would create credit standards for engines used in heavy-duty vehicles as proposed Section 1956.9, Title 13, of the California Code of Regulations (CCR). The proposed credit standards are similar to credit standards the Board adopted in June 1993 for heavy-duty transit buses.

Improper vehicle retrofits can actually increase emissions. The ARB requires retrofit kit manufacturers to certify their kits and demonstrate that they will not increase emissions. There were some problems with excessive emissions under the earlier retrofit certification procedures. Although retrofitted vehicles passed initial emissions testing, surveillance testing showed that some retrofitted vehicles were not achieving in-use compliance with applicable standards.

In 1994 the ARB began phasing-in more rigorous certification procedures. These certification procedures, which apply to 1994 and subsequent model-year retrofits, require durability testing, and put more responsibility on the retrofit kit manufacturer and installer. This proposal would require all retrofits for credit to certify under these 1994 and later retrofit procedures. This proposal would also add some provisions to those procedures to prevent any significant increase in emissions from retrofits for credit.

The phase-in of the 1994 and later retrofit procedures has not gone as smoothly as expected. In fact, retrofit kit manufacturers were unable to complete durability testing to certify any kits under the new procedures by the end of 1994. To address manufacturer's concerns, the ARB staff proposes regulatory changes to the 1994 and subsequent retrofit procedures. These regulatory changes include:

a) extending the phase-in schedule of the 1994 and later retrofit procedures,

b) allowing manufacturers until the end of the next calendar year to certify each year's retrofit systems, and

c) allowing an alternative inspection plan for high-volume retrofit installations, such as fleet conversions.

Very few retrofit kits for heavy-duty vehicles or the heavier medium-duty vehicles have been certified, under any retrofit certification procedures. These vehicles were originally certified on an engine dynamometer. This proposal includes an alternate test plan for these vehicles. The alternate test plan would allow the manufacturers to complete durability testing after certification, and includes further changes to the durability testing provisions. These changes should encourage the retrofit of heavy-duty vehicles, and those medium-duty vehicles certified on an engine dynamometer.

This proposal would also make minor changes to the earlier retrofit certification procedures that are being phased-out. The proposed changes reflect the new schedule and the high-volume inspection allowance.

The proposed changes are expected to provide flexibility to industry in meeting air quality requirements through the use of emission credits trading. They are also expected to facilitate retrofit kit certification and make more kits available to the public for installation.

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Attachment C: Proposed Amendments to the California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels

Attachment D: Proposed Amendments to Article 5 and Sections 2030 and 2031 of Article 5, Title 13, California Code of Regulations

Attachment E: Proposed Optional Exhaust Emission Standards for Retrofitted Heavy-Duty Engines

Attachment F: Analysis of Greenhouse Gas Emissions from Alternative Fuel Bus Retrofits

I. INTRODUCTION AND BACKGROUND

A. Introduction

The Air Resources Board (ARB or Board) staff is proposing credit standards for heavy-duty vehicle retrofits. Vehicle retrofits can include alternative fuel vehicle conversions, and the addition of emission control hardware. The proposed credit standards for heavy-duty vehicle retrofits are needed to qualify the vehicles for mobile source emission reduction credits.

The staff is also proposing amendments to the retrofit certification procedures. The amendments are applicable to light-, medium-, and heavy-duty vehicles. The proposed amendments would affect three separate retrofit certification procedures. The main changes are to the retrofit certification procedures for 1994 and subsequent model year vehicles. A major portion of this report deals with those changes. Minor changes are proposed to two earlier sets of retrofit certification procedures. The minor changes, mainly housekeeping items, are discussed in this report as "related regulatory changes."

The changes to the 1994 and subsequent model year retrofit certification procedures relate to either:

a) mobile source emission reduction credits, or
b) facilitating certification.

B. Background on the ARB's Motor Vehicle Program

In California, mobile sources account for about 60 percent of all ozone-forming emissions and for over 90 percent of all carbon monoxide (CO) emissions. The ARB has, and continues to develop and implement, a comprehensive motor vehicle emissions control program. The ARB's on-road motor vehicle program includes stringent certification and emissions standards for new vehicles, as well as other motor vehicle programs such as in-use compliance, inspection and maintenance, emissions warranties, and clean fuel regulations. These programs are projected to decrease reactive organic gas (ROG) emissions by 80 percent and oxides of nitrogen (NOx) emissions by 40 percent over the period 1990 to 2010. Similar programs are being implemented for off-road vehicles and engines.

Motor vehicle retrofits can reduce emissions. However, improper retrofits have been shown to increase emissions. Retrofit certification procedures are designed to prevent any significant increase in emissions.

C. Background on Mobile Source Credit Programs

Mobile source emission reduction credits can be created when reductions in emissions from cars, buses, or other mobile sources exceed the reductions required by federal, state, and local laws. Mobile source emission reduction programs are voluntary and they allow industry flexibility in obtaining required emission reductions.

Mobile source emission reduction credits can be used:

a) to delay compliance with prohibitory rules,
b) to offset emissions from temporary sources,
c) as alternatives to transportation control measures,
d) to improve air quality, and
e) as an alternative to industrial source controls.

Districts have the authority and responsibility for implementing mobile source credit programs. The districts are not required to have emission credit programs. Many districts have had stationary source emission credit programs in place for a number of years. However, mobile source emission credit programs are relatively recent, and only a few districts have developed programs.

Emission reduction credits are usually traded -- a reduction in emissions from one source is used to allow an increase in emissions from another source. Because credit programs are generally pollution trading mechanisms, they do not necessarily benefit air quality. Some districts reserve a portion of each emission reduction credit trade to benefit air quality.

D. Background on Retrofit Procedures

1. Historical perspective

Regulations regarding the retrofit of vehicles to use alternative fuels were first adopted in the 1970s. Most retrofits were vehicle conversions to use liquefied petroleum gas (LPG). In 1983, a regulation specific to conversions to alcohol or alcohol/gasoline blends was added. Over the past few years there has been a trend toward more conversions to compressed natural gas (CNG).

The estimated composition of the 1992 retrofit fleet is given below in Table 1. Most conversions since 1992 have been natural gas conversions. There were about 5,000 conversions in 1993, and fewer than 3,000 in 1994.

TABLE 1

1992 Retrofit Fleet

Fuel	Number of Vehicles
LPG	8,000 LDV 24,000 MDV 48,000 HDV 80,000 TOTAL
CNG	300 - 400 TOTAL

Source: ARB, 1992

2. Problems with the earlier retrofit certification procedures

The early, fuel-specific retrofit regulations were developed for a fledgling retrofit industry. They did not require durability testing, warranties, in-use testing, or installation inspections. In addition, since conversion systems were certified for each vehicle category, the kit manufacturer could test 3 or 4 vehicles and certify kits applicable to the entire fleet.

In practice, the early regulations did not ensure that emissions would remain at or below pre-conversion levels. Surveillance testing of vehicles converted to use gaseous fuels indicated that those vehicles were not achieving in-use compliance with applicable emission standards. This appeared to be due to poor installation and insufficient durability of the retrofit systems. Thus, the Board adopted more rigorous retrofit certification procedures to be phased-in from 1994 through 1996, and required inspections of all retrofit installations.

3. Adoption of the 1994+ retrofit certification procedures

On May 14, 1992, the "California Certification and Installation Procedures for Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years" were approved by the Board, and following a required administrative review, were adopted on March 11, 1993. This new regulation strengthened the procedures for approving alternative fuel retrofit systems, beginning with the 1994 model year. The "California Certification and Installation Procedures for Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years" will be referred to as the "1994+ retrofit procedures." The 1994+ retrofit procedures with proposed revisions are Attachment A of this document.

4. The earlier procedures

When the Board adopted the 1994+ retrofit procedures, the Board also made some minor changes to the earlier retrofit certification procedures. The earlier procedures were renamed, and provisions were added to require inspection of all retrofit installations. The current titles of these earlier model-year procedures are the "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels", and the "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels." They will be referred to as the "earlier procedures", and are included with proposed revisions as Attachments B and C to this report.

These earlier procedures are incorporated by reference in Section 2030 "Liquefied Petroleum Gas or Natural Gas Retrofit Systems" and Section 2031 "Alcohol or Alcohol/Gasoline Fuels Retrofit Systems", Article 5, Title 13 of the California Code of Regulations (CCR). Section 2030 and Section 2031, with minor proposed revisions, are included as Attachment D.

5. Relation of the 1994+ procedures to the earlier procedures

The earlier procedures are still in effect. However, they are essentially being phased-out. Each year, the retrofit kit manufacturers are required to certify more of their new model year kits under the 1994+ retrofit procedures. According to current requirements, all kits for 1996 model year vehicles would have to be certified under the 1994+ retrofit procedures.

Retrofit kits for older (pre-1994 model year) vehicles can still be certified under the earlier retrofit procedures, even after 1996. However, vehicles are typically retrofitted when nearly new to obtain the biggest benefit from the conversion. Thus, the market for these kits is expected to diminish quickly.

E. Statutory Authority

Several state statutes provide the Board's authority regarding motor vehicle retrofit systems. Health and Safety Code section 43018(a) is a general directive for the motor vehicle program. Health and Safety Code section 43018(a) directs the Board to endeavor to achieve the maximum degree of emission reduction possible from vehicular and other mobile sources in order to accomplish the attainment of state air quality standards at the earliest practicable date. Section 43018(c) provides that in carrying out 43018(a), the Board is to adopt standards and regulations that will result in the most cost-effective combination of controls to achieve reductions in motor vehicle exhaust and evaporative emissions.

In addition to the general directive to adopt emission standards for motor vehicles under Health and Safety Code section 43018(c), the ARB is further directed to consider methods for reducing emissions specifically from heavy-duty diesel motor vehicles. Health and Safety Code sections 43701 (b) and (c) provide that the ARB shall adopt emission standards and procedures for the qualification of equipment used to reduce emissions from existing heavy-duty diesel motor vehicles.

Vehicle Code section 27156 contains provisions to ensure that vehicle retrofits do not increase emissions. Section 27156 provides that no person shall advertise, sell, or install any device or system intended for use with, or as part of, any required motor vehicle pollution control system which modifies its original design or performance. Vehicle Code section 27156 further authorizes the Air Resources Board to allow a device or system to be sold only if it satisfies either of the following conditions:

a) the device or system does not reduce the effectiveness of any required emission control device; or

b) the modified vehicle complies with the applicable emission standards for the model year in which it was produced.

Health and Safety Code section 43004 provides that the exhaust emission standards applicable to gasoline-powered motor vehicles shall also apply to gasoline- or diesel-powered vehicles converted to use fuels other than the fuel for which the vehicle was originally certified. Health and Safety Code section 43006 authorizes the Board to adopt test procedures for certifying alternative fuel retrofit systems.

II. PROPOSED HEAVY-DUTY VEHICLE CREDIT STANDARDS

1. Introduction

Vehicle owners can reduce emissions by retrofitting their vehicles' engines. To generate mobile source emission reduction credits, a retrofitted vehicle's engine must be certified to a credit standard for at least one pollutant. The ARB staff is proposing new credit standards for heavy-duty vehicle retrofits. Adoption of this proposal would add the credit standards as a new subsection of the motor vehicle standards: Section 1956.9 of Title 13, "Optional Exhaust Emission Standards for Retrofitted Heavy-Duty Engines." The proposed Section 1956.9 is contained in Attachment E.

2. Existing and proposed credit standards

The Tier 1 and Low-Emission Vehicle (LEV) standards are the existing credit standards for light- and medium-duty vehicles. In June 1993, the Board adopted credit standards for new heavy-duty transit bus engines. Credit standards for heavy-duty vehicle retrofits do not currently exist. The credit standards proposed here for heavy-duty vehicles retrofits were developed through discussions and workshops with industry and districts, and are similar to the new heavy-duty transit bus engine standards.

3. Pollutants eligible for credits

NOx is the primary pollutant of interest when considering heavy-duty engine emission credit generation. Heavy-duty diesel trucks and urban buses emit significantly more NOx on a per-vehicle basis than any other category of motor vehicle in California. However, reductions in other pollutants are also possible. Older diesel engine emission levels for particulate matter (PM) are well above what could be achieved with current technology. Reductions in CO emissions and hydrocarbon (HC) emissions are also possible. Thus, heavy-duty diesel engines would be eligible for NOx, PM, CO, and HC credit.

Heavy-duty gasoline engines can emit significant amounts of CO and HC that may be reduced with proper modifications. Reductions in NOx emissions are also possible. Heavy-duty gasoline engines could generate emission reduction credits for NOx, CO, and HC, but not PM. Emissions of PM from gasoline engines are very small, and therefore would not considered eligible for emission reduction credits.

4. Calculation of credits

The difference in emission standards before a vehicle is retrofitted (the "ceiling" standard) and after (the "credit" standard) would determine the credit amount. Both dual-fuel vehicle retrofits and conventional fuel vehicle retrofits could generate credit. Credit standards would start at least 25 percent below the applicable ceiling standard. Additional credit standards would range from this level down to 0.0 in fixed increments. The size of the fixed increment would vary for different pollutants (see

examples and discussion of tables 2 through 5 following this subsection). This multi-tier approach would allow the vehicle operator to have flexibility in selecting an appropriate engine conversion option. The credit standard chosen would have to be prominently displayed on the vehicle emission control label.

Emission standards for heavy-duty vehicles are measured in grams per brake horsepower-hour (g/bhp-hr). In contrast, light- and medium-duty vehicle emissions are measured in grams per mile. A grams per mile emission factor is necessary to calculate the emission reduction credit. Thus, heavy-duty vehicle emission rates need to be converted to a grams per mile basis. The applicant would submit a justified conversion factor which would be subject to district approval. The ARB staff is available to assist the districts in reviewing conversion factors.

5. Example credit standards

An example of the allowable NOx conversion credit standards for a 1987 model year diesel-fueled truck or bus is given in Table 2. The ceiling standard is 6.0 g/bhp-hr, and the first credit standard would be 25 percent below that level, at 4.5 g/bhp-hr. Additional credit standards would range from 4.5 g/bhp-hr down to 0.0 g/bhp-hr in 0.5 gram increments.

TABLE 2

1987 Model Year Heavy-Duty Diesel-Fueled Vehicle NOx Retrofit Credit Certification Standards

Ceiling Standard:	6.0 g/bhp-hr
Credit Standards:	4.5
	4.0
	3.5
	3.0
	2.5
	2.0
	1.5
	1.0
	0.5
	0.0

Similarly, the maximum PM credit standard would be 25 percent below the applicable ceiling standard, rounded to the nearest lower 0.05 g/bhp-hr increment and decreasing to zero in 0.05 g/bhp-hr increments. Finally, CO credit standards would start 25 percent below the applicable ceiling standard, rounded to the nearest lower 5 g/bhp-hr increment, decreasing in 5.0 g/bhp-hr increments. Example credit standards for these pollutants are presented in Tables 3, 4 and 5. The examples in Tables 3 and 4 are for heavy-duty vehicles over 14,000 pounds gross vehicle weight rating (GVWR).

TABLE 3

1987 Model Year Heavy-Duty Diesel-Fueled Vehicle PM Retrofit Credit Certification Standards

Ceiling Standard:	0.60 g/bhp-hr
Credit Standards:	0.45
	0.40
	0.35
	0.30
	0.25
	0.20
	0.15
	0.10
	0.05
	0.00

TABLE 4

1987 Model Year Heavy-Duty Gasoline-Fueled Vehicle THC Retrofit Credit Certification Standards
(Over 14,000 lbs. GVWR)

Ceiling Standard:	1.9 g/bhp-hr
	1.4
	1.2
	1.0
	0.8
	0.6
	0.4
	0.2
	0.0

TABLE 5

1987 Model Year Heavy-Duty Gasoline-Fueled Vehicle CO Retrofit Credit Certification Standards
(Over 14,000 lbs. GVWR)

Applicable Standard:	37.1 g/bhp-hr
Credit Standards:	25.0
	20.0
	15.0
	10.0
	5.0
	0.0

6. Basis for setting heavy-duty credit standards

Manufacturers certify new vehicles or engines to discrete emission levels as opposed to continuous emission levels. Discrete emission standards were chosen for the heavy-duty credit standards to be consistent with new engine standards. New engine manufacturers also allow a margin of safety between the certification level and what the engines really emit to account for engine deterioration over time, variability between engines, and other factors. The first credit level was set at least 25 percent below the ceiling standard to ensure that a real, significant emission reduction is achieved, as opposed to just decreasing the manufacturer's margin of safety.

III. CURRENT REQUIREMENTS OF THE 1994+ RETROFIT PROCEDURES

A. Introduction

The 1994 and later model year retrofit procedures prescribe the procedures for installation and certification of motor vehicle retrofit systems. The retrofit procedures contain provisions to ensure that there will be no increase in emissions from motor vehicle retrofits. To certify a retrofit kit for use with an engine family, the kit manufacturer must demonstrate that the modified engine can meet emission standards at least as stringent as the original certification standards.

Emissions tend to increase over time as the engine and emission control systems deteriorate. The retrofit kit manufacturer must conduct durability or bench testing to show that the retrofitted engine will continue to meet the required emission standard over the engine's useful life. The retrofit manufacturer must supply technical information including an owner's manual, detailed descriptions of the system and its parts, and installation and maintenance procedures, as well as tune-up specifications.

In certifying a retrofit kit, the kit manufacturer assumes some of the original equipment manufacturer's responsibility for meeting emission standards over the useful life of the engine. The ARB's Executive Officer may order retrofit kit manufacturers to conduct in-use testing of some of their retrofit systems. If the average emissions of the tested vehicles, even after proper tune-ups, exceed the certification standards, the retrofit kit may be subject to recall. In addition, the kit manufacturer is required to warrant the parts of the retrofit kit. In-use testing, recall, and parts warranty are requirements for both the original equipment manufacturer and the retrofit kit manufacturer.

The retrofit kit installer is also subject to certain requirements under the retrofit procedures. The installer must follow the retrofit kit manufacturer's installation procedures. The installer must certify each installation at a BAR Referee Smog Check Station, and report each installation to the retrofit kit manufacturer. The installer must also warrant the installation.

B. Miscellaneous Requirements

1. Applicability

The current retrofit procedures apply to alternative fuel retrofits for light-, medium-, and heavy-duty vehicles for 1994 and subsequent model years. The specifications may, as an option, be used to certify 1993 and earlier model year vehicles.

2. Phase-in and durability testing schedules

Manufacturers are currently required to certify 15 percent of 1994, 55 percent of 1995, and 100 percent of 1996 and subsequent model year engine family retrofit systems under the retrofit procedures. The remaining retrofit systems may be certified under the earlier retrofit procedures. Durability testing must be completed by the end of the applicable calendar year.

3. General requirements

The general requirements specify that a retrofitted vehicle must retain driveability. The kit manufacturer must maintain the function of the on-board diagnostic (OBD) system, and may make modifications as needed to the OBD system to do so. The modifications must be specified as part of the retrofit kit. The retrofit kit installer can adjust only the idle speed and throttle position controls. Any other adjustment would be considered tampering.

4. BAR certificate of compliance

The retrofit procedures call for each retrofitted vehicle to be inspected at a BAR Referee Station between the time of retrofit hardware installation and the time the vehicle is turned over to the operator. The BAR would issue a certificate of compliance for each vehicle that passes inspection.

C. Vehicle Categories

The retrofit procedures define three categories of vehicles. Category I contains passenger cars, light-duty trucks, and medium-duty trucks originally certified on a chassis dynamometer. Category II consists of vehicles less than 14,000 pounds GVWR which were originally certified on an engine dynamometer. Category III consists of vehicles rated at 14,001 pounds or greater GVWR. Test procedures for each of these vehicle categories are discussed below.

The number of vehicles in Category II is decreasing. Currently, Category II consists of light heavy-duty vehicles originally certified using the United States Environmental Protection Agency (U.S. EPA) engine dynamometer procedure. Beginning with the 1995 model year, many of these vehicles will be subject to chassis dynamometer-based new vehicle emission standards. These vehicles will be subject to the Category I requirements. However, some vehicles, such as those with diesel engines or an incomplete chassis, may remain in Category II.

D. Test Procedures

New motor vehicles must certify to emission standards given in Title 13, sections 1950 through 1977. To ensure there is no increase in emissions, retrofitted vehicles must certify to standards at least as stringent as the original engine certification standard. Vehicle emission levels tend to increase over time with wear on the engine and emission control system. Retrofit kit manufacturers must perform durability or bench testing to demonstrate that the retrofitted engine can meet the certification standards as the vehicle ages. The test procedures reference the emission standards for certifying Category I, II, or III retrofitted vehicles. The test procedures also specify how the retrofit kit manufacturer must obtain the data needed to certify the retrofit device or system.

If the emissions tests, and durability or bench test data, show acceptable results, the ARB's Executive Officer is authorized to certify the retrofit kit. Manufacturers may apply to be allowed to use test data from one model year for subsequent model years (carry-over), or to use data from one engine family for other engine families (carry-across). Such applications must include proper supporting engineering analysis.

1. Category I test procedures

The Category I vehicle test procedures are very similar to those that the Board has adopted for new vehicle certification, except that durability testing requirements are not as extensive. Vehicles of 1994 and subsequent model years in the passenger car, light-duty truck, and medium-duty vehicle classes are subject to five different categories of emission standards. These are the Tier 1 standards, and the four low-emission vehicle (LEV) standards: transitional low-emission (TLEV), low-emission vehicle (LEV), ultra-low-emission vehicle (ULEV), and zero-emission (ZEV). Retrofit system manufacturers must certify their systems to standards at least as stringent as those to which the engine family was originally certified. This ensures that the installation of retrofit systems does not reduce the effectiveness of the emission control system or cause a violation of the applicable emission standards.

The test procedures require retrofitted dual-fuel vehicles to be certified on both fuels. Dual-fuel vehicles, while operating on gasoline, are required to certify to a standard no more than one tier above the standard to which they certify when operating on clean fuel. For example, a retrofitted LPG and gasoline dual-fuel passenger car certified to the LEV standard on LPG must be certified to the TLEV standard on gasoline.

2. Category II test procedures

Category II includes vehicles 14,000 pounds GVWR and under with engines that were certified according to the U.S. EPA transient engine test procedure. Generally, these are vehicles that use diesel engines, which are also used in heavier class trucks, and thus have been certified based on engine dynamometer testing. The retrofit procedures allow these vehicles to be certified using less-expensive chassis dynamometer testing.

3. Category III test procedures

New engine certification requirements for Category III vehicles (heavier than 14,000 pounds GVWR) require U.S. EPA transient engine dynamometer tests. The applicant has two options for certifying retrofit systems. The applicant can compare emissions measured after installation of the retrofit system against those of an unmodified vehicle over an 8-mode steady-state chassis test cycle. Under the other option, the applicant can submit an alternative test plan, provided that the applicant can demonstrate that there will not be an increase in emissions from the engine families for which certification is sought. Testing would begin after the Executive Officer approves the test plan.

E. Retrofit Kit Manufacturer Responsibilities

1. Vehicle useful life

The useful life, for durability testing and in-use recall purposes, is 100,000 miles for passenger cars and light-duty trucks, 120,000 miles for medium-duty vehicles, and 180,000 miles for heavy-duty vehicles. During the vehicle's useful life, the retrofit kit manufacturer is responsible for the proper functioning of emissions-related equipment. This means that the retrofit kit manufacturer is subject to the recall testing provisions up to the point that the odometer reads 100,000 miles, 120,000 miles, or 180,000 miles, whichever is appropriate. The ARB staff realizes that some vehicles are driven farther than these defined mileages. Although vehicles are subject to inspection and maintenance requirements for as long as they are on the road, the ARB does not enforce emission standards once a vehicle exceeds the useful life mileage.

2. Recall testing

The Executive Officer can call for up to 20 percent per year of a manufacturers' certified engine family conversions to be subject to in-use testing. Vehicles are tested by the original kit certification procedure, and the retrofit kit manufacturer must pay for testing. If average test emissions exceed applicable standards, then a recall or other corrective action can be required.

3. Warranties

The retrofit kit manufacturer and the retrofit kit installer have specific responsibilities for warranty of the retrofit. The manufacturer must warrant the kit to be free from defects for 50,000 miles or 3 years from installation. The manufacturer also warrants that kit parts costing more than $300 (adjusted for the consumer price index) will be free from defects for 7 years or 70,000 miles from installation. The retrofit kit installer must warrant for three years or 50,000 miles from installation that the kit is properly certified for the particular application, and is correctly installed. The installer must pay the vehicle operator for damages if the kit is improperly installed or tampered.

The manufacturer and installer are responsible during the entire warranty period, even if the vehicle is past the end of its useful life.

IV. PROPOSED REVISIONS TO THE 1994+ RETROFIT PROCEDURES

A. Introduction

The proposed changes to the 1994+ retrofit procedures include general revisions which would apply to any retrofit, changes specific to light- and medium-duty vehicle retrofits, and changes specific to heavy-duty vehicle retrofits for credit. The proposal would require all vehicles retrofitted for credit to certify under the 1994+ retrofit procedures. Even 1993 and earlier model year vehicles retrofitted for credit would have to follow the 1994 and subsequent model year requirements.

The proposal also expands the retrofit procedures to include other retrofits in addition to alternative fuel retrofits, and makes changes required for recently developed mobile source emission reduction credit programs. The proposal includes some strengthening and clarification of emission standards to ensure that the retrofits for emission reduction credits would not result in excess emissions.

B. General Revisions

The proposed general revisions to the regulation include changes to the phase-in schedule, extension of the time to complete durability testing, changes to the installation procedures, and modifications to make the regulation applicable to credit-generating conventional fuel conversions.

1. Phase-in and durability testing schedules

The proposed changes would extend the phase-in schedule an extra year, and give the manufacturers to the end of the next respective calendar year to finish durability testing. Thus, manufacturers would have to certify 15 percent of 1994, 55 percent of 1995, 55 percent of 1996, and 100 percent of 1997 and subsequent model year vehicles under the 1994 and subsequent model-year retrofit procedures. Also, manufacturers would have until the end of 1995 to finish durability testing for 1994 model year kits, until the end of 1996 for 1995 model year kits, and so forth.

2. Allow alternative inspection plan for high-volume installations

To accelerate certification for high-volume installations of the same type of kit, such as a fleet conversion, the ARB staff proposes a regulatory change to allow the use of an alternative inspection plan. The installer would need to obtain ARB approval to use the alternative inspection plan. The first ten installations would need to be inspected at a BAR referee station and obtain a certificate of compliance. After the first ten vehicles, every tenth vehicle would also need to be inspected by the BAR. The remaining vehicles would be inspected by the installer. The ARB is entitled to require random inspections of any installation.

This proposed revision would not affect any of the ARB's other in-use enforcement programs. These include Smog Checks, which are currently required on all light-, medium-, and heavy-duty vehicles, except diesels; and the ARB's roadside inspection program for heavy-duty diesel vehicles.

3. Addition of conventional fuel retrofits for credit

The proposed changes would expand the retrofit procedures to apply to conventional fuel retrofits for credit, in addition to alternative fuel retrofits. This change would allow the addition of aftermarket control systems, such as particulate traps for diesel engines, or catalytic controls.

4. Additional manufacturer requirements

Retrofit kit manufacturers would need to provide the name(s) and location(s) of assembly line(s), fabrication facility(ies), and test facility(ies), where the retrofit kit is manufactured and tested. In addition, the Executive Officer of the ARB could require an ARB-approved engineering analysis of any retrofit device that is certified to a low-emission vehicle standard.

5. OEM exemption

Original equipment manufacturers (OEMs) certifying retrofit hardware that upgrades one of the OEM's old engines to the identical configuration of a newer engine can submit the newer engine certification test data for the retrofit application. The OEM would be exempt from further emission test data requirements, as well as in-use testing requirements. As the OEM is already subject to emissions testing and in-use testing for the new engines, additional requirements would be duplicative.

6. Remove eight mode chassis dynamometer test

At the time the 1994 and later model year retrofit procedures were adopted, the Society of Automotive Engineers (SAE) was planning on developing an eight mode steady-state chassis dynamometer test. Therefore, that test was specified for heavy-duty vehicle certification testing. Because SAE did not develop an eight mode chassis dynamometer test procedure, the proposed change would remove that reference from the regulation. The manufacturer would still be required to submit a test plan for approval. The manufacturers would likely use the original engine dynamometer certification test procedure.

7. Carry-over and carry-across test reference

The criteria for evaluating carry-over and carry-across are referenced in the 1994 and later model year retrofit certification procedures. The proposed change updates the reference to cite the correct paragraph.

C. Revisions Specific to Light- and Medium-Duty Vehicle Retrofit for Credit

These revisions apply to vehicles in Category I and Category II of the 1994+ retrofit procedures. Category I consists of light- and medium-duty vehicles certified on a chassis dynamometer. Category II consists of medium-duty vehicles originally certified on an engine dynamometer.

The 1994+ retrofit procedures require all retrofitted vehicles to certify to emission standards that are at least as stringent as the original

engine certification standards. The 1994+ retrofit procedures also contain provisions to allow light- and medium-duty retrofitted vehicles to certify to levels lower than the original engine certification standards: the low-emission vehicle standards. The low-emission vehicle standards were adopted by the ARB in September 1990, and are contained in Section 1960.1 of Title 13.

Light- and medium-duty vehicles retrofitted to meet low-emission vehicle standards could be eligible for mobile source emission reduction credit. The difference in emission certification standards before and after a vehicle is retrofitted would determine the credit amount.

1. Tier 1 Standard

The first proposed change would allow light- and medium-duty vehicles to certify to Tier 1 standards. Tier 1 is the primary certification standard for 1993 and subsequent model year light- and medium-duty vehicles. It is not a low-emission standard. Currently, the 1994+ retrofit procedures allow certification only to low-emission standards.

This amendment would allow older vehicles to certify to the Tier 1 standard and generate emission reduction credit. The emission control label would have to prominently display the title "Tier 1 Vehicle."

2. Dual-fuel systems

The second proposed change would apply to dual-fuel vehicles retrofitted for credit. These vehicles would have to certify to a standard no more than one tier above the standard they certify to when operating on clean fuel. This would prevent the retrofit kit manufacturer from optimizing the system for one fuel exclusively, to the detriment of the performance on the other fuel.

Because there are likely to be times when the vehicle would be operated on the "dirtier" of the two fuels, this requirement should result in a net air quality benefit. Vehicle emissions, and therefore potential emission reduction credits, would depend on the amount of time the vehicle operates on each of the fuels. If the emission standards are similar for both fuels, it should be easier for the districts to arrange reasonable enforcement requirements.

3. Category II testing

Chassis dynamometer testing is currently specified for emissions testing of vehicles in Category II. Under the proposed requirement, Category II vehicle retrofits for credit would have to use a transient engine emissions test, which is the original engine certification test. Using the same emissions test would make it easier to compare emissions levels, and ensure that there is no increase.

D. Revisions Specific to Heavy-Duty Vehicle Retrofit for Credit

New heavy-duty engines are certified to mandatory emission standards. These standards specify the maximum amount of pollutants that an engine is

permitted to emit. For some specific pollutants and model years, heavy-duty engines had no original engine certification level. In other cases, the original certification level would not be appropriate as a ceiling standard.

The proposed changes, discussed below, would define ceiling standards for those cases where the original certification level is missing or inappropriate. These proposed changes would prevent a significant increase in the emissions of any pollutant, and provide ceiling standards from which to calculate creditable decreases.

1. Formaldehyde standard

Some engines, such as gasoline engines, have negligible formaldehyde emission levels. It is not practical to require that retrofits of those engines be held to an increase in formaldehyde emissions of 10 percent or less, because very small amounts of formaldehyde could cause a violation. Therefore, a more appropriate restriction is that formaldehyde emissions from any 1993 and earlier model year converted engines should remain at or below the standards applicable to the 1993 model year. Engines from the 1994 or later model year must meet the formaldehyde standard for that model year.

2. PM standard

Because there were no heavy-duty diesel PM standards before the 1987 model year, the proposed ceiling standard for converted engines of earlier model years is the 1987 model year PM standard of 0.6 g/bhp-hr.

3. CO and HC standards for diesel engines

Some engine types emit certain pollutants at significantly lower levels than the applicable emission standard. The primary example of this is the case of CO emissions from diesel engines. The current CO standard for heavy-duty diesel engines is 15.5 g/bhp-hr while typical diesel emission rates for CO are as low as 2.0 to 3.0 g/bhp-hr. For cases such as this, the proposed ceiling standard is the original emission certification value for that engine, instead of the engine certification standard. Another example is that of HC emissions from diesel engines, which generally are a small percentage of the applicable standard. For HC credit calculations based on conversions of such engines, the proposed ceiling standard is also the original emission certification value.

4. Apportioning combined HC + NOx standard

Some engines were originally certified to a combined HC plus NOx standard rather than to a separate HC standard and a separate NOx standard. In these cases, the proposed individual ceiling standards for each of these pollutants are based on the combined certification standard as pro-rated by the original emission certification values of each pollutant, as shown on the certification Executive Order. Table 6 provides an example of this determination process. If the original emission certification levels are not available, the HC and NOx standards would be pro-rated by the HC and NOx values of the next later model year with separate HC and NOx standards.

TABLE 6

Example HC+NOx Ceiling Standard Determination

HC + NOx std.	6.0 g/bhp-hr
HC certification value	0.5
NOx certification value	5.3
HC + NOx certification value	5.8
HC portion of value	8.6 %
NOx portion of value	91.3 %
HC ceiling std.	0.5 g/bhp-hr
NOx ceiling std.	5.5

5. Display credit standard

The heavy-duty vehicle credit standard would have to be displayed on the vehicle emission control label.

E. Alternate Test Procedure

1. Background

An alternate test procedure is proposed for heavy-duty vehicles and medium-duty vehicles in Category II. These medium- and heavy-duty vehicles were originally certified on an engine dynamometer. Retrofits of heavy-duty vehicles must be certified on an engine dynamometer. As discussed earlier, it is proposed that Category II vehicle retrofits for credit be certified on an engine dynamometer.

Engine dynamometer testing is expensive -- an order of magnitude more costly than the chassis dynamometer testing required for light-duty vehicles and most medium-duty vehicles. With design, testing, and other expenses, the cost of developing a heavy-duty vehicle retrofit kit can run from $100,000 to $300,000.

While the cost of developing heavy-duty vehicle retrofit kits is high, the potential air quality benefits are also high. These vehicles account for about 30 percent of mobile source NOx emissions, and more than 80 percent of mobile source exhaust particulate emissions.

The ARB recognizes the importance of controlling emissions from these heavy-duty and medium-duty vehicles. The 1994 State Implementation Plan contains a number of planned control measures to reduce emissions from heavy- and medium-duty vehicles.

2. New retrofit technology

SIP measures would cut emissions of NOx from new diesel engines to a 2.0 g/bhp-hr level over the next decade. The SIP contains a measure to encourage the early introduction of these lower-emission engines.

Conversion of new heavy- and medium-duty vehicles to alternative fuels is part of the SIP measure M4, for the early introduction of 2.0 g/bhp-hr NOx engines. Retrofit technology is available now that may be able to meet that emission level over the useful life of the vehicle.

3. Retrofit of older engines

While the new diesel engines on the road today are cleaner, older diesel vehicles will still contribute significantly to emissions. Thus, there is currently a window of opportunity to gain significant reductions from retrofits of these vehicles. Retrofit of older heavy-duty and vehicle engines is part of SIP measure M5, for alternative NOx reductions from heavy-duty diesel vehicles.

4. Scarcity of heavier engine retrofits

Very few heavy-duty or Category II medium-duty vehicles have been retrofitted. This is probably due to a number of factors, including:

a) the cost of engine dynamometer testing and kit development

b) the higher cost of the actual kits compared to the light-duty kits

c) the longer time to do durability testing for the useful life of the vehicle, and

d) alternative fuel infrastructure concerns, particularly for heavy-duty vehicles which typically have a greater range than light-duty fleet vehicles.

5. Proposed requirements

The alternate test procedure should encourage the retrofit of heavy-duty vehicles and those medium-duty vehicles in Category II. Currently, the 1994+ retrofit certification procedures require manufacturers to do durability testing for the useful life of the vehicle, and to complete the durability testing before certification is granted. The alternate test procedure would allow manufacturers of retrofit kits for heavy-duty vehicles and Category II medium-duty vehicles to certify their kits, put retrofitted vehicles on the road, and then complete durability testing.

To use the alternative test procedure, the manufacturer would have to submit derived deterioration factors, and a plan for completing durability testing. The ARB will work with the manufacturers to suggest appropriate deterioration factors. Next the retrofit system would be installed, and emissions tested on an engine dynamometer. The emissions would be projected to the end of the useful life of the vehicle, using the manufacturer derived deterioration factors. Those projected emissions must meet the certification standards for the OEM engine when it was new.

Following certification, the manufacturer would have to complete durability testing. The 1994+ retrofit procedure requires durability testing for the useful life of the vehicle. The useful life is 180,000

miles for heavy-duty vehicles, and 120,000 miles for medium-duty vehicles. Under the proposed alternate test procedure, the retrofit kit manufacturer would propose an appropriate durability test period as part of the proposed test plan. Staff believes that a shorter durability test period may be appropriate for Category II and Category III vehicles. These vehicles, particularly the heavy-duty vehicles, typically are very stable and show little deterioration in comparison with light-duty vehicles. The durability test plan must be reviewed and approved by the Executive Officer.

The results of the durability testing would be used to project emissions to the useful life of the vehicle. The deteriorated emissions based on the durability testing would have to be below the OEM engine certification level. If durability testing shows that the retrofitted engine does not meet the certification standard, or would not meet the certification standard at the end of the vehicle's useful life, the retrofit kit manufacturer would be responsible for recalling the vehicles and fixing the kits.

If the retrofit kit manufacturer has done upfront durability testing, for example as part of a joint OEM and retrofit kit manufacturer project, they may also use the alternate test plan. Since durability testing would already be completed, no further testing would be necessary after certification. Use of the alternative test plan, in this case, would allow the manufacturer greater flexibility with respect to durability testing and the emissions certification level. The manufacturer would have to show that deteriorated useful life emissions would meet the applicable emission standards for the engine's model year and fuel type.

V. RELATED REGULATORY CHANGES

Several related regulatory changes are needed in addition to the proposed credits standards and the proposed changes to the 1994+ retrofit procedures. These are minor changes to other regulations that reference the title and phase-in schedule of the retrofit procedure.

The 1993 and earlier model-year retrofit procedures, and Sections 2030 and 2031 of Article 5, Chapter 1, Division 3, Title 13, of the California Code of Regulations, reference the 1994+ retrofit procedures and the phase-in schedule. They would need to reflect the proposed title change and phase-in schedule change. The proposed changes are shown in Attachments B, C, and D.

The earlier retrofit procedures require that every retrofit installation be inspected at a BAR referee station. The proposed changes would allow the use of an alternative inspection plan for high-volume installations of the same type of retrofit kit on engines of the same size. This change would accelerate high-volume installations and is consistent with the proposed change to the 1994+ retrofit procedures. For the earlier procedures, the alternative inspection plan would apply to engines of the same size, rather than engines from the same engine family. Under the 1993 and earlier retrofit procedures, kits are not certified by engine family. The proposed changes are shown in Attachments B and C.

VI. REGULATORY ALTERNATIVES AND POTENTIAL IMPACTS

A. Regulatory Alternatives

Alternatives considered by the staff ranged from no changes to the existing retrofit procedures, to identical requirements for credit-generating retrofits and other retrofits, to even more stringent requirements than those proposed here. The staff believes that the general changes proposed are necessary to add specificity and clarity to the existing requirements, and to ensure that there would be no increase in emissions as a result of vehicle retrofit.

The more stringent specifications for retrofits-for-credit are appropriate in light of their intended use to allow the introduction of other sources of emissions.

Alternatives considered for the proposed alternative test plan for heavy-duty and Category II vehicles included: no change to the existing requirement; and extending the alternative test plan to light-duty vehicles and other medium-duty vehicles. With no change in the current provisions, retrofit of these vehicles would likely continue at a very low rate. The potential air quality benefits from increased retrofits could not be realized. Retrofitting vehicles represents an established, commercially proven way of increasing the fleet of alternatively-fueled vehicles and promoting the development of an alternative fuel infrastructure, and as a potential source of low-emission vehicles.

Staff believes extending the alternative test plan option to light-duty and other medium-duty vehicles is not appropriate. The cost of emissions testing and mileage accumulation for those light-duty and medium-duty vehicles is currently less than for heavy-duty vehicles. The current number of light- and medium-duty vehicle retrofits is substantially higher than the number of heavy-duty retrofits. And finally, staff believes that past problems with excess emissions from some light- and medium-duty vehicles make it inappropriate to extend the alternative testing plan to those vehicles.

The staff believes the proposed amendments are preferable to the alternatives, as they are sufficiently stringent to give reasonable assurance of in-use compliance with applicable emission standards, while allowing enough flexibility to industry to meet those standards. No alternative considered by the ARB staff would be more effective in carrying out the purpose for which the amendments and standards are proposed, or would be as effective and less burdensome than the proposed amendments and standards.

B. Potential Air Quality Impacts

The proposed adoption of heavy-duty vehicle retrofit credit standards, and many of the proposed changes to the 1994+ retrofit procedures relate to credit programs. Any emission reductions generated as credits are expected to be used as replacements for emission reductions that would otherwise be required. Therefore, the proposed credit-related changes are expected to be

neutral in terms of air quality benefits. There might be a slight air quality benefit if districts require a "discount factor" in calculating offset credits.

Other proposed changes to the retrofit certification procedures address the concerns of the retrofit kit manufacturers. They would:

a) extend the phase-in of the 1994+ retrofit procedures,
b) allow manufacturers more time to complete durability testing, and
c) allow installers to use an alternative installation inspection schedule.

These changes could have a minor, negative impact on air quality. They would allow a higher percentage of retrofit kits to certify under the earlier procedures during the 1995 and 1996 phase-in period. If the kits certified under the earlier procedures do not perform as well as kits certified under the 1994+ procedures, there could be a slight increase in emissions. In addition, under the proposed alternative installation inspection schedule, there is more potential for improper installation. This is expected to be mitigated by the response of the retrofit kit manufacturers to random inspections by the ARB. The ARB staff believes the potential minor negative impact on air quality is outweighed by the potential economic benefits.

The final proposed change is the alternative test plan for heavy-duty vehicles, and those medium-duty vehicles originally certified on an engine dynamometer. Because the alternate test plan would allow those vehicles on the road before durability testing is complete, there is a potential for an increase in emissions. Any increase would be temporary, however, as the retrofitted vehicles must complete the durability testing and are subject to recall for excessive emissions.

There is a potential air quality benefit as a result of the alternative test plan. Alternative fuel and other vehicle retrofits can decrease emissions from preconversion levels. These potential air quality benefits would vary greatly, depending on the number of vehicles retrofitted, type of retrofit, the availability of alternative fuel facilities, pre- and post-conversion emissions, and vehicle usage. Because of the uncertainty, particularly in the number of vehicles that might be retrofitted under these provisions, the potential air quality benefits are not estimated. However, staff believes the potential air quality benefits outweigh the potential increase in emissions.

C. Greenhouse Gas Emissions and Evaporative Emissions

There is increasing concern today about the environmental effects of greenhouse gases, primarily carbon dioxide (CO_2) and methane (CH_4) emissions. Alternative fuel retrofits have the potential to change greenhouse gas emissions and evaporative emissions. Possible sources of greenhouse gases from vehicle retrofits include CO_2 and unburned CH_4 emissions in the engine exhaust, and CH_4 evaporative emissions from the vehicle and from alternative fuel distribution systems. An analysis of greenhouse gas emissions and evaporative emissions from alternative fuel bus retrofits is presented in Attachment F.

The analysis indicates that there would be no net increase in greenhouse gas exhaust emissions or evaporative emissions from alternative fuel bus retrofits. A similar conclusion would be expected for other vehicle retrofits. In addition, the proposed changes would allow no increase in evaporative emissions from retrofits for credit. Finally, any changes in fuel distribution emissions are expected to be negligible relative to vehicle exhaust emissions. Therefore, these proposed changes are not expected to increase greenhouse gas emissions significantly.

D. Cost of Vehicle Retrofits

Vehicle retrofits are optional. Therefore, there are no mandated costs to vehicle operators. Depending on the ages and types of vehicles involved, the fleet size, the fuel used, and the type of retrofit conducted, the cost and the amount of emission reductions would vary widely.

The typical cost range for retrofitting vehicles is given below in Table 7. These estimates are based on discussions with alternative fuel suppliers and retrofit kit manufacturers. These costs are for the vehicle conversion. They do not include vehicle operating costs, financial incentives for alternative fuel conversions, or the capital or operating costs for alternative fuel infrastructure. Refueling infrastructure adds substantially to the costs of a retrofit. Owners of large vehicle fleets may find it cost-effective to install their own refueling facilities. Owners of smaller vehicle fleets may find access to other refueling facilities.

TABLE 7

Typical Cost Range for Vehicle Retrofits

Light-duty vehicles	$2,000 - $4,000
Medium-duty vehicles	$3,000 - $7,000
Heavy-duty vehicles	$8,000 - $15,000+

Preliminary cost evaluations indicate that the capital and operating costs of retrofitting existing heavy-duty engines and vehicles to low-emission configurations can be high. Operators of certain heavy-duty vehicles may find it attractive, because of circumstances such as the availability of an alternative fuel terminal, the type of service that the vehicles are engaged in, or the availability of financial incentives, to retrofit their vehicles to obtain mobile source emission reduction credits.

E. Cost of the Proposed Revisions

Since retrofitting for credit is optional, businesses would presumably only participate if it were financially advantageous. The changes proposed to facilitate durability testing, retrofit kit certification, and installation inspection, as well as the alternative test plan for heavy-duty

vehicles and Category II vehicles, are expected to slightly reduce the cost to retrofit kit manufacturers and installers.

F. Cost to State Agencies

The retrofit of motor vehicles for credit is optional. Therefore, the proposed regulatory amendments would not create costs to any state agency, local agency, or school district. To the extent that such credits could be sold, the proposed changes could create savings.

G. Potential Economic Impacts

The ARB staff has evaluated the potential economic impact on California businesses of the proposed adoption of heavy-duty vehicle credit standards, and the proposed amendments to the retrofit certification procedures. The businesses that may be affected include manufacturers and installers of retrofit systems, and businesses operating commercial retrofit vehicle fleets. An amendment to Section 11346.53 of the Government Code requires that, in proposing to adopt or amend any administrative regulation, state agencies shall assess not only the potential for adverse economic impacts on California business enterprises and individuals, but also the ability of California businesses to compete with businesses in other states. Also, a new section to the Government Code (Section 11346.54) requires state agencies to assess the potential impact of their regulations on California jobs and on business expansion, elimination, or creation.

The proposed adoption of heavy-duty vehicle retrofit credit standards, and many of the changes to the 1994+ retrofit procedures relate to credit programs. Those proposed changes would allow heavy-duty vehicle retrofits to generate mobile source emission reduction credits. The proposed use of the Tier 1 standard would expand the opportunities for light- and medium-duty vehicle credits.

Participation in credit programs is voluntary. Therefore, no noticeable economic impact is expected from the adoption of the proposed credit-related changes. Any minor economic impact is expected to be positive, since mobile-source credit programs allow businesses the flexibility to choose the most cost-effective way to meet emission reduction requirements.

Other proposed changes to the retrofit certification procedures address the concerns of the retrofit kit manufacturers. They would:

a) extend the phase-in of the 1994+ retrofit procedures,
b) allow manufacturers more time to complete durability testing, and
c) allow installers to use an alternative installation inspection schedule.

These proposed regulatory changes would have no noticeable economic impact on California businesses. In fact, the proposed changes would slightly reduce the cost of durability testing during the 1995 and 1996 phase-in period. The proposed changes would also reduce the cost of installation inspections for high-volume conversions.

The proposed alternative test plan for heavy-duty vehicles and Category II vehicles would slightly decrease the cost of certifying retrofit kits for those vehicles. While kit manufacturers would still have to do the same number of transient engine tests, less engine aging would be required in most cases. Since the manufacturers could begin selling kits before they complete durability testing, they would see a return on development costs sooner. However, manufacturers might need to spend more on kit development up-front to ensure that their kits would not need to be recalled later. Because their are very few manufacturers producing kits for these heavier engines, and because the initial investment is significant, only a gradual increase in the number of these retrofits would be expected. Overall, no noticeable economic impact is expected from adoption of the proposed alternative test plan. Any minor economic impact is expected to be positive.

Adoption of the proposed credit standards and the proposed regulatory amendments would have no noticeable impact on the profitability of California businesses as a whole. Therefore, the ARB staff expects no significant change in employment; business creation, elimination, or expansion; or in business competitiveness.

H. Issues

1. Expense of retrofit certification

Retrofit kit manufacturers and installers have commented that certification under the 1994+ procedures is expensive. Most of the expense of retrofit certification is the cost of durability testing. Durability test data carry-over to subsequent model years, and carry-across to similar engine families are allowed under the 1994+ retrofit certification procedures. The ARB staff has clarified the conditions under which carry-over and carry-across are allowed. Carry-over and carry-across to similar engine families are allowed based on similarities in the engine design, weight category, engine displacement, fuel metering system, and catalytic converter design and location.

The ARB staff has also clarified the procedures for applying DFs, derived from durability testing of conventional-fuel stock vehicle testing, to alternative fuel or other retrofits. The retrofit kit manufacturer must demonstrate that the conventional fuel DFs are equal to or greater than the DFs from the actual mileage accumulation of a retrofitted vehicle. This demonstration can be done for a "worst-case" vehicle and applied to other vehicles from similar engine families.

These clarifications should help retrofit kit manufacturers take advantage of durability test data carry-over/carry-across, and the use of conventional fuel DFs. Therefore, the clarifications should decrease the cost of certification.

2. Time to complete durability testing

Retrofit kit manufacturers have also expressed concern about the length of time it takes to complete durability testing. With the phase-in of the new retrofit certification procedures, 1994 was the first year that

manufacturers were required to do durability testing. Manufacturers were unable to complete durability testing under the new procedures by the end of 1994. A regulatory change that is part of this proposal would give manufacturers until the end of the following calendar year to complete durability testing. For example, manufacturers would have until the end of 1995 to complete durability testing for their 1994 model year retrofit kits.

3. Model availability

Retrofit kit manufacturers and installers have commented that due to the expense of the new retrofit certification process, they are no longer able to certify a wide variety of systems. Under the 1993 and earlier procedures, kit manufacturers could do emissions testing on 3 or 4 retrofitted vehicles and certify an entire fleet of vehicles. The 1994+ retrofit certification procedures require durability testing for each engine family. Therefore, retrofit kit manufacturers are certifying fewer models than they did in the past.

The clarification of the durability testing carry-over/carry-across and the use of conventional fuel DFs should facilitate the certification process and make it less expensive. This should make it easier for retrofit kit manufacturers to certify more engines from similar engine families. However, it is likely that retrofit kit manufacturers will be certifying fewer systems than they have in the past. Some of the largest retrofit kit manufacturers have told us that by analyzing their customer demand, they can cover about 80 percent of their market base with a handful of certified systems. The ARB also supports the retrofit kit manufacturers in their efforts to inform fleet owners about retrofit kit availability before the fleet owners make vehicle purchasing decisions.

4. Installation inspection

Retrofit kit installers and manufacturers have expressed concerns with the BAR installation inspection process. The BAR has instituted a number of changes over the past year. With training, the time required to inspect retrofit installations has decreased to about half an hour. The BAR has allotted four slots per day at each BAR referee station for retrofit installation inspections. The BAR will also work with large volume installers to locate a BAR inspector on-site. Business at BAR referee stations has decreased this year, and scheduling installation inspections appears to no longer be a concern. Finally, as part of this report, the ARB staff is proposing an alternative installation inspection schedule for high-volume conversions. These changes should all facilitate installation inspection.

5. Self-certification

Some retrofit kit manufacturers have asked to be allowed to self-certify their retrofit kits. They argue that retrofit kit manufacturers have become much more sophisticated since the ARB's retrofitted vehicle emissions testing. The larger manufacturers have asked to be exempted on the basis of their expertise. The smaller manufacturers have asked to be exempted to encourage the growth of small businesses.

The ARB staff recognizes the improvements in retrofit kits in the past few years. The ARB also has outreach programs to assist small businesses and facilitate their environmental compliance. However, the ARB staff cannot ensure proper protection of air quality under self-certification programs. Therefore, the ARB staff does not recommend self-certification. The changes just discussed address the problems that lead retrofit kit manufacturers to propose self-certification.

VII. CONCLUSION

The proposed revisions to the installation and certification procedures for motor vehicle retrofits would enable the implementation of the mobile source emission reduction credits programs. They would ensure that there is no significant increase in emissions from vehicles retrofitted for credit, and allow conventional-fuel vehicles to be retrofitted for credit. In addition, this proposal would create low-emission certification standards for optional retrofits for heavy-duty vehicles for credit.

The proposed changes to the certification procedures would facilitate the certification and installation process, make more kits available to the public, and speed up fleet conversions. The proposed alternative test plan should facilitate certification of retrofit kits for heavy-duty vehicles and those medium-duty vehicles originally certified on an engine dynamometer. The proposed changes should encourage the retrofit of those vehicles and increase the potential for air quality benefits.

Adoption of these provisions would provide flexibility to industry in meeting air quality regulations by allowing participation in credit programs, and by facilitating certification/conversion process, while safeguarding air quality through the additional requirements.

REFERENCES

Air Resources Board (ARB). March 27, 1992. Staff Report: Adoption of Amendments to the Certification and Compliance Test Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles.

ATTACHMENT A

PROPOSED AMENDMENTS TO THE CALIFORNIA CERTIFICATION AND INSTALLATION PROCEDURES FOR ALTERNATIVE FUEL RETROFIT SYSTEMS FOR MOTOR VEHICLES CERTIFIED FOR 1994 AND SUBSEQUENT MODEL YEARS

PROPOSED

State of California
AIR RESOURCES BOARD

CALIFORNIA CERTIFICATION AND INSTALLATION PROCEDURES FOR ALTERNATIVE FUEL RETROFIT SYSTEMS FOR MOTOR VEHICLES CERTIFIED FOR 1994 AND SUBSEQUENT MODEL YEARS AND FOR ALL MODEL YEAR MOTOR VEHICLE RETROFIT SYSTEMS CERTIFIED FOR EMISSION REDUCTION CREDIT

Note: Changes to the text originally adopted March 11, 1993 are indicated by strike-out (deletion) and underline (addition).

Adopted March 11, 1993
Amended: xxxxxxx

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California Certification and Installation Procedures
for Alternative Fuel Retrofit Systems for Motor Vehicles
Certified for 1994 and Subsequent Model Years
and for all Model Year Motor Vehicle Retrofit Systems
Certified for Emission Reduction Credit

1. APPLICABILITY

(a) "Certification and Installation Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years and Retrofit Procedures for Emission Reduction Credit for all Model Years" ("these Procedures") apply to alternative fuel retrofit systems designed for installation on gasoline- or diesel-fueled light-, medium-, and heavy-duty motor vehicles for 1994 and subsequent model years, and alternative fuel and conventional fuel retrofit systems for emission reduction credits for all model years.

(b) Only these procedures shall be used to certify a retrofit system for the purpose of generating emission reduction credits. Each retrofit system manufacturer shall certify all engine family systems to be used for generating emission reduction credits regardless of model year (MY) or fuel used.

(c) Only these Procedures shall be used to certify a retrofit system for installation on a transitional low-emission vehicle ("TLEV"), low-emission vehicle ("LEV"), or ultra-low-emission vehicle ("ULEV") or to certify a retrofit system designed to convert a vehicle to TLEV, LEV, or ULEV emission standards (as defined in Section 1960.1, Title 13, CCR).

(d) Each manufacturer shall certify a minimum of 15 percent of 1994, 55 percent of 1995, 55 percent of 1996, and 100 percent of 1996~~7~~ and subsequent model year engine family retrofit systems according to the requirements of these Procedures except as provided in paragraph 1.(b). "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels," (for certifying liquefied petroleum gas or natural gas retrofit systems) and "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels" (for certifying alcohol and alcohol/gasoline retrofit systems) shall be used to certify the remaining percentage of 1994, 1995, and 1996~~6~~ model year engine family systems and 1993 and prior model year engine family systems, except as provided in paragraph 1.(b) and 1.(e) The percentages shall be determined from the total number of retrofit systems certified and shall be met prior to the end of the next respective calendar year.

~~(b)~~
(e) A retrofit system manufacturer may as an option use these Procedures to certify non-credit generating alternative fuel retrofit systems designed for installation on pre-1994 model year gasoline- or diesel-fueled light-, medium-, and heavy-duty motor vehicles, with the following addition: the Executive Officer may order 25,000 mile durability vehicle testing for alternative fuel retrofit systems designed for installation on pre-1994 model year vehicles which include hardware or components other than the fuel conversion system as part of the overall retrofit system.

~~(c)~~
(f) A certification for an alternative fuel retrofit system issued pursuant to these Procedures shall have the effect of a certification of an alternative fuel retrofit system pursuant to Health and Safety Code Section 43006~~,~~. A certification for retrofit equipment utilizing any fuel, issued pursuant to these regulations, and~~shall also~~have the effect of an exemption issued pursuant to Vehicle Code Sections #27156 and 38395.

2. DEFINITIONS

"Alternative fuel" refers to liquefied petroleum gas, natural gas, alcohol and alcohol/gasoline fuels.

An "alternative fuel retrofit system" ~~or "retrofit system"~~ is a package of fuel, ignition, emission control, and engine components that are modified, removed, or added during the process of modifying a motor vehicle to operate on an alternative fuel. Such systems can be optionally certified to generate credits.

"Conventional fuel" means gasoline or diesel fuel.

"Credit-generating conventional fuel retrofit system" is a retrofit system that is certified to generate credits and that operates exclusively on the fuel for which the engine family was originally certified.

"Credits" refers to mobile source emission reduction credits.

"Driveability" of a vehicle refers to the smooth delivery of power, as demanded by the driver. Typical causes of driveability degradation are rough idling, misfiring, surging, hesitation, or insufficient power. Conversion from gasoline to gaseous fuels usually entails a loss of volumetric efficiency, resulting in some power loss. Normal power loss shall not be considered to be driveability degradation.

"Dual fuel" refers to a retrofit system which utilizes both an alternative fuel and a conventional fuel without further hardware changeover required.

"Installer" refers to a person who installs alternative fuel or credit-generating conventional fuel retrofit systems on motor vehicles.

"Retrofit system" is a package of fuel, ignition, emission control, and engine components that are modified, removed, or added during the process of modifying an engine to operate at an emission rate lower than the rate to which the engine family was originally certified.

"Retrofit system manufacturer" or "manufacturer" refers to a person who manufactures or assembles an alternative fuel or credit-generating conventional fuel retrofit system for sale in California and requests or is granted the Executive Order certifying the alternative fuel or credit-generating conventional fuel retrofit system.

"Tier 1" refers to the emission standards applicable to 1995 and subsequent model year light-duty vehicles, not considered as TLEV's, ULEV'S or LEV'S, and as described in Section 1960.1, Title 13, California Code of Regulations.

For purposes of these Procedures "useful life" is the duration, expressed in miles, of the longest durability period for the new vehicle or engine emission standards to which the vehicle or engine family was certified. (This is typically 50,000 miles for light-duty vehicles. However, as of the 1993 model year, a phase-in of new, more stringent, light-duty standards with 100,000 mile useful life requirements will begin.)

3. GENERAL REQUIREMENTS

(a) Product Specifications:

In addition to all other standards or requirements imposed, the following general requirements shall apply to all alternative fuel or credit-generating conventional fuel retrofit systems to be certified for installation on California-certified gasoline or diesel-fueled motor vehicles:

(i) Alternative fuel retrofit systems for gaseous fuels shall be equipped with a lockoff valve, actuated by an electrical or vacuum signal, preventing delivery of fuel to the carburetor, or fuel injection system, while the engine is shut down.

(ii) The driveability of a vehicle equipped with a retrofit system shall not be degraded in such a way as to encourage consumer tampering. To verify that the driveability of a retrofitted vehicle is acceptable, the Executive Officer may require that an independent laboratory evaluate driveability. The Executive Officer's determination that driveability must be evaluated shall be based on an engineering evaluation of the retrofit system described in the application for certification or on reports or observations that retrofit systems similar in design to the system for which certification is sought have caused driveability degradation. The cost of this evaluation shall be borne by the applicant.

(iii) If the vehicle to be retrofitted was certified with an on-board diagnostic (OBD) system pursuant to Section 1968 or 1968.1, Title 13, California Code of Regulations (CCR), the proper

function of the on-board diagnostic system shall not be impaired as a result of the installation and operation of the alternative fuel or credit-generating conventional fuel retrofit system. This requirement may necessitate modification of the OBD system to prevent it from storing erroneous trouble codes (e.g., storing a code signifying faulty operation of the evaporative canister purge valve because the evaporative emission control system has been removed). All modifications to OBD components, programming or wiring, must be fully specified as parts of the retrofit system. If the retrofit system includes modifications to the OBD system, the applicant must submit an analysis showing that these modifications will not adversely affect OBD performance.

(iv) With the exception of idle speed control and throttle position control, no component or calibration of the fuel system that could affect emission performance shall be adjustable by the system installer or the vehicle's user.

(b) Emission Control Labels:

"California Motor Vehicle Emission Control Label Specifications," incorporated by reference in Title 13, CCR, Section 1965, shall apply to installations of alternative fuel or credit-generating conventional fuel retrofit systems, with the following additions:

(i) The retrofit system manufacturer shall provide a supplemental Emission Control Information label, which shall be affixed in a permanent manner to each retrofitted vehicle, in a location adjacent to the original Emission Control Information Label. If the supplemental label cannot be placed adjacent to the original label, it shall be placed in a location where it can be seen by a person viewing the original label.

(ii) The supplemental label ~~shall clearly state that the vehicle has been equipped with an alternative fuel retrofit system designed to allow it to operate on a fuel other than gasoline or diesel, and shall identify the fuel(s) which the vehicle is designed to use. The label~~ shall show the vehicle model year; the Executive Order number certifying the retrofit system; the retrofit system manufacturer's name, address, and telephone number; and shall state that the retrofitted vehicle complies with California emission requirements. If the retrofit system has been certified as being capable of converting the vehicle into a Tier 1, TLEV, LEV, or ULEV, the label shall prominently display the title, "Tier 1 Vehicle," "Transitional Low-Emission Vehicle," "Low-Emission Vehicle," or "Ultra-Low-Emission Vehicle," as appropriate. If the retrofit system has been certified for credit-generation use on a heavy-duty vehicle, the label will state the applicable credit standards, as defined in Section 1956.9, Title 13, California Code of Regulations. The label shall also list any original parts that were removed during installation of the retrofit system, as well as any changes in tune-up specifications required for the retrofit system. In addition, the label shall show the installer's name, address, and telephone number; the date on which the retrofit system was

installed; and the mileage (retrofitted vehicle odometer reading) and date at which the retrofit system warranty expires. It is not necessary for emission control labels installed with retrofit systems to be machine readable. The supplemental label for an alternative fuel retrofit vehicle shall clearly state that the vehicle has been equipped with an alternative fuel retrofit system designed to allow it to operate on a fuel other than gasoline or diesel, and shall identify the fuel(s) that the vehicle is designed to use.

(iii) The retrofit system manufacturer shall provide a vacuum hose routing diagram for each alternative fuel retrofit system sold, and for any other retrofit that includes changes to the vacuum hose routing. The vacuum hose routing diagram shall be placed underhood in a permanent manner at a visible and accessible location and shall show modifications to the original vacuum system.

(c) Owner's Manuals:

Each retrofit system installed shall include an owner's manual containing at least the following information:

(i) a brief description of the retrofit system, including major components and their theory of operation;

(ii) the correct refueling procedure for alternative fuel retrofits;

(iii) a listing of necessary service and service intervals, as well as tune-up data, which differ from the service requirements specified by the vehicle's or engine's original manufacturer;

(iv) the name, address, and phone number of the installer, as well as a list of the names, addresses, and phone numbers of the major dealers in California who supply parts for, or service, the retrofit system; and

(v) warranty information.

(d) Manufacturer Recordkeeping Requirement:

Manufacturers of retrofit systems shall maintain a record of the vehicle identification numbers and California license plate numbers of those vehicles on which their product has been installed. As part of this record, manufacturers shall identify the installation date and the certification number of those systems installed on each vehicle and shall identify the vehicles' owners at the time of installation, including the owners' current addresses and phone numbers at the time of installation. The retrofit system manufacturer shall supply a copy of all installation information to the Executive Officer upon request.

(e) Installer Recordkeeping Requirement:

Installers of retrofit systems shall maintain a record as specified in paragraph 3(d) and shall provide this information to retrofit system manufacturers upon request.

4. REQUEST FOR CERTIFICATION

(a) A request for certification of an alternative fuel or credit-generating conventional fuel retrofit system may be submitted by an authorized representative of the retrofit system manufacturer intending to offer the retrofit system for sale or installation in the State of California.

(b) A separate request shall be required for each model year, even though the emission standards for certifying new vehicles may be the same for consecutive model years. The request shall include all test data and other information required pursuant to these Procedures, except where other provisions of these Procedures allow carry-over or carry-across of test data from an engine family to the engine family(ies) for which certification is sought. Procedures governing carry-over and carry-across are discussed under paragraph 6, "Approval."

(c) The request for certification shall be submitted in writing, signed by an authorized representative of the retrofit system manufacturer, and shall include the following:

(i) Identification and description of the engine families for which the retrofit system to be certified is designed; the emission standards applicable to those engine families; and if applicable, a statement that the retrofit system is designed [A] to convert conventional vehicles into either TLEVs, LEVs or ULEVs, [B] to convert a TLEV into either an LEV or ULEV, or [C] to convert an LEV into a ULEV, [D] to convert 1994 or earlier model year vehicles into Tier 1 Vehicles, or [E] to convert heavy-duty vehicles for emission reduction credit. For [E] include the credit standard(s) proposed for certification from the "Optional Exhaust Emission Standards for Retrofitted Heavy-Duty Engines", as contained in Section 1956.9, Title 13, California Code of Regulations.

(ii) A complete description of the alternative fuel retrofit system, including details of the carburetor, mixer, regulator, vaporizer, or fuel injection system; the feedback mixture control system (if applicable), part number(s), calibration data, hose routing, specifications for the fuel tank, and pressure regulator; a sample of the emission control label as specified in 3.(b); a sample of the warranty statement as specified in 9(a) and (b); and all necessary modifications to the engine, emission control system, or other parts of the vehicle.

(iii) Procedures for installing and maintaining the retrofit system, including tune-up specifications and discussion of any special

tools or techniques required for proper installation, maintenance, or operation.

(iv) An agreement to supply the Air Resources Board, within 45 calendar days of the Executive Officer's request, with any one or more of the vehicles used for certification testing, or to provide Air Resources Board personnel with the equipment to inspect and test such vehicles at the applicant's facility, if requested by the Executive Officer.

(v) For retrofit systems being certified for credit-generation, the manufacturer shall provide, in writing, the name(s) and address(es) of the fabrication, assembly line(s), and test facility(ies) where the retrofit kit is manufactured and tested.

(vi) For retrofit systems being certified for credit-generation, the manufacturer shall provide an engineering analysis upon request from the Executive Officer. Such analysis shall describe the detailed operating theory of the retrofit system based on accepted scientific and engineering principles. Final certification will require ARB acceptance and approval of the analysis.

(vii) For conventional fuel retrofits for credit-generation, the manufacturer shall provide a complete description of the major components of the retrofit system and part number(s).

5. TEST PROCEDURES

(a) Description of Vehicle Categories:

For the purposes of these certification Procedures, the motor vehicle fleet is divided into three major categories:

I. Passenger cars, light-duty trucks, and medium-duty vehicles as defined in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" (as incorporated by reference in Section 1960.1, Title 13, CCR), which were certified to an exhaust emission standard based on a chassis-dynamometer test procedure;

II. Vehicles with gross vehicle weight ratings less than or equal to 14,000 lbs and not originally certified to a chassis dynamometer-based exhaust emission standard; and

III. Vehicles with gross vehicle weight ratings greater than 14,000 lbs.

(b) Test Procedures for Vehicles in Category I:

For vehicles in Category I, the emission standards and test procedures set forth in the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" also apply to the

certification of alternative fuel or credit-generating conventional fuel retrofit systems, with the following exceptions:

(i) The applicable emission standards shall be at least as stringent as the emission standards applicable to the engine families for which the retrofit systems to be certified are designed. For credit-generation, the applicable emission standards shall be the Tier 1 and LEV program standards. Dual-fuel vehicles must be certified on each of the two fuels. For dual-fuel vehicles certified for credit, the certification standards for the two fuels shall be no more than one tier apart. In addition, vehicles retrofitted to operate on a given alternative fuel shall also be subject to any additional emission standards applicable to new motor vehicles that are designed to operate on the alternative fuel, and that are of the model year and vehicle class for which certification is sought. A maximum of one emission-data vehicle per engine family for which certification is sought shall be required. Where durability testing is required, a bench-test vehicle may be substituted for a durability vehicle and may also be considered an emission-data vehicle. Prior to the commencement of testing, the choice of durability vehicle or bench-test vehicle, emission-data vehicle(s) and engine(s) must be approved by the Executive Officer as being representative of the range of engine families for which certification is sought.

(ii) For the purpose of applying the provisions of the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" to certification testing of alternative fuel or credit-generating conventional fuel retrofit systems, test vehicles equipped with an alternative fuel or credit-generating conventional fuel retrofit system shall be assumed to have zero miles of mileage accumulation at the time that the retrofit system is installed. Mileage may be subsequently accumulated by driving the vehicle on the road, following a typical suburban route, or on a chassis dynamometer using the Automobile Manufacturer's Association mileage accumulation cycle (40 C.F.R., Part 86, Appendix IV, as adopted January 28, 1977).

(iii) Vehicle mileage accumulation on a durability vehicle or bench aging of retrofit system components shall be conducted to determine deterioration factors. Prior to the commencement of any emission or bench aging, the applicant's test plan must be approved by the Executive Officer. Approval of the test plan shall be contingent upon a demonstration by the applicant that bench aging produces deterioration factors at least as great as durability vehicle testing.

(iv) Bench aging conducted in lieu of vehicle mileage accumulation shall be conducted for a period of time such that the resulting deterioration of the retrofit system is equivalent to that which would occur during durability vehicle mileage accumulation over a mileage equal to the useful life of the vehicle.

(v) Vehicle mileage accumulation on a durability vehicle shall be performed in conjunction with emission testing. Before beginning vehicle mileage accumulation of the retrofit system, the system shall be installed on the durability vehicle, the vehicle shall be driven 4,000 + 100 miles and then tested. An alternative fuel retrofit the vehicle shall be tested using the alternative fuel. A dual-fuel retrofit system shall be emission tested using each fuel that it is capable of operating on. At the conclusion of vehicle mileage accumulation, a second emission test or series of tests shall be performed.

Alternatively, if bench aging is used to determine deterioration factors, then bench aging shall be performed in conjunction with emission testing of a bench-test vehicle. Before beginning bench aging of the retrofit system, it shall be installed on the bench-test vehicle, the vehicle shall be driven for 4,000 + 100 miles, and the vehicle shall then be emission tested. Alternative fuel retrofits shall be tested using the alternative fuel. A dual-fuel retrofit system shall be emission tested using each fuel that it is capable of operating on. After the emission tests are completed, the retrofit system shall be removed from the vehicle and subjected to bench aging. At the conclusion of bench aging, the retrofit system shall be reinstalled on the bench-test vehicle, and a second emission test or series of tests shall be performed.

(vi) For exhaust emissions of each regulated pollutant measured during the vehicle mileage accumulation or bench-test procedure, a deterioration factor shall be calculated by dividing the emission rate obtained during the second emission test by that obtained during the first. If the resulting quotient is less than one, the deterioration factor shall be assigned a value of one. The deterioration constant for evaporative emissions shall be calculated by subtracting the evaporative emissions found during the first emission test from those found during the second test. If the resulting difference is less than zero, the deterioration constant shall be assigned a value of zero.

(vii) Choices of vehicle models, engines, and transmissions for use in emission-data vehicles shall be approved by the Executive Officer as being representative of the engine families for which certification is sought, prior to the commencement of testing. Following installation of the retrofit system, the emission-data vehicle shall be driven 4,000 + 100 miles to stabilize emission rates. After the specified mileage has been accumulated, the emission-data vehicles' exhaust and evaporative emissions, where applicable, shall be tested, using the appropriate procedure as set forth in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles." Dual fuel vehicles shall be emission tested using each fuel that the vehicle is capable of operating on.

(viii) The deteriorated emissions of emission-data vehicles shall be calculated using the deterioration factors and constants found

during vehicle mileage accumulation or bench testing. The useful life exhaust emission values are defined as the product of each emission value at 4,000 miles times the corresponding deterioration factor. For evaporative emissions, the certification emission value is equal to the sum of the emissions measured at, or extrapolated to 4,000 miles, plus the deterioration constant. The durability vehicle, bench-test vehicle, and all emission-data vehicles shall meet the applicable new vehicle useful life emission standards, as well as all applicable emission standards for intermediate mileage levels, for the vehicles' model year and fuel type(s).

(c) Test Procedures for Vehicles in Category II Not Being Certified for Credit-Generation Purposes:

Vehicles in Category II not being certified for credit may certify under these provisions, or under the alternate test procedures given in 5(g).

For durability, bench-test and emission-data vehicles in Category II, test vehicles shall have accumulated a total mileage greater than 4,000 miles and less than 10,000 miles with the original fuel system, prior to emission testing. If the manufacturer chooses to use the option as described in 1~~(b)~~ (e) for pre-1994 model year vehicles, then the 10,000 mile limit shall not be applicable. A test vehicle's engine and emission control system shall be equipped and calibrated as certified. The vehicle shall then be tested for exhaust and, if applicable, evaporative emissions using the test procedures set forth in the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles". The inertia weight setting shall be equal to the average of the vehicle's curb weight and gross vehicle weight rating and road load horsepower based on the frontal area of the vehicle without modifications, as determined in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," Section 9.b. The test results shall be defined as the baseline emission rates. After the baseline emission rates have been measured, the retrofit system shall be installed.

(i) The procedures outlined in paragraphs 5(b)(iii) through 5(b)(vi) shall be used with the following modifications: "useful life" shall equal 120,000 miles for vehicles in Category II; the durability or bench-test vehicle's emission rates of regulated pollutants measured at 4,000 ± 100 miles after the installation of the retrofit system shall not exceed 1.10 times the baseline rates; the deteriorated exhaust emissions of regulated pollutants projected to 120,000 miles shall not exceed 1.3 times the baseline emissions; and the deteriorated evaporative emissions of regulated pollutants projected to 120,000 miles shall not exceed the baseline emissions plus 0.5 grams.

(ii) When the Executive Officer determines that deterioration factors determined in paragraph 5(c)(i) may be carried across

or carried over to other engine families in Category II, the representative emission-data vehicles shall be tested as specified in paragraph 5(b)(vii). Emission rates measured at 4,000 ± 100 miles after installation of the retrofit system shall not exceed 1.10 times the vehicles' baseline rates.

(d) Test Procedures for Vehicles in Category III Not Being Certified for Credit-Generation Purposes:

Vehicles in Category III not being certified for credit may certify under these provisions, or under the alternate test procedures given in 5(g).

Applicants requesting certification for retrofit systems for use in Category III vehicles shall submit a test plan ~~utilizing eight mode chassis dynamometer testing~~, subject to the Executive Officer's approval, to verify that the retrofit system will not cause excess emissions from engine families for which certification is sought. Test vehicles shall have accumulated a total mileage greater than 4,000 miles and ~~less than 10,000 miles~~ with the original fuel system prior to emission testing. ~~If the manufacturer chooses to use the option as described in 1(b) for pre-1994 model year vehicles, then the 10,000 mile limit shall not be applicable.~~ A test vehicle's engine and emission control system shall be equipped and calibrated as certified. The vehicle shall then be tested for exhaust emissions ~~using the eight mode chassis dynamometer test~~ as specified in the test plan. The test result shall be defined as the baseline emission rate. After the baseline emission rate has been measured, the retrofit system shall be installed. Emission rates shall then be measured at 4,000 ± 100 miles after installation of the retrofit system using the ~~eight mode chassis dynamometer~~ test specified in the test plan.

~~(i) Subject to the Executive Officer's approval of the applicant's test plan prior to commencing testing, testing utilizing procedures other than the eight mode chassis dynamometer test shall be allowed.~~

(ii) Emission testing shall be conducted to determine exhaust emission rates of carbon monoxide and the sum of non-methane hydrocarbons plus nitrogen oxides. Emissions shall not exceed 1.10 times the baseline rates.

(iii) The procedures outlined in paragraphs 5(b)(iii) through 5(b)(vi) shall be used with the following modifications: "useful life" shall equal 180,000 miles for vehicles in Category III; the durability or bench-test vehicle's emission rates of CO, and the sum of non-methane hydrocarbons plus NOx measured at 4,000 ± 100 miles shall not exceed 1.10 times the baseline rates; the deteriorated exhaust emissions projected to 180,000 miles shall not exceed 1.3 times the baseline emissions; and, the deteriorated evaporative emissions projected to 180,000 miles shall not exceed baseline emissions plus 0.5 grams. For the purposes of this section, the evaporative baseline emissions shall be estimated by the manufacturer based on good engineering principles and judgment.

The manufacturer's test plan shall specify the evaporative baseline emissions estimate and describe how this estimate was derived.

(~~iv~~viii) The Executive Officer may allow carry-across of durability data from certification bench testing of retrofit systems designed for vehicles in Categories I or II to Category III retrofit system applications, if the Executive Officer determines that the carry-across durability data will adequately represent the durability performance of the retrofit system to be certified.

(iv) Applicants requesting certification for retrofit systems designed to allow Category III vehicles to operate on an alternative fuel in addition to diesel fuel shall conduct smoke opacity testing on the emission-data vehicle(s) utilizing the peak smoke opacity standards and procedures set forth in "Heavy-Duty Diesel Vehicle Smoke Opacity Test Procedure," as incorporated by reference in Title 13, CCR, Section 2182. Smoke opacity testing shall be conducted using each fuel that the retrofitted vehicle is designed to operate on. The applicable peak smoke opacity standard shall be that set for the model year for which certification is sought.

(v~~i~~) The selection of duty cycle(s) and all other aspects of the test procedure shall be subject to approval by the Executive Officer, and emission testing shall commence only after the Executive Officer has approved the test plan. The Executive Order shall be issued following review of the test data and determination that they meet the criteria specified in the test plan.

(e) Test Procedures for Vehicles in Category II Certified for Emission Reduction Credit

Vehicles in Category II certified for emission reduction credit may use these provisions, or the alternate test plan as given in 5(h).

The procedures outlined in paragraphs 5(c)(i) and (ii) shall be used with the following modifications:

(i) Certification for credit-generation purposes shall be conducted on the retrofitted engine system, utilizing an engine dynamometer, and not on the engine and vehicle combination. The test procedure used shall be the same procedure used to certify the engine family when new.

(ii) Emissions for any pollutant shall not exceed the baseline rate by more than a factor of 1.10. Baseline emissions for pre- and post-retrofit comparison purposes will be the certification emission levels determined during the original engine family certification, except:

[A] The baseline for particulate matter (PM) emissions for diesel engines whose PM emission levels were not determined during the new engine family certification process shall be 0.6 gram/bhp-hr.

[B] Formaldehyde emissions from any 1993 and earlier model year engine operating on methanol- or ethanol-based fuel shall be at or below the 1993 model year standard. Formaldehyde emissions from any 1994 or subsequent model year engine operating on methanol- or ethanol-based fuel shall be at or below the formaldehyde standard for that model year.

[C] For diesel engines, baseline carbon monoxide and hydrocarbon emissions shall be the original emission certification value for the engine's model year.

[D] For engine families originally certified to a combined HC plus NOx standard, the baseline HC and NOx standards will be the combined standard pro-rated by the HC and NOx portions, respectively, of the original emission certification levels. If the original emission certification levels are not available, the HC and NOx baseline standards will be pro-rated by the HC and NOx certification standards of the next later model year with separate HC and NOx standards.

(iii) The "useful life" shall be 120,000 miles for vehicles in Category II, and 180,000 miles for vehicles in Category III. Deteriorated exhaust emissions projected to the useful life shall not exceed the baseline rate by more than a factor of 1.30, except for the pollutant(s) for which credits will be generated, which will not exceed the credit standard declared on the certification application as required under 4(c)(i). The deteriorated evaporative emissions, if any, projected to the useful life shall not exceed baseline emissions.

(f) Test Procedures for Vehicles in Category III Certified for Emission Reduction Credit

Vehicles in Category III certified for emission reduction credit may use these provisions, or the alternate test plan as given in 5(h).

The procedures outlined in paragraphs 5(d)(i) through (v) shall be used with the modifications listed in 5(e)(i) through 5(e)(iii).

(g) Alternate Test Procedure for Vehicles in Category II or Category III Not Being Certified for Credit Generation Purposes

The manufacturer shall submit data from durability testing conducted using the test procedures used in the new engine certification. The deteriorated useful life emission levels shall meet the applicable emission standards for engines of that model year and fuel type. The Executive Officer may certify the retrofit system based on review of the durability test data. If durability test data are not available, the manufacturer shall use the following procedures:

(i) The retrofit manufacturer shall submit derived deterioration factors, and test data that shows similar

performance characteristics between the retrofitted engine and the original equipment manufacturer engine. The manufacturer shall submit test data showing component durability of the retrofit system. The manufacturer shall also submit a test plan describing the procedures that will be used to validate the derived deterioration factors within two years. The manufacturer derived deterioration factors and the test plan must be reviewed and approved by the Executive Officer.

(ii) The retrofit system shall be installed on the test engine. Certification shall be conducted on the retrofitted engine system, using the same test procedure used to certify the engine family when new. Deteriorated useful life emissions based on manufacturer derived deterioration factors shall meet the applicable new engine emission standards.

(iv) Following retrofit system certification, the manufacturer will conduct engine aging, either in-use or on an engine dynamometer, according to the specified test plan. Emissions testing shall be conducted on the aged retrofit engine system using the same test procedure used to certify the engine family when new. Deteriorated useful life emissions based on durability testing shall meet the applicable new engine emission standards for that vehicle model.

(iv) Vehicles in Category III must meet the requirements of 5(d)(iii) and 5(d)(iv).

(h) Alternate Test Procedure for Vehicles in Category II or Category III Certified for Credit Generation Purposes

The procedures outlined in 5(g) shall be used, with the following modifications:

(i) The manufacturer shall also meet the requirements in 5(e)(i) and 5(e)(ii).

(ii) Deteriorated useful life emissions based on durability testing shall not exceed the original equipment manufacturer engine certification emissions level by more than a factor of 1.30, except for the pollutant(s) for which credits will be generated, which will not exceed the credit standard declared on the certification application as required under 4(c)(i). The deteriorated evaporative emissions, if any, projected to the useful life, shall not exceed baseline emissions.

6. APPROVAL

(a) Issuance of Executive Orders:

If, after reviewing the test data and other information submitted by the retrofit system manufacturer, the Executive Officer determines that the retrofit system meets the applicable emission

standards or the criteria of an approved test plan, as applicable, an Executive Order shall be issued certifying the retrofit system for sale and installation on vehicles in the engine families specified in the application. The Executive Order shall specify, if applicable, that the retrofit system is certified as [A] converting a conventional motor vehicle into a TLEV, LEV or ULEV, [B] converting a TLEV into a LEV or ULEV, ~~or~~[C] converting a LEV into a ULEV or [D] for heavy-duty credit conversions, the applicable credit standard(s).

(b) Carry-Over and Carry-Across:

(i) Carry-over of emission test data from the previous model year to the following model year will be allowed, if the Executive Officer determines that the carry-over data will adequately represent the emissions performance of the retrofit system to be certified.Carry-across to similar engine families will also be allowed.

(ii) An original equipment manufacturer (OEM) that produces retrofit hardware which upgrades an old engine to the identical configuration of a newer engine family that the manufacturer also produces, may carry-across the newer engine family certification test data for the retrofit hardware certification process. (For these purposes, the term "identical" means that all engine parts on the retrofitted engine which affect emissions, such as pistons, cylinder heads, etc., must be of the same design and construction as those on the newer engine family. Engine calibration, including injection timing must also be identical.)

(iii) Applications for carry-over and carry-across must be accompanied by an engineering analysis demonstrating that the emissions and durability of the retrofit system and engine family for which certification is being sought will be adequately represented by a certified retrofit system/engine family application.

(iv) Applications for carry-over and carry-across will be evaluated according to the the criteria contained in EPA Advisory Circular 17F, which is incorporated herein by reference, and paragraph 4.~~b~~.4 c.5 of the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles." These include, but are not limited to, similarity of catalyst location and configuration, similarity of fuel metering system, similarity of emission control system logic and design, and similarity of any other features that may affect the durability of the retrofit system's emission performance.

7. INSTALLATION REQUIREMENTS

(a) Prior to releasing a converted vehicle to the consumer, the installer of an alternative fuel or credit-generating conventional

fuel retrofit system shall submit the converted vehicle to a Bureau of Automotive Repair Referee Smog Check Station for inspection and testing except as provided in 7 (b).

(i) The installer of an alternative fuel or credit-generating conventional fuel retrofit system shall keep a copy of the certificate of compliance, issued by the Bureau of Automotive Repair Referee Smog Check Station, as part of the record specified in paragraph 3(e). The certificate of compliance shall contain, but need not be limited to, the following: the vehicle's identification number, the vehicle's model year and make, the date of installation, and the emissions category to which the retrofitted system is certified (i.e., conventional vehicle, TLEV, LEV, or ULEV) or, for heavy-duty vehicles, the credit standard to which the system is certified. The original certificate of compliance shall be submitted to the vehicle owner upon the vehicle's release.

(ii) The installer of an alternative fuel or credit-generating conventional fuel retrofit system shall not release the converted vehicle to the consumer without the issuance of a certificate of compliance for the vehicle by a Bureau of Automotive Repair Referee Smog Check Station.

(iii) The installer of an alternative fuel or credit-generating conventional fuel retrofit system shall also meet the requirements of paragraph 9(c).

(b) The retrofit system installer may request Air Resources Board approval to use the alternative inspection schedule for fleet installation of the same retrofit kit on more than 10 vehicles with engines from similar engine families. If approval is granted, the installer shall submit ten vehicles with engines from similar engine families, retrofitted with the same kit, to a Bureau of Automotive Repair Station as provided in 7 (a)(i) and 7 (a)(ii).

(i) If all ten vehicles receive a certificate of compliance, for subsequent applications of the same type, the installer need only submit every tenth retrofitted vehicle to the Bureau of Automotive Repair pursuant to 7 (a)(i) and 7 (a)(ii) . For the remaining vehicles included in the alternative inspection schedule that are not submitted to the Bureau of Automotive Repair, the installer shall maintain a record of the vehicle's identification number, the vehicle's model year and make, the engine size, the manufacturer and fuel type of the retrofit kit, the date of installation, and the emissions category to which the retrofitted system is certified (i.e., conventional vehicle, TLEV, LEV, or ULEV), or for heavy-duty vehicles, the credit standard to which the system is certified. The Air Resources Board may require random inspection of any vehicles subject to the alternative inspection schedule.

(ii) If any of the ten vehicles fail to pass inspection, the next set of ten retrofitted vehicles shall be subject to inspection at the Bureau of Automotive Repair, until an entire group of 10 passes.

8. IN-USE ENFORCEMENT TEST REQUIREMENTS

(a) Manufacturers of alternative fuel or credit-generating conventional fuel retrofit systems shall, upon order by the Executive Officer, perform in-use enforcement emission testing of their products. The Executive Officer may order in-use enforcement emission testing of not more than 20 percent of a manufacturer's certified retrofit systems/engine family applications per year. If 20 percent constitutes less than one of a manufacturer's certified systems, the Executive Officer may order in-use enforcement emission testing of not more than one certified system/engine family application per year. Manufacturers shall be required to perform emission testing of not less than ten vehicles per certified retrofit system/engine family application selected by the Executive Officer for in-use enforcement emission testing. Upon order by the Executive Officer, manufacturers shall perform the applicable emission tests pursuant to the following:

(i) No vehicle shall be accepted by the manufacturer as a representative vehicle for enforcement testing unless the following criteria are met:

(1) California certified and registered.

(2) Odometer indication of less than certified useful-life mileage and vehicle age within useful-life time period.

(3) No indication of abuse (e.g., racing, overloading, misfueling, or other misuse), neglect, improper maintenance or other factors that would have an effect on emission performance.

(4) No major repair to engine or major repair of vehicle resulting from collision.

(5) Lead content of fuel sample from the vehicle tank meets applicable standards.

(6) No indication of any problem that might jeopardize the safety of laboratory personnel.

(ii) The manufacturer shall, under ARB supervision, perform diagnosis or restorative maintenance on those vehicles selected for in-use enforcement testing. The manufacturer or a laboratory approved by the Executive Officer shall (1) identify part numbers of all essential emission control system components; (2) check air filter, all drive belts, all fluid levels, radiator cap, all vacuum hoses and electrical wiring related to emission control for integrity; check fuel metering and emission control system components for maladjustments and/or tampering, and record all discrepancies; (3) check ignition system with oscilloscope and replace any defective components; i.e., spark plugs, wires, etc.; (4) check compression; (5) check and adjust engine parameters to

manufacturer's specifications; and (6) perform maintenance if the vehicle is within 500 miles of scheduled maintenance service.

(iii) For vehicles in Category I, the manufacturer or a laboratory approved by the Executive Officer shall perform the applicable emission test procedures set forth in the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles." The applicable emission standards shall be the vehicle's useful life standards as well as any intermediate emission standards, as stated in the Executive Order.

(iv) For vehicles in Category II not certified for credit generation, in-use enforcement exhaust and, if applicable, evaporative emissions shall be performed using the test procedures set forth in the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles". The inertia weight setting shall be equal to the average of the vehicle's curb weight and gross vehicle weight rating and road load horsepower based on the frontal area of the vehicle without modifications, as determined in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," Section 9.b. For vehicles in Category III not certified for credit generation, in-use enforcement exhaust emission tests shall be performed in accordance with the test plan approved by the Executive Officer prior to certification testing of the engine family applications specified for in-use enforcement testing. For vehicles in Categories II and III which are certified for credit generation, in-use enforcement testing will consist of repeating the procedures and requirements of paragraphs 5(e) and 5(f), respectively, except as provided for in paragraph 8(a)(viii), below.

(v) The applicable exhaust emission standards for vehicles in Categories II and III shall be the baseline emission rates established during certification testing of the engine family applications specified for in-use enforcement testing times 1.3 except as provided in paragraphs 5(e) and 5(f) for credit generating systems. The applicable evaporative emission standards for vehicles in Categories II and III shall be the baseline emission rates established during certification testing of the engine family applications specified for in-use enforcement testing plus 0.5 grams except as provided in paragraphs 5(e) and 5(f) for credit generating systems.

(vi) Manufacturers shall complete in-use enforcement testing within 6 months of the issuance of the in-use compliance testing order and shall submit all test data to the Executive Officer within 30 calendar days following completion of testing.

(vii) Following review of manufacturer in-use enforcement test data, the Executive Officer may conduct confirmatory in-use enforcement testing.

(viii) OEM upgrade systems certified for credit-generation use as described in paragraph 6(b), shall be subject to the new engine family in-use testing requirements for the engine family on which the system is originally certified. Such systems will not be subject to the in-use enforcement testing requirements of these Procedures.

(b) If the results of the in-use vehicle emission tests conducted pursuant to paragraphs 8(a)(i) through 8(a)(viii) indicate that the average emissions of the test vehicles for any pollutant exceed the applicable emission standards or specified limits for credit generation certification, the entire vehicle population so represented shall be deemed to exceed such standards. Upon order by the Executive Officer, the manufacturer shall have 45 days to submit an influenced recall plan in accordance with Sections 2111 through 2121, Title 13, CCR. If no such recall plan is submitted, the Executive Officer may order corrective action including recall of the affected vehicles in accordance with Sections 2122 through 2135, Title 13, CCR. For the purpose of these Procedures, the term "manufacturer," as referenced in Sections 2111 through 2135, Title 13, CCR, shall mean "retrofit system manufacturer."

9. WARRANTY REQUIREMENTS

(a) Requirements of Manufacturers:

The manufacturer of an alternative fuel or credit-generating conventional fuel retrofit system shall warrant to the person having the vehicle retrofitted and to each subsequent purchaser of the vehicle that the alternative fuel or credit-generating conventional fuel retrofit system is designed and manufactured to conform with the applicable requirements of these Procedures and is free from defects in materials and workmanship which cause the alternative fuel or credit-generating conventional fuel retrofit system to fail to conform with the applicable requirements of these Procedures or cause damage to any part on the retrofitted vehicle. This warranty shall be effective for three years or 50,000 miles, whichever first occurs, of customer service, and shall cover the full repair or replacement costs including the costs of diagnosis, labor, and parts (including any part on the retrofitted vehicle that is damaged due to a defect in the alternative fuel or credit-generating conventional fuel retrofit system).

(b) Extended Warranty Requirements:

Each manufacturer of an alternative fuel or credit-generating conventional fuel retrofit system shall identify in its application for certification the warranted parts whose individual replacement cost, at the time of certification, exceeds the cost limit defined in paragraph 9(b)(i). The replacement cost shall include the cost of the diagnosis, parts, and labor. The costs shall be those of the highest cost metropolitan area of California. Each manufacturer shall warrant to the person having the vehicle retrofitted and to each subsequent purchaser of the vehicle that those parts identified in its application for certification as

exceeding the cost limit defined in paragraph 9(b)(i) are free from defects in materials and workmanship which cause the alternative fuel or credit-generating conventional fuel retrofit system to fail to conform with the requirements of these Procedures or cause damage to any part on the retrofitted vehicle, for seven years or 70,000 miles, whichever first occurs.

(i) The cost limit shall be calculated using the following equation:

$$\text{Cost limit}_n = \$300 \times (CPI_{n-2}/121.9)$$

where:
Cost limit_n is the cost limit for the year in which the alternative fuel or credit-generating conventional fuel retrofit system is to be certified.

n is the year in which the alternative fuel or credit-generating conventional fuel retrofit system is to be certified.

CPI is the annual average consumer price index for California published by the United States Bureau of Labor Statistics.

(ii) The cost limit shall be revised annually by the Executive Officer. The highest cost metropolitan area in California shall be identified by the Executive Officer.

(iii) Each manufacturer shall submit to the Executive Officer the documentation used to identify the warranted parts required in this subsection. The documentation shall include the estimated retail parts costs, labor rates in dollars per hour, and the labor hours necessary to replace the parts.

(c) Requirements of Installers:

Each installer of an alternative fuel or credit-generating conventional fuel retrofit system shall warrant to the person having the vehicle retrofitted and to each subsequent purchaser of the vehicle that the alternative fuel or credit-generating conventional fuel retrofit system will not fail to conform with the applicable requirements of these Procedures due to incorrect installation, and that no part on the retrofitted vehicle will be damaged due to incorrect installation. Installers of alternative fuel or credit-generating conventional fuel retrofit systems shall install only those systems of a certified configuration and shall agree to indemnify the person having the vehicle retrofitted and to each subsequent purchaser of the vehicle for the cost of repair of any vehicle upon which a noncertified configuration was installed. In addition, the installer shall agree to indemnify the person having the vehicle retrofitted and to each subsequent purchaser of the vehicle for any tampering fines that may be imposed as a result of improper installation of the alternative fuel or credit-generating conventional fuel retrofit system. The warranties and agreements to indemnify shall be effective for three years or 50,000 miles, whichever first occurs, of customer service, and

shall cover the full repair or replacement costs including the costs of diagnosis, labor, and parts (including any part on the retrofitted vehicle that is damaged due to incorrect installation of the alternative fuel or credit-generating conventional fuel retrofit system).

Before an installer installs an alternative fuel or credit-generating conventional fuel retrofit system, he or she shall have submitted to the ARB a sample of the warranty statement to be provided by the installer in accordance with this paragraph.

ATTACHMENT B

PROPOSED AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES CERTIFIED FOR 1993 AND EARLIER MODEL YEARS TO USE LIQUEFIED PETROLEUM GAS OR NATURAL GAS FUELS

State of California
AIR RESOURCES BOARD

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES CERTIFIED FOR 1993 AND EARLIER MODEL YEARS TO USE LIQUEFIED PETROLEUM GAS OR NATURAL GAS FUELS

Adopted: April 16, 1975
Amended: April 18, 1981
Amended: September 14, 1984
Amended: March 11, 1993
Amended: [Insert date of amendment]

Note: These procedures are printed in a style that shows the proposed amendments. Originally proposed new text is indicated by underline and deletions are indicated by strikeout. Changes to the text originally noticed to the public on March 27, 1992 are indicated as follows: additions to the text are denoted by underline and deletions are denoted by ~~strikeout~~.

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CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES CERTIFIED FOR 1993 AND EARLIER MODEL YEARS TO USE LIQUEFIED PETROLEUM GAS OR NATURAL GAS FUELS

The authority for these Exhaust Emission Standards and Test Procedures is found in Sections 43004 and 43006 of the California Health and Safety Code which contain the following:

> 43004. "--the standards applicable under this part for exhaust emissions for gasoline-powered motor vehicles shall apply to motor vehicles which have been modified or altered to use a fuel other than gasoline or diesel."
>
> 43006. "The state board may certify the fuel system of any motor vehicle powered by a fuel other than gasoline or diesel which meets the standards specified by Section 43004 and adopt test procedures for such certification."

1. GENERAL APPLICABILITY

"California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels" ("these test procedures" or "these procedures") are applicable to any single- or dual-fuel motor vehicle conversion system using liquefied petroleum gas (LPG) or natural gas (NG) in lieu of the original gasoline or diesel fuel system for 1993 and earlier model year emission-controlled vehicles used or registered in the State of California.

A retrofit system manufacturer may apply these test procedures to certify conversion systems for 1994, ~~and~~ 1995, and 1996 model-year vehicles in accordance with the following implementation phase-in schedule. Each manufacturer may certify a maximum of 85 percent of its total 1994 model-year engine family conversion systems, ~~and~~ 45 percent of its total 1995 model-year systems, and 45 percent of its total 1996 model-year systems, according to the requirements of these test procedures and "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels." The remaining percentage of each manufacturer's certified 1994, ~~and~~ 1995, and 1996 model-year engine family conversion systems and all of 1996 and subsequent model-year engine family conversion systems shall be certified according to "California Certification and Installation Procedures for Alternative Fuel Retrofit Systems For Motor Vehicles Certified For 1994 and Subsequent Model Years and for All Model-Year Motor Vehicle Retrofit Systems Certified for Emission Reduction Credit." The percentages shall be determined from the total number of conversion systems certified and shall be met prior to the end of the ~~applicable~~ next respective calendar year. If the above referenced 85 percent maximum is exceeded for 1994 or the above referenced 45 percent maximum is exceeded for 1995 or 1996, the Executive Officer shall rescind the Executive Order for those conversion systems most recently certified which caused the

percentages to be exceeded. These procedures shall not be used to certify a retrofit system for installation on a transitional low-emission vehicle ("TLEV"), low-emission vehicle ("LEV"), or ultra-low-emission vehicle ("ULEV") or to certify a retrofit system designed to convert a vehicle to TLEV, LEV, or ULEV emission standards (as defined in Section 1960.1, Title 13, CCR). These procedures shall not be used to certify retrofits for emission reduction credit.

2. DEFINITIONS

The definitions shall be the same as those in the applicable model year California exhaust emission standards and test procedures for passenger cars, light-duty trucks, and medium-duty vehicles.

All provisions of these procedures (except where specifically noted) shall apply to single-fuel liquefied petroleum gas (LPG), single-fuel natural gas (NG), AND DUAL-FUEL (LPG/gasoline or NG/gasoline)

3. GENERAL STANDARDS

(a) In addition to all other standards or requirements imposed, any modification of a gasoline- or diesel-fueled motor vehicle to allow the use of liquefied petroleum gas or natural gas as a fuel:

(i) Shall not in its operation or function cause the emission into the ambient air of any noxious or toxic substance that is not emitted in the operation of such vehicle without such modification, except as specifically permitted by regulation; and

(ii) Shall not in its operation, function, or malfunction, result in any unsafe condition endangering the motor vehicle, it occupants, other persons, or property in close proximity to the vehicle, in accordance with the safety requirements specified for the original vehicle.

(b) In the case of a dual-fuel conversion, where the vehicle may run on gasoline (or diesel) or a gaseous fuel, removal of originally required emission control systems will not be permitted. These provisions shall not apply to heated intake air systems or the original air cleaner when replaced by an air cleaner compatible with the LPG/NG carburetor.

4. NON-APPLICABLE REGULATIONS

All requirements in the referenced California exhaust emission standards and test procedures for gasoline or diesel-powered vehicles not directly related to exhaust emission test procedures shall not be applicable to these procedures.

5. APPLICATION FOR APPROVAL

a. An application for approval of a modification to use LPG and NG fuel in a gasoline- or diesel-powered engine may be made by any engine, vehicle, or conversion equipment manufacturer.

b. An application shall be required for each model year even though the exhaust emission standards for approval of new vehicles may be the same for consecutive model years.

c. The application shall be in writing, signed by an authorized representative of the manufacturer, and shall include the following:

i. Identification and description of the vehicles in each vehicle category and engine displacement ranges for which approval is requested.

There are three vehicle categories.

a) Passenger Cars (PC)

b) Light-Duty Trucks (LDT) and Medium-Duty Vehicles (MDV)

c) Heavy-Duty Vehicles (HDV) powered by Heavy-Duty Engines (HDE)

ii. A complete description and identification of the conversion system, including carburetor model number(s), carburetor configuration/calibration codes(s), vaporizer/regulator model number(s), evidence of proper assembly of the fuel tank and fuel lines, and the necessary modification to the engine or vehicle.

iii. A statement of recommended maintenance procedures, including initial installation and initial tuning, and equipment necessary to ensure that the vehicle and engine in operation conform to the regulations. If the procedures are not uniform, then the specific procedures for each difference make and model shall be given. A description of the program for training of personnel for such maintenance and installation.

iv. An agreement that upon the Executive Officer's request any one or more of the test vehicles will be supplied to the Air Resources Board (ARB) for such testing as it may require, or (by mutual consent between the ARB and applicant) will be made available at the manufacturer's facility for such testing. Provided, that in the latter case, it is further agreed that the instrumentation and equipment specified by the ARB will be made available for testing operations. Any testing conducted at a manufacturer's facility pursuant to this subparagraph will be scheduled as promptly as possible.

v. An agreement that up to two test vehicles per vehicle category will be made available to the ARB for testing for such reasonable periods as may be required. These vehicles shall be selected from time to time by the Executive Officer and shall be typical of production models available for sale to the public. They shall also be representative of the engines and transmissions offered by the vehicle manufacturers.

vi. An agreement that the modifications made in the field will be properly identified. To meet this requirement, the model number shall be permanently marked on the carburetor. A permanent label, to be affixed in the engine compartment where it may be easily read, covering the following for the specific installation, shall be furnished. The label shall set forth the following:

1. Manufacturer's name and address.
2. The California Air Resources Board certification number identified as "CARB E.O. No. B-XX."
3. Spark timing.
4. Idle speed.
5. Mixture adjustment (if used) including idle, cruise, and/or full throttle together with the method.
6. Diagrams for vacuum hose routing and electrical wiring harness.
7. Carburetor, vaporizer/regulator model numbers, and carburetor configuration/calibration codes.

vii. For retrofit systems applicable to 1994, ~~and~~ 1995, and 1996 model year vehicles, a complete listing of the engine families for which the manufacturer's retrofit systems are designed for installation. The number of a manufacturer's 1994, ~~and~~ 1995, and 1996 model-year engine family retrofit systems certified according to these test procedures shall be limited according to the phase-in schedule described in the General Applicability section of these procedures.

d. An application may be made for certification to emission standards or to typical baseline emission levels.

6. EMISSION STANDARDS AND TEST PROCEDURES FOR PC, LDT, MDV, AND HDE

(a) For certification to emission standards, the appropriate model-year exhaust emission standards to be used are the applicable California new vehicle exhaust emission standards. Test procedures shall be the applicable California new vehicle certification test procedures for the model-year of the test vehicle. Compliance is demonstrated by applying a deterioration factor to both the cold and hot start emission test results to project the emission levels to the end of the vehicle's useful life and comparing the results with the emission standards. These test results must meet the applicable emission standards. A retest is permitted if the vehicle fails the first test. The assigned deterioration factor will be based on gasoline-powered or diesel-powered vehicle certification deterioration rates as specified by the Executive Officer. In addition, dual-fuel systems will require CVS-75 tests using the original fuel with the conversion system installed. This test result (with the certification deterioration factor or, if not available, an assigned deterioration factor applied) must also meet the applicable emissions standards.

(b) For certification to typical baseline emission levels, the exhaust emission levels to be used are those from representative vehicles in good operating condition selected by the Executive Officer for testing. Test procedures shall be the applicable California test procedures for the model-year of the vehicle. Back-to-back tests must be conducted and a significant increase in the emissions from the baseline may be cause for denial. In order to improve data reliability, the manufacturer may elect to perform two back-to-back tests, in which case a significant increase in the average emissions of the two conversion system tests over the average baseline test emissions may be cause for denial. Test variability will be considered in establishing significant increases in emissions. In addition, for dual-fuel systems, a CVS-72 test using the original fuel with the conversion system is required. This test shall also not significantly increase emissions from the baseline level.

The test variability factors applicable for back-to-back tests are 1.10 for HC and NOx and 1.15 for CO emissions. The conversion system meets the compliance requirements when the emission data from the tests with the conversion system installed, are at or below the emission levels of the baseline emissions with the variability factors applied.

(c) For certification of conversion systems to be installed only on heavy-duty engines, the appropriate model-year exhaust emission standards and applicable (diesel or gasoline) exhaust emission test procedures shall be used. However, approval of a conversion system to be installed on PC or LDT/MDV shall automatically qualify the system for use with heavy-duty engines with similar or less sophisticated emission control systems without additional testing.

(d) The durability of all systems will be determined by an engineering evaluation. For cause, and based on the engineering evaluation, the Executive Officer may require durability tests.

7. SELECTION OF TEST VEHICLES FOR THE LIMITED FLEET

A maximum of two test vehicles may be required by the Executive Officer for each vehicle category. One test vehicle can represent the worst case and the other the most popular vehicle for which the conversion system is applicable. The Air Resources Board will notify the applicant in writing of the vehicles which can be used to demonstrate compliance. In requesting emission tests, the Air Resources Board will consider emission control system similarity over vehicle categories when determining the test fleet size.

8. VEHICLE TESTING

To assure better test data utilization, each applicant shall obtain prior approval in writing from the Executive Officer on the test vehicle fleet.

(a) Test Vehicles

(1) Vehicles Certifying to New Vehicle Exhaust Emission Standards

Each test vehicle shall be a California certified version having been driven a minimum of 4,000 miles on gaseous fuel. The vehicle mileage accumulation must be done by driving the vehicle on the road following a route of typical suburban type driving, or on a chassis dynamometer utilizing the Automobile Manufacturer's Association (AMA) mileage accumulation cycle. The applicant may request and the Executive Officer may allow test vehicles with less mileage if the applicant demonstrates emission stability. Emission stability can be demonstrated by performing two (2) consecutive CVS-75 emission tests with 500 miles of AMA type driving between tests and showing no change in emissions outside of test variability.

Each test vehicle must also be subjected to a thorough examination prior to any emissions test(s) to detect and correct possible defects and deviations from manufacturer's specifications in emissions-related parts.

Testing may be performed at any independent laboratory properly equipped to conduct the tests. The test vehicles shall be under the control of the laboratory for the entire test period. Return of test vehicles to the applicant during the test period may invalidate the test results.

The laboratory's report must be submitted directly to the Executive Officer and contain all related information, including failed test data. Tests performed for research and development purposes before the application is submitted need not be reported. The applicant may not edit the laboratory report but may submit additional clarifying comments or information.

(ii) Vehicles Certifying to Typical Emission Levels

Each test vehicle shall be a California certified version having been driven a minimum of 4,000 miles on the original certification fuel as required for new vehicle certification. In the event that a manufacturer acquires a vehicle with less than 4,000 miles, the vehicle mileage must be brought to 4,000 miles by driving the vehicle on the road following a route of typical suburban type driving, or by accumulating mileage on a chassis dynamometer utilizing the AMA mileage accumulation cycle. The Executive Officer may allow test vehicles with less mileage if the applicant demonstrates emission stability. Emission stability can be demonstrated by performing two (2) consecutive CVS-75 emission tests with 500 miles of AMA type driving between tests and showing no change in emissions outside of test variability.

Each test vehicle must also be subjected to a thorough examination prior to the baseline test to detect and correct possible defects and deviations from manufacturer's specification in emissions-related parts. The baseline emissions of the test vehicle should be typical for that particular make and model-year. Typical vehicle emissions will be determined by using the vehicle surveillance test data, supplemented by assembly-line test and certification test data as required and appropriate.

If a vehicle exceeds typical emission values, the applicant may make a full diagnostic evaluation of the vehicle, make any necessary repairs, and retest the vehicle. If no abnormal conditions of the engine or the emission controls are noted, the vehicle will be accepted as a test vehicle and its emissions data will be used for comparison with conversion system test results. The applicant may forego the above and select another test vehicle from the given list of alternative vehicles.

Testing may be performed at any laboratory properly equipped to conduct the tests. The test vehicle shall be under the control of the laboratory for the entire test period. Return of the test vehicle to the applicant during the test period may invalidate prior test results.

After the baseline test has been run, prior approval must be obtained from the Executive Officer before any servicing, maintenance, or parts replacements are made, except those that are in accordance with the written instructions provided with the application. The same fuel shall be used for the back-to-back tests using gasoline or diesel. There should be sufficient fuel in the fuel tank to permit the baseline and with conversion system tests. The laboratory shall record all the above information and include it as part of the report. The laboratory's report must be submitted directly to the Executive Officer and contain all related information, including failed test data. Tests performed for research and development purposes before the application is submitted need not be reported. The applicant may not edit the laboratory report but may submit additional clarifying comments or information.

(b) Test Sequence

(i) Straight liquefied petroleum or natural gas conversions certifying to emission standards

1. Adjust vehicle to vehicle manufacturer's specification.

2. Install conversion system in accordance with conversion system manufacturer's installation instructions (permanent installation of gaseous fuel tank is not required).

3. Run one cold start CVS-75 test using gaseous fuel.

4. Run one cold start CVS-75 test using gaseous fuel (only if first CVS-75 test fails the emission standards).

(ii) Dual-fuel systems certifying to standards

1. Adjust vehicle to vehicle manufacturer's specifications.

2. Install conversion system in accordance with the conversion system manufacturer's installation instructions (permanent installation of gaseous fuel tank is not required).

3. Run one cold start CVS-75 test using gaseous fuel.

4. Run one cold start CVS-75 test using gaseous fuel (only if first CVS-75 test on gaseous fuel fails the emission standards).

5. Run one hot start CVS-72 test using gasoline or diesel fuel.

6. Run one hot start CVS-72 test using gasoline or diesel fuel (only if first CVS-72 test on gasoline or diesel fuel fails the emission standards).

(iii) Straight liquefied petroleum or natural gas conversions certifying to typical baseline emission levels

1. Adjust vehicle to vehicle manufacturer's specification.

2. Run one cold start CVS-75 test using gasoline or diesel fuel.

3. Install conversion system in accordance with conversion system manufacturer's installation instructions (permanent installation of gaseous fuel tank is not required).

4. Run one cold start CVS-75 test using gaseous fuel.

(iv) Dual-fuel systems certifying to typical baseline emission levels

1. Adjust vehicle to vehicle manufacturer's specifications.

2. Run two baseline tests using gasoline or diesel fuel. One is a cold start CVS-75, and the other is a hot start CVS-72.

3. Install conversion system in accordance with the conversion system manufacturer's installation instructions (permanent installation of gaseous fuel tank is not required).

4. Repeat cold start CVS-75 test using gaseous fuel and the hot start CVS-72 test using gasoline or diesel as the fuel.

5. As an alternative, the applicant may delete the two hot start CVS-72 tests and in their places run a cold start CVS-75 test with conversion system using gasoline or diesel fuel.

9. CALCULATION PROCEDURES

The following calculation procedures are based on the Federal CVS-1975 Test Procedure. The final reported test results shall be computed by use of the following formulas:

Meaning of Symbols

PC - Passenger cars
LDT - Light-duty trucks
MDV - Medium-duty vehicles (over 6000-8500 lbs. GVW)
HDV - Heavy-duty vehicles (those vehicles over 8500 lbs. GVW)

CO_{conc} = Carbon monoxide concentration of the dilute exhaust sample corrected for background, water vapor, and CO_2 extraction, in ppm.

CO_{dm} = Carbon monoxide concentration of the dilution air sample as measured, in ppm.

CO_d = Carbon monoxide concentration of the dilution air corrected for water vapor extraction, in ppm.

CO_e = Carbon monoxide concentrations of the dilute exhaust sample volume corrected for water vapor and carbon dioxide extraction, in ppm. The calculation assumes the carbon to hydrogen ratio of the fuel to be 1:3.802 for natural gas and 1:2.656 for LPG.

CO_{em} = Carbon monoxide concentration of the dilute exhaust sample as measured, in ppm.

CO_{mass} = Carbon monoxide emissions, in grams per test phase.

$CO_{2_{conc}}$ = Carbon dioxide concentration of the dilute exhaust sample corrected for background and water vapor, in percent.

CO_{2_e} = Carbon dioxide concentration of the dilute exhaust sample, in percent.

$CO_{2_{mass}}$ = Carbon dioxide emissions, in grams per test phase.

$Density_{CO}$ = Density of carbon monoxide is 32.97 g/ft^3 of 68°F and 760 mm Hg pressure.

$Density_{HC}$ = Density of hydrocarbons is 18.64 g/ft^3 for natural gas and 17.28 g/ft^3 for LPG assuming an average carbon to hydrogen ratio of 1:3.802 for natural gas and 1:2.656 for LPG, at 68°F and 760 mm Hg pressure.

$Density_{NO_2}$ = Density of oxides of nitrogen is 54.16 g/ft^3 assuming they are in the form of nitrogen dioxide, at 68°F and 760 mm Hg pressure.

DF = Dilution Factor.

H = Absolute humidity in grains of water per pound of dry air.

HC_{conc} = Hydrocarbon concentration for the dilute exhaust sample corrected for background, in ppm carbon equivalent, i.e., equivalent propane x 3.

HC_d = Hydrocarbon concentration of the dilution air as measured, in ppm carbon equivalent.

HC_e = Hydrocarbon concentration of the dilute exhaust sample, in ppm carbon equivalent.

HC_{mass} = Hydrocarbon emissions, in grams per test phase.

K_H = Humidity correction factor.

N = Number of revolutions of the positive displacement pump during the test phase while samples are being collected.

$NO_{x_{conc}}$ = Oxides of nitrogen concentration of the dilute exhaust sample corrected for background, in ppm.

NO_{x_d} = Oxides of nitrogen concentration of the dilute air as measured, in ppm.

NO_{x_e} = Oxides of nitrogen concentration of the dilute exhaust sample as measured, in ppm.

$NO_{x_{mass}}$ = Oxides of nitrogen emissions, in grams per test phase.

P_B = Barometric pressure, in mm Hg.

P_d = Saturated vapor pressure, in mm Hg at ambient dry bulb temperature.

P_i = Pressure depression below atmospheric measured at the inlet to the positive displacement pump.

T_p = Average temperature of dilute exhaust entering positive displacement pump during test while samples are being collected, in degrees Rankine.

R_a = Relative humidity of the ambient air, in percent.

V_{mix} = Total dilute exhaust volume in cubic feet per test phase corrected to standard conditions ($528^{\circ}R$ and 760 mm Hg).

Vo = Volume of gas pumped by the positive displacement pump, in cubic feet per revolution. This volume is dependent on the pressure differential across the positive displacement pump.

Y_{ct} = Mass emissions as calculated from the "transient" phase of the cold start test, in grams per test phase.

Y_{ht} = Mass emissions as calculated from the "transient" phase of the cold start test, in grams per test phase.

Y_s = Mass emissions as calculated from the "stabilized" phase of the cold start test, in grams per test phase.

Y_{wm} = Weighted mass emissions of each pollutant, i.e., HC, CO, or NO_x, in grams per vehicle mile.

For passenger cars, light-duty trucks, and medium-duty vehicles:

(a) The mass emissions of each pollutant in grams per mile is $Y_{wm} = (0.43Y_{ct} + 0.57\ Y_{ht} + Y_s)/7.5$

(b) The mass of each pollutant for each phase of both the cold start test and the hot start test is determined from the following:

(1) Hydrocarbon mass:

$$HC_{mass} = V_{mix} \times Density_{HC} \times (HC_{conc}/1{,}000{,}000)$$

(2) Oxides of nitrogen mass:

$$NO_{x_{mass}} = V_{mix} \times Density_{NO_2} \times K_H \times (NO_{x_{conc}}/1{,}000{,}000)$$

K_H = humidity correction factor

(3) Carbon monoxide mass:

$$CO_{mass} = V_{mix} \times Density_{CO} \times (CO_{conc}/1{,}000{,}000)$$

(4) Carbon dioxide mass:

$$CO_{2_{mass}} = V_{mix} \times Density_{CO_2} \times (CO_{2_{conc}}/100)$$

$$V_{mix} = \frac{V_o \times N \times (P_b - P_i) \times 528}{(760)(T_p)}$$

$$HC_{conc} = HC_e - HC_d(1 - 1/DF)$$

$$NO_{x_{conc}} = NO_{x_e} - NO_{x_d}\ (1-1/DF)$$

$$CO_{conc} = CO_e - CO_d\ (1-1/DF)$$

$$CO_e = (1-0.02901\ CO_{2_e} - 0.000323\ R_a)\ CO_{em} \text{ for natural gas}$$

$$CO_e = (1-0.02328\ CO_{2_e} - 0.000323\ R_a)\ CO_{em} \text{ for LPG}$$

$$CO_d = (1-0.000323\ R_a)\ CO_{dm}$$

$$K_H = \frac{1}{1-0.0047(H-75)}$$

$$H = \frac{(43.478R_a)(Pd)}{P_d - P_d \times R_a/100}$$

$$DF = \frac{9.77}{CO_{2_e} + (HC_e + CO_e) \times 10^{-4}} \text{ for natural gas}$$

$$DF = \frac{11.7}{CO_{2_e} + (HC_e + CO_e) \times 10^{-4}} \text{ for LPG}$$

For hydrocarbons the Y_{wm} value must be multiplied by the methane content correction factor (MCCF).

$$HC_{wm} = Y_{wm} \times MCCF$$

HC_{wm} = weighted mean HC mass in gms per vehicle mile after correction for methane content

For 1981 and earlier model year vehicles, the MCCF values as determined by the vehicle manufacturer and approved by the ARB during certification shall be used. In the absence of such values, the following shall apply:

Gasoline = PC = 0.89 (catalyst only)
PC = 1.0 (non catalyst cars)
LDT = 1.0
MDV = 1.0
HDV = 1.0

Natural Gas = 0.5 (all vehicle categories)

LPG = 0.75 (all vehicle categories)

In the alternative, the applicant may choose to determine the actual MCCF by using the "California Non-Methane Hydrocarbon Test Procedures" adopted May 24, 1978.

For 1982 and later model year vehicles, non-methane hydrocarbons must be determined using non-methane instrumentation. In the alternative, the applicant may measure only total hydrocarbons during all testing. However, in such event, no methane credit will be given either gasoline or gaseous fuels.

Sample Calculation:

(i) For the "transient" phase of the cold-start test assume

V_o = 0.29344 cu ft per revolution; N = 10,485;

R_a = 48.2%; P_B = 762 mm Hg; P_d = 22.225 mm Hg; P_i = 70 mm Hg;

T_p = 570°R; HC_e = 105.8 ppm carbon equivalent; NO_{x_e} = 11.2 ppm;

CO_{em} = 306.6 ppm; CO_{2e} = 1.43%; HC_d = 12.1 ppm

NO_{x_d} = 0.8 ppm; CO_{dm} = 15.3 ppm.

Then, for an LPG fueled vehicle:

$$V_{mix} = \frac{(0.29344)(10.485)(762-70)(528)}{(760)(570)} = 2595.0 \text{ cu ft per test phase}$$

$$H = \frac{(43.478)(48.2)(22.225)}{762 - (22.225 \times 48.2/100)} = 62 \text{ grains of water/pound dry air}$$

$$K_H = \frac{1}{1-0.0047(62-75)} = 0.9424$$

$$CO_e = (1-0.02328(1.43) - 0.000323(48.2))306.6 = 291.6 \text{ ppm}$$

$$CO_d = (1-0.000323(48.2))15.3 = 15.1 \text{ ppm}$$

$$DF = \frac{11.7}{1.43 + (105.8 + 291.6) \times 10^{-4}} = 7.961$$

$$HC_{conc} = 105.8-12.1\ (1-1/7.961) = 95.22 \text{ ppm}$$

HC_{mass} = (2595)(17.28)(95.22/1,000,000) = 4.270 grams per test phase

$NO_{x_{conc}}$ = 11.2-0.8(1-1/7.961) = 10.50 ppm

$NO_{x_{mass}}$ = (2595)(54.16)(10.50/1,000,000)(0.9424) = 1.391 grams per test phase

CO_{conc} = (291.6) - 15.1(1-1/7.961) = 278.4 ppm

CO_{mass} = (2595)(32.97)(278.4/1,000,000) = 23.82 grams per test phase

(ii) For the "stabilized" portion of the cold-start test assume that similar calculations resulted in HC_{mass} = 0.62 grams per test phase; $NO_{x_{mass}}$ = 1.27 grams per test phase; and CO_{mass} = 5.98 grams per test phase.

(iii) For the "transient" portion of the hot-start test assume that similar calculations resulted in HC_{mass} = 0.51 grams per test phase; $NO_{x_{mass}}$ = 1.38 grams per test phase; and CO_{mass} = 5.01 grams per test phase.

(iv) For an LPG fueled vehicle:

$$HC_{wm} = \frac{(0.43)(4.27) + (0.57)(0.51) + 0.62}{7.50} \times 0.75 = 0.275 \text{ grams per vehicle mile}$$

$$CO_{wm} = \frac{(0.43)(23.82) + (0.57)(5.01) + 5.98}{7.50} = 2.54 \text{ grams per vehicle mile.}$$

$$NO_{x_{wm}} = \frac{(0.43)(1.391) + (0.57)(1.38) + 1.27}{7.50} = 0.354 \text{ grams per vehicle mile}$$

10. APPROVAL

(a) If, after a review of the data and other information submitted by the manufacturer, the Executive Officer determines that a modification to use LPG or NG conforms to these procedures, he or she will issue an Executive Order of approval for such modifications.

(b) Such Executive Order may be issued upon such terms as the Executive Officer deems necessary to ensure that any modifications to use LPG or NG will meet the requirements of these procedures.

(c) Approval for a conversion system for a given model year is deemed as approval for all previous model years unless specifically limited in the Executive Order. Approval for subsequent model years (i.e., carryover) may be given, after request by the applicant, if further engineering evaluation and/or testing demonstrates that the system will meet the standards for the applicable model year and engine displacements.

(d) Approval for installation on vehicles with similar emission control systems (i.e., carry-across) may be given, if requested by the applicant, if further engineering evaluation and/or testing demonstrates that the system will meet standards for the applicable model-year(s) and engine displacement(s).

11. CHANGES TO CONVERSION SYSTEM AFTER APPROVAL

All changes to the conversion system, including installation changes, must be submitted to the Executive Officer. The Executive Officer may require additional testing prior to approval.

12. NON-CONVENTIONAL SYSTEMS

The Executive Officer may deviate from these procedures for non-conventional systems, such as diesel fuel used in conjunction with LPG, in the event that such systems cannot be tested using these procedures. Such deviations shall be limited to those necessary for the proper testing and evaluation of such systems.

13. INSTALLATION REQUIREMENTS

a. Beginning January 1, 1994, installers of alternative fuel retrofit systems shall submit the converted vehicles to a Bureau of Automotive Repair Referee Smog Check Station for inspection and testing, prior to releasing the converted vehicles to the consumer, except as provided in 13 b.

i. Installers of alternative fuel retrofit systems shall not release the converted vehicle(s) to the consumer without the issuance of a certificate of compliance for the vehicle(s) by a Bureau of Automotive Repair Referee Smog Check Station.

b. The retrofit system installer may request Air Resources Board approval to use the alternative inspection schedule for fleet installation of the same retrofit kit on more than 10 vehicles with engines of the same size. If approval is granted, the installer shall submit ten vehicles with engines from similar engine families, retrofitted with the same kit, to a Bureau of Automotive Repair Referee Station.

i. If all ten vehicles receive a certificate of compliance, for subsequent applications of the same type, the installer need only submit every tenth retrofitted vehicle to the Bureau of Automotive Repair for inspection. For the remaining vehicles included in the alternative inspection schedule that are not submitted to the Bureau of Automotive Repair for inspection, the installer shall maintain a record of the vehicle's identification number, the vehicle's model year and make, the date of installation, and the emissions category to which the retrofitted system is certified (i.e., conventional vehicle, TLEV, LEV, or ULEV), or for heavy-duty vehicles, the credit standard to which the system is certified. The Air Resources Board may require random inspection of any vehicles subject to the alternative inspection schedule.

ii. If any of the ten vehicles fail to pass inspection, the nest set of ten retrofitted vehicles shall be subject to inspection at the Bureau of Automotive Repair, until an entire group of ten passes.

bc. Installation of retrofit systems certified according to the requirements of these test procedures for 1994, and 1995, and 1996 model years shall be restricted to those engine families listed in the Executive Order.

ATTACHMENT C

PROPOSED AMENDMENTS TO THE CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES CERTIFIED FOR 1993 AND EARLIER MODEL YEARS TO USE ALCOHOL OR ALCOHOL/GASOLINE FUELS

State of California
AIR RESOURCES BOARD

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES CERTIFIED FOR 1993 AND EARLIER MODEL YEARS TO USE ALCOHOL OR ALCOHOL/GASOLINE FUELS

Adopted: April 28, 1983
Amended: March 11, 1993
Amended: [Insert date of amendment]

Note: These procedures are printed in a style that shows the proposed amendments. Originally proposed new text is indicated by underline and deletions are indicated by strikeout. Changes to the text originally noticed to the public on March 27, 1992 are indicated as follows: additions to the text are denoted by underline and deletions are denoted by ~~strikeout~~.

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CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES
FOR SYSTEMS DESIGNED TO CONVERT MOTOR VEHICLES
CERTIFIED FOR 1993 AND EARLIER MODEL YEARS TO USE
ALCOHOL OR ALCOHOL/GASOLINE FUELS

The authority for these Exhaust Emission Standards and Test Procedures is found in Sections 43004 and 43006 of the California Health and Safety Code which contain the following:

> 43004. "--the standards applicable under this part for exhaust emissions for gasoline-powered motor vehicles shall apply to motor vehicles which have been modified or altered to use a fuel other than gasoline or diesel."
>
> 43006. "The state board may certify the fuel system of any motor vehicle powered by a fuel other than gasoline or diesel which meets the standards specified by Section 43004 and adopt test procedures for such certification."

I. GENERAL APPLICABILITY

"California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels" ("these test procedures" or "these procedures") are applicable to any single- or dual-fuel motor vehicle conversion system using alcohol or alcohol/gasoline fuels in lieu of the original certification fuel system for 1993 and earlier model year emission-controlled vehicles used or registered in the State of California.

A retrofit system manufacturer may apply these test procedures to certify conversion systems for 1994, ~~and~~ 1995, and 1996 model-year vehicles in accordance with the following implementation phase-in schedule. Each manufacturer may certify a maximum of 85 percent of its total 1994 model-year engine family conversion systems, ~~and~~ 45 percent of its total 1995 model-year systems, and 45 percent of its total 1996 model-year systems, according to the requirements of these test procedures and "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels." The remaining percentage of each manufacturer's certified 1994, ~~and~~ 1995, and 1996 model-year engine family conversion systems and all of 1996~~7~~ and subsequent model-year engine family conversion systems shall be certified according to "California Certification and Installation Procedures for Alternative Fuel Retrofit Systems For Motor Vehicles Certified For 1994 and Subsequent Model Years and for All Model-Year Motor Vehicle Retrofit Systems Certified for Emission Reduction Credit." The percentages shall be determined from the total number of conversion systems certified and shall be met prior to the end of the ~~applicable~~ next respective calendar year. If the above referenced 85 percent maximum is exceeded for 1994 or the above referenced 45 percent maximum is exceeded for 1995 or 1996, the Executive Officer shall rescind the Executive Order for those conversion systems most recently certified which caused the percentages to be exceeded. These procedures shall not be used to

certify a retrofit system for installation on a transitional low-emission vehicle ("TLEV"), low-emission vehicle ("LEV"), or ultra-low-emission vehicle ("ULEV") or to certify a retrofit system designed to convert a vehicle to TLEV, LEV, or ULEV emission standards (as defined in Section 1960.1, Title 13, CCR). These procedures shall not be used to certify retrofits for emission reduction credits.

II. DEFINITIONS

The definitions used in these test procedures shall be the same as those in the California Exhaust Emission Standards and Test Procedures for passenger cars, light-duty trucks, medium-duty vehicles, and heavy-duty engines and vehicles.

The term alcohol fuel shall mean methanol, ethanol, methanol/ethanol blends, methanol/gasoline blends, or ethanol/gasoline blends for purposes of these procedures, and all provisions shall apply to methanol, ethanol, and blends unless specifically noted. However, federally approved fuels or fuel additives which comply with Section 211(f) of the Clean Air Act (42 U.S.C. 7545(f)) are not deemed alcohol fuels for the purposes of this procedure. Dual-fuel vehicle shall mean a vehicle capable of operating on either the original certification fuel or alcohol fuel, but not both concurrently.

III. GENERAL STANDARDS

In addition to all other standards or requirements imposed, any modification of an original certification-fuel motor vehicle to allow the use of alcohol fuel:

A. Shall not cause, in the operation or function of the vehicle, the emission into the ambient air of any noxious or toxic substance which may present a significant hazard to public health or welfare that is not emitted in the operation of such vehicle without such modification, except as specifically permitted by regulation; and

b. Shall not result, in the operation, function, or malfunction of the vehicle, in any unsafe condition endangering the motor vehicle, its occupants, other persons, or property in close proximity to the vehicle, in accordance with the safety requirements specified for the original vehicle.

IV. EXEMPT VEHICLES

Vehicles participating in the Department of Motor Vehicles' Methanol Fuel Experimental Program may, but are not required to, have a certified conversion system. Owners or lessees of these vehicles shall, however, annually obtain a Certificate of Compliance in accordance with the provisions of Title 13, California Code of Regulations, section 2177.

V. NON-APPLICABLE REGULATIONS

All subjects in the referenced California Exhaust Emission Standards and Test Procedures for non-alcohol-powered vehicles not directly related to exhaust or evaporative emission testing shall not be applicable to these procedures.

VI. TEST FLEET

Each applicant is required to test a limited fleet to obtain certification. Emissions tests will be conducted at an independent laboratory at the conversion device manufacturer's expense. Fleet vehicles shall be selected by the Executive Officer.

A. FLEET SELECTION

The passenger car, light-duty truck, and medium-duty vehicle[1] test fleets shall consist of three to ten vehicles for each alcohol fuel system. The number of test vehicles required will depend upon the manufacturer's application outlining the vehicles for which approval is requested, and may be reduced from three if the fuel system applies to a limited number of vehicles. Vehicles will be selected to include a wide variation in engine size from different vehicle manufacturers, and engines with unusual or sensitive emission control systems.

B. SINGLE FUEL TESTING

The following test sequence shall be used when testing a fleet vehicle for straight alcohol or alcohol blend operation:

1. Adjust vehicle to manufacturer's specifications.
2. Run one cold start CVS-75 test (baseline).
3. Install conversion system in accordance with conversion system manufacturer's instructions.
4. Run one cold start CVS-75 test on the modified vehicle using alcohol fuel.

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1. For the purposes of these procedures, 1977 and older medium-duty vehicles shall be selected and tested in accordance with the heavy-duty protocol contained in Section VII.

C. DUAL-FUEL TESTING

The following test sequence shall be used when testing a dual-fuel vehicle:

1. Adjust vehicle to vehicle manufacturer's specifications.

2. Run one cold start CVS-75 test (baseline).

3. Run one hot start CVS-72 test (baseline).

4. Install conversion system in accordance with conversion system manufacturer's instructions.

5. Run one cold start CVS-75 test using the appropriate alcohol fuel.

6. Run one hot start CVS-72 using the original certification fuel.

Dual-fuel system manufacturers may elect to delete steps 3 and 6 by substituting a cold start CVS-75 gasoline test for step 6.

The Executive Officer may require Sealed Housing Evaporative Determination (SHED) tests in addition to the required emission tests for any system that, in the judgement of the Executive Officer, may increase evaporative emissions (e.g., change in fuel tank surface area).

VII. HEAVY-DUTY VEHICLES

Approval of an alcohol fuel system for passenger cars, light-duty trucks, or 1978 and newer medium-duty vehicles can qualify that system for use on heavy-duty vehicles over 8500 pounds GVWR and 1977 and older medium-duty vehicles, provided an engineering evaluation indicates similar emissions patterns are anticipated.

If approval is sought solely for heavy-duty vehicles over 8500 pounds GVWR and/or 1977 and older medium-duty vehicles, the Executive Officer shall select engines and require tests in accordance with the provisions of Section XII of this procedure.

VIII. TEST VEHICLES

Each test vehicle shall be a California certified version having between 4,000 and 50,000 miles. In the event that a manufacturer acquires a vehicle with less than 4,000 miles, the vehicle mileage must be brought to 4,000 miles by driving the vehicle on the road, or by accumulating mileage on a chassis dynamometer.

Each test vehicle shall be subjected to a thorough diagnostic examination prior to the baseline test to detect and correct possible defects and deviations from manufacturer's specifications for emissions-related parts. Baseline emission results within applicable standards shall be taken as an indicator that the vehicle is acceptable for testing. Baseline emission results exceeding applicable standards shall be grounds for rejecting a test vehicle unless the applicant chooses to perform a second diagnostic examination. If the second diagnostic examination does not reveal a malfunction in the engine/emission control system, the vehicle shall be deemed an acceptable test vehicle. If the second diagnostic test reveals a fault or maladjustment, the vehicle shall be deemed unacceptable for test purposes. The applicant may either make repairs and retest the vehicle, or may obtain another vehicle acceptable to the staff.

Any properly equipped emission test laboratory may perform the test. Test vehicles shall be under the control of the laboratory for the entire test period. Return of a test vehicle to an applicant during the test period may invalidate test results.

After a fleet baseline test has been run on the original certification fuel (e.g., Indolene fuel for gasoline-powered vehicles), prior approval is required from the Executive Officer before any servicing, maintenance, modifications, or parts replacements are made that are not listed in the applicant's written instructions. A chemical analysis of the fuel must be performed and reported. The analysis should include a determination of purity and water content. The laboratory shall record all the above information and include it as part of the report submitted to the Executive Officer. The report must be submitted directly to the Executive Officer and must contain all related information, including failed tests. Tests performed for research and development purposes before the application is submitted need not be reported. The applicant may not edit the laboratory report but may submit additional clarifying comments or information.

IX. DATA TO BE RECORDED

Vehicle:

Make, Model and Model Year
Vehicle Identification Number or License Number
Odometer Reading
Engine Displacement

Fuel System:

Original Fuel Tank Capacity
Alcohol Fuel Tank Capacity
Type of Fuel Metering System

Tuning Specifications:

Idle RPM
Ignition Timing
Carburetor Setting (specify method used)
Other

Dynamometer Setting Specifications:

Inertia Loading
Curb Weight
Road Load Horsepower at 50 mph
Drive Wheel Tire Pressure

X. CALCULATION PROCEDURE

The final reported test results shall be computed by use of the following calculations for neat methanol or neat ethanol as a guide. Calculations for blends of ethanol or methanol will be determined based on the relative proportions of the constituents. Unburned fuel (UBF) emissions shall mean unburned original certification fuel, methanol or ethanol and all other oxygenated and non-oxygenated hydrocarbon by-products of combustion. Correction factors shall be determined and applied to UBF emissions from alcohol-fueled vehicles. In the absence of an acceptable empirically derived factor, a factor of 2.5 shall be applied.

A description of the laboratory equipment used and the emission tests performed shall be attached to any emission data submitted to the Air Resources Board. An applicant shall have the option of using a gas chromatograph (GC) or equivalent to determine concentrations of unburned fuel in exhaust or evaporative gas samples. If a flame ionization detector (FID) is used, instrument calibration procedures and corrections for FID response to oxygenated hydrocarbons must be specified. A heated sample line shall be used in conjunction with a FID for measurement of UBF from alcohol-fueled vehicles.

No allowance or trade-off shall be permitted to reduce exhaust emission levels of alcohol-fueled vehicles on the basis of low evaporative emission levels.

Meaning of Symbols

CO_{conc} = Carbon monoxide concentration of the dilute exhaust sample corrected for background, water vapor, and CO_2 extraction, in ppm.

CO_{dm} = Carbon monoxide concentration of the dilution air sample as measured, in ppm.

CO_d = Carbon monoxide concentration of the dilution air corrected for water vapor extraction, in ppm.

CO_e = Carbon monoxide concentrations of the dilute exhaust sample volume corrected for water vapor and carbon dioxide extraction, in ppm.

CO_{em} = Carbon monoxide concentration of the dilute exhaust sample as measured, in ppm.

CO_{mass} = Carbon monoxide emissions, in grams per test phase.

$CO_{2_{conc}}$ = Carbon dioxide concentration of the dilute exhaust sample corrected for background and water vapor, in percent.

CO_{2_e} = Carbon dioxide concentration of the dilute exhaust sample, in percent.

$CO_{2_{mass}}$ = Carbon dioxide emissions, in grams per test phase.

$Density_{CO}$ = Density of carbon monoxide is 32.97 g/ft^3 at 68°F and 760 mm. Hg pressure.

$Density_{CO_2}$ = Density of carbon dioxide is 51.85 g/ft^3 at 68°F and 760 mm. Hg pressure.

$Density_{NO_2}$ = Density of oxides of nitrogen is 54.16 g/ft^3 assuming they are in the form of nitrogen dioxide, at 68°F and 760 mm Hg pressure.

$Density_{UBF}$ = Density of methanol (less the mass of oxygen) is 18.93 g/ft^3 and density of ethanol (less the mass of oxygen) is 17.74 g/ft^3 on a per carbon atom basis at 68°F and 760 mm Hg pressure.

DF = Dilution Factor

H = Absolute humidity in grains of water per pound of dry air.

HC_d = Hydrocarbon concentration of the dilution air as measured, in ppm carbon equivalent.

K_H = Humidity correction factor.

N = Number of revolutions of the positive displacement pump during the test phase while samples are being collected.

$NO_{x_{conc}}$ = Oxides of nitrogen concentration of the dilute exhaust sample corrected for background, in ppm.

NO_{x_d} = Oxides of nitrogen concentration of the dilute air as measured, in ppm.

NO_{x_e} = Oxides of nitrogen concentration of the dilute exhaust sample as measured, in ppm.

$NO_{x_{mass}}$ = Oxides of nitrogen emissions, in grams per test phase.

P_B = Barometric pressure, in mm Hg.

P_d = Saturated vapor pressure in mm Hg at ambient dry bulb temperature.

P_i = Pressure depression below atmospheric measured at the inlet to the positive displacement pump.

T_p = Average temperature of dilute exhaust entering positive displacement pump during test while samples are being collected, in degrees Rankine.

R_a = Relative humidity of the ambient air, in percent.

UBF_{conc} = Unburned fuel concentration for the dilute exhaust sample corrected for background, in ppm carbon equivalent, i.e., equivalent propane x 3.

UBF_e = Unburned fuel concentration of the dilute exhaust sample, in ppm carbon equivalent.

UBF_{mass} = Unburned fuel emissions, in grams per test phase.

V_{mix} = Total dilute exhaust volume in cubic feet per test phase corrected to standard conditions ($528^{\circ}R$ and 760 mm Hg).

V_o = Volume of gas pumped by the positive displacement pump, in cubic feet per revolution. This volume is dependent on the pressure differential across the positive displacement pump.

Y_{ct} = Mass emissions as calculated from the "transient" phase of the cold start test, in grams per test phase.

Y_{ht} = Mass emissions as calculated from the "transient" phase of the cold start test, in grams per test phase.

Y_s = Mass emissions as calculated from the "stabilized" phase of the cold start test, in grams per test phase.

Y_{wm} = Weighted mass emissions of each pollutant, i.e., UBF, CO, or NO_x, in grams per vehicle mile.

A. For passenger cars, medium-duty vehicles and light-duty trucks:

The mass of each emission in grams per mile is

$$Y_{wm} = (0.43Y_{ct} + 0.57\ Y_{ht} + Y_s)/7.5$$

B. The mass of each pollutant for each phase of both the cold start test and the hot start test is determined from the following:

1. Unburned fuel mass:

$$UBF_{mass} = V_{mix} \times Density_{UBF} \times (UBF_{conc}/1{,}000{,}000)$$

2. Oxides of nitrogen mass:

$$NO_{x_{mass}} = V_{mix} \times Density_{NO_2} \times K_H \times (NO_{x_{conc}}/1{,}000{,}000)$$

3. Carbon monoxide mass:

$$CO_{mass} = V_{mix} \times Density_{CO} \times (CO_{conc}/1{,}000{,}000)$$

4. Carbon dioxide mass:

$$CO_{2_{mass}} = V_{mix} \times Density_{CO_2} \times (CO_{2_{conc}}/100)$$

$$V_{mix} = \frac{V_o \times N \times (P_B - P_i) \times 528}{(760)(T_p)}$$

$$UBF_{conc} = UBF_e - HC_d\ (1-1/DF)$$

$$NO_{x_{conc}} = NO_{x_e} - NO_{x_d} \ (1-1/DF)$$

$$CO_{conc} = CO_e - CO_d \ (1-1/DF)$$

$$CO_e = (1-0.03 \ CO_{2_e} - 0.000323 \ R_a) CO_{em} \text{ for methanol}$$

$$CO_e = (1-0.025 \ CO_{2_e} - 0.000323 \ R_a) \ CO_{em} \text{ for ethanol}$$

$$CO_d = (1-0.000323 \ R_a) \ CO_{dm}$$

$$K_h = \frac{1}{1-0.0047(H-75)}$$

$$H = \frac{(43.478 R_a)(P_d)}{P_B - P_d \times R_a/100}$$

$$DF = \frac{11.57}{CO_{2_e} + (UBF_e + CO_e) \times 10^{-4}} \text{ for methanol}$$

$$DF = \frac{12.29}{CO_{2_e} + (UBF_e + CO_e) \times 10^{-4}} \text{ for ethanol}$$

For gasoline fuel the Y_{wm} value must be multiplied by the methane content correction factor (MCCF).

$$UBF_{wm} = Y_{wm} \times MCCF$$

UBF_{wm} = weighted mean unburned fuel mass in grams per vehicle mile after correction for methane content

The following MCCF values (or as determined by the vehicle manufacturer and approved by the ARB during certification) may be used on all gasoline tests:

Catalyst equipped passenger cars = 0.89
All other vehicles = 1.0

The applicant, if he or she so desires, may determine the actual MCCF of a fuel by using the "California Non-Methane Hydrocarbon Test Procedures" adopted May 24, 1978. For alcohol fuels, reference to "HC" in the non-methane test procedures shall mean "UBF" where appropriate. The fuel used to calibrate the flame ionization detector and method of calibration shall be specified.

The above HCCF values are valid through 1981 model year vehicles. Beginning with 1982 model year vehicles the non-methane unburned fuel emissions must be determined using non-methane instrumentation. The above factors can no longer be used. The applicant may test for total unburned fuel, but no factor will be permitted.

Example calculation of mass emission values:

a. For the "transient" phase of the cold-start test assume:

V_o = 0.29344 cu ft per revolution; N = 10,485;

R_a = 48.2%; P_b = 762 mm Hg; P_d = 22.225 mm Hg; P_i = 70 mm Hg;

T_p = 570°R; UBF_e = 105.8 ppm carbon equivalent; NO_{x_e} = 11.2 ppm;

CO_{em} = 306.6 ppm; CO_{2e} = 1.43%; HC_d = 12.1 ppm

NO_{x_d} = 0.8 ppm; CO_{dm} = 15.3 ppm.

Then, for a methanol fueled vehicle:

$$V_{mix} = \frac{(0.29344)(10,485)(762-70)(528)}{(760)(570)} = 2595.0 \text{ cu ft per test phase}$$

$$H = \frac{(43.478)(48.2)(22.225)}{762 - (22.225 \times 48.2/100)} = 62 \text{ grains of water/pound dry air}$$

$$K_h = \frac{1}{1-0.0047(62-75)} = 0.9425$$

$$CO_e = (1-0.03(1.43) - 0.000323(48.2))306.6 = 288.7 \text{ ppm}$$

$$CO_d = (1-0.000323(48.2))15.3 = 15.1 \text{ ppm}$$

$$DF = \frac{11.57}{1.43 + (105.8 + 288.7) \times 10^{-4}} = 7.87$$

$$UBF_{conc} = 105.8-12.1\ (1-1/7.87) = 95.24 \text{ ppm}$$

$$UBF_{mass} = (2595)(18.93)(95.24/1,000,000) = 4.63 \text{ grams per test phase}$$

$$NO_{x_{conc}} = 11.2-0.8(1-1/7.87) = 10.50 \text{ ppm}$$

$NO_{x_{mass}}$ = (2595)(54.16)(10.50/1,000,000)(0.9424) = 1.391 grams per test phase

CO_{conc} = (288.7) - 15.1(1-1/7.87) = 275.5 ppm

CO_{mass} = (2595)(32.97)(275.5/1,000,000) = 23.57 grams per test phase

b. For the "stabilized" portion of the cold-start test assume that similar calculations result in UBF_{mass} = 0.31 grams per test phase;
$NO_{x_{mass}}$ = 1.27 grams per test phase; and
CO_{mass} = 5.98 grams per test phase.

c. For the "transient" portion of the hot-start test assume that similar calculations resulted in UBF_{mass} = 0.25 grams per test phase;
$NO_{x_{mass}}$ = 1.38 grams per test phase;
and CO_{mass} = 5.01 grams per test phase.

d. For a methanol fueled vehicle:

$$UBF_{wm} = \frac{(0.43)(4.68) + (0.57)(0.25) + 0.31}{7.50} = 0.33 \text{ grams per vehicle mile}$$

$$CO_{wm} = \frac{(0.43)(23.57) + (0.57)(5.01) + 5.98}{7.50} = 2.53 \text{ grams per vehicle mile.}$$

$$NO_{x_{wm}} = \frac{(0.43)(1.391) + (0.57)(1.38) + 1.27}{7.50} = 0.354 \text{ grams per vehicle mile}$$

XI. APPLICATION FOR APPROVAL

A. An application for approval to use alcohol fuel in a non-original, certification-fuel engine may be made by any engine, vehicle, or conversion system manufacturer.

B. An application shall be required for each model year even though the exhaust emission standards for approval of new vehicles may be the same for consecutive model years.

C. The application shall be in writing, signed by an authorized representative of the manufacturer, and shall include the following:

1. Identification and description of the vehicles for which approval is requested. The application may limit the years, makes, and models for which a system is applicable.

2. A complete description of all modifications and additions to the engine or vehicle.

3. A written specification of the recommended fuel and fuel composition including the amount of variation in composition that may be tolerated. Specifications allowing more than 1,000 ppm of water shall be accompanied by an explanation of the need for, or purpose of, such allowance.

4. Emissions data on such vehicles and engines tested in accordance with the applicable exhaust emission test procedures and standards.

5. A statement of recommended maintenance procedures, including initial installation and initial tuning, and equipment necessary to ensure that the vehicle and engine in operation conform to the specific procedures for each different make and model shall be given. A description of the program for training personnel for such maintenance and installation.

6. An agreement, that upon the Executive Officer's request, any one or more of the test vehicles will be supplied to the ARB, for such testing as may be required, or (by mutual consent between the ARB and applicant) will be made available at the manufacturer's facility for such testing. Provided, that in the latter case, it is further agreed that the instrumentation and equipment specified by the ARB will be made available for testing operations. Any testing conducted at a manufacturer's facility pursuant to this subparagraph will be scheduled as promptly as possible.

7. An agreement that a reasonable number of vehicles will be made available to the ARB for testing for such reasonable periods as may be required. These vehicles shall be selected from time to time by the Executive Officer and shall be typical of production models available for sale to the public.

8. A sample or facsimile of a proposed engine compartment label and an agreement that the modifications made in the field will be properly identified. The model number shall be permanently marked on the carburetor. A permanent label covering the following for the specific installation shall be furnished for installation on the air cleaner or any other area where it may be easily read. The label shall be set for the following:

   a. Manufacturer's name and address.

   b. Approved by the California ARB for use on _____ model year vehicles with engine size _____ in^3 to _____ in^3.

   c. Spark timing.

   d. Idle speed.

   e. Mixture adjustment (if used) including idle, cruise, and/or full throttle together with the method.

   f. Type of fuel.

   g. Date of installation.

   h. Carburetor Model No.

   i. A statement, "for vehicles over 8,500 lbs GVW only," if applicable.

   j. For dual-fuel systems, a description of any changes to the Original Equipment Manufacturer's evaporative emission-control systems.

9. An agreement that labels will be applied to the exterior of a modified vehicle adjacent to fill pipes specifying the correct fuel for each tank.

10. For retrofit systems applicable to 1994, and 1995, and 1996 model year vehicles, a complete listing of the engine families for which the manufacturer's conversion systems are designed for installation. The number of a manufacturer's 1994, and 1995, and 1996 model-year engine family retrofit systems certified according to these test procedures shall be limited according to the phase-in schedule described in the General Applicability section of these procedures.

XII. VEHICLES REQUIRING ALTERNATE TESTING

Vehicles equipped with the following systems require individual consideration and may require tests other than those described in this procedure. The Executive Officer shall make the determination of the required testing, taking into account any test plans submitted by the applicant.

Heavy-duty engines
Vehicles equipped with closed-loop feedback emission controls
Engines that have altered compression ratios
Engines of unconventional design

XIII. APPROVAL CRITERIA

A. EMISSIONS

The Executive Officer shall review the applicant's emission data and any other laboratory data available to determine the conversion system's effect on emissions. Test data from the vehicles must demonstrate that operation on alcohol fuel (modified configuration) results in no significant increase in emissions. A significant increase in a vehicle's emissions when operated on alcohol fuel shall be grounds for denial of certification even if the emissions are within applicable standards.

B. DRIVEABILITY

The Executive Officer shall evaluate the effects of the alcohol fuel conversion system on the vehicle's performance or

driveability. Cold starting and operating performance will be considered as part of the evaluation procedure. If the system degrades the driveability or vehicle performance such that owners may be tempted to adjust the engine settings or tamper with required emission control systems to improve driveability or vehicle performance, the Executive Officer may find that the alcohol fuel conversion system will increase emissions.

C. DURABILITY

If the Executive Officer has reason to believe, on the basis of an engineering evaluation, that an alcohol fuel conversion system will affect the durability of the vehicle emission control system, or the conversion system itself does not demonstrate durability equivalent to the part or system replaced or added to, he or she may find that the modification will increase emissions. The manufacturer may be required to submit durability data in order to show that the durability of the vehicle emission control system is not affected, and/or that the fuel conversion system demonstrates adequate durability.

XIV. FINAL APPROVAL

A. If, after a review of the data and other information submitted by the manufacturer, the Executive Officer determines that a modification to use alcohol fuel conforms to the procedures outlined in these regulations, the Executive Officer will issue an Executive Order of approval for such modifications.

B. The Executive Order may be issued upon such terms as the Executive Officer deems necessary to ensure that any modifications to use alcohol fuel will meet the requirements of the procedures outlined in these regulations.

C. Approval for a conversion system for a given model year is deemed as approval for all previous model years, unless otherwise specified in the Executive Order. Approval for subsequent model years may be given, after request by the applicant, if further evaluation and/or testing demonstrates that the system will meet the standards for the applicable model year.

XV. CHANGES TO CONVERSION SYSTEM AFTER APPROVAL

All changes made to the conversion system, including installation changes, must be submitted to the Executive Officer for approval. The Executive Officer may require additional testing prior to approval.

XVI. INSTALLATION REQUIREMENTS

A. Beginning January 1, 1994, installers of alternative fuel retrofit systems shall submit the converted vehicles to a Bureau of Automotive Repair Referee Smog Check Station for inspection and testing, prior to releasing the converted vehicles to the consumer, except as provided in B.

1. Installers of alternative fuel retrofit systems shall not release the converted vehicle(s) to the consumer without the issuance of a certificate of compliance for the vehicle(s) by a Bureau of Automotive Repair Referee Smog Check Station.

B. The retrofit system installer may request Air Resources Board approval to use the alternative inspection schedule for fleet installation of the same retrofit kit on more than 10 vehicles with engines of the same size. If approval is granted, the installer shall submit ten vehicles with engines from similar engine families, retrofitted with the same kit, to a Bureau of Automotive Repair Referee Station.

i. If all ten vehicles receive a certificate of compliance, for subsequent applications of the same type, the installer need only submit every tenth retrofitted vehicle to the Bureau of Automotive Repair for inspection. For the remaining vehicles included in the alternative inspection schedule that are not submitted to the Bureau of Automotive Repair for inspection, the installer shall maintain a record of the vehicle's identification number, the vehicle's model year and make, the date of installation, and the emissions category to which the retrofitted system is certified (i.e., conventional vehicle, TLEV, LEV, or ULEV), or for heavy-duty vehicles, the credit standard to which the system is certified. The Air Resources Board may require random inspection of any vehicles subject to the alternative inspection schedule.

ii. If any of the ten vehicles fail to pass inspection, the next set of ten retrofitted vehicles shall be subject to inspection at the Bureau of Automotive Repair, until an entire group of ten passes.

BC. Installation of retrofit systems certified according to the requirements of these test procedures for 1994, and 1995, and 1996 model years shall be restricted to those engine families listed in the Executive Order.

ATTACHMENT D

PROPOSED AMENDMENTS
TO ARTICLE 5, CHAPTER 1, DIVISION 3, TITLE 13
OF THE CALIFORNIA CODE OF REGULATIONS AND
TO SECTIONS 2030 AND 2031 OF ARTICLE 5

PROPOSED AMENDMENTS
TO ARTICLE 5, CHAPTER 1, DIVISION 3, TITLE 13
OF THE CALIFORNIA CODE OF REGULATIONS
AND SECTION 2030 OF ARTICLE 5

Approval of Systems Designed to Convert Motor Vehicles to Use Fuels Other Than the Original Certification Fuel or to Convert Motor Vehicles for Emission Reduction Credit

Note: Changes to the text last amended May 7, 1993 are indicated by strike-out (deletion) and underline (addition).

Adopted: April 28, 1975
Amended: March 16, 1977
Amended: May 21, 1981
Amended: June 2, 1983
Amended: October 18, 1984
Amended: May 7, 1993
Amended: [insert date of amendment]

Article 5. Approval of Systems Designed to Convert Motor Vehicles to Use Fuels Other Than the Original Certification Fuel or to Convert Motor Vehicles for Emission Reduction Credit

2030. Liquefied Petroleum Gas or Natural Gas Retrofit Systems.

a) Applicable Standards and Test Procedures.

The standards and test procedures for approval of systems designed to convert 1993 and earlier model year motor vehicles to use liquefied petroleum gas or natural gas fuels are contained in "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels" adopted by the State Board on April 16, 1975, as amended March 11, 1993. The standards and test procedures for approval of systems designed to convert 1994 and subsequent model year motor vehicles to use liquefied petroleum gas or natural gas fuels are contained in "California Certification and Installation Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years and for all Model Year Motor Vehicle Retrofit Systems Certified for Emission Reduction Credit," adopted by the State Board March 11, 1993, as amended [insert date of amendment]. At the option of the retrofit system manufacturer, the standards and test procedures for approval of systems designed to convert 1994 and subsequent model year vehicles to use liquefied petroleum gas or natural gas fuels may be used for approval of systems designed to convert 1993 and earlier model year motor vehicles to use liquefied petroleum gas or natural gas fuels in lieu of the "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels."

b) Implementation Phase-In Schedule.

Notwithstanding subsection (a), a retrofit system manufacturer may apply "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels" to certify retrofit systems for 1994 and 1995 model-year vehicles in accordance with the following implementation phase-in schedule. Each manufacturer may certify a maximum of 85 percent of its total 1994 model-year engine family retrofit systems, and 45 percent of its total 1995 model-year systems, and 45 percent of its total 1996 model-year systems, according to the requirements of these test procedures and "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels", adopted by the State Board on April 28, 1983, as amended March 11, 1993. The remaining percentage of each manufacturer's certified 1994, and 1995, and 1996 model-year engine family retrofit systems and all of 1996 and subsequent model-year engine family retrofit systems shall be certified according to "California Certification and Installation Procedures for Alternative Fuel Retrofit Systems For Motor Vehicles Certified For 1994 and Subsequent Model Years and for all Model Year Motor Vehicle Retrofit Systems Certified for Emission Reduction Credit." The

percentages shall be determined from the total number of retrofit systems certified and shall be met prior to the end of the ~~applicable~~ next respective calendar year. "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels" shall not be applied to certify a retrofit system for installation on a transitional low-emission vehicle ("TLEV)", low-emission vehicle ("LEV)", or ultra-low emission vehicle ("ULEV)" or to certify a retrofit system designed to convert a vehicle to TLEV, LEV, or ULEV emission standards (as defined in Section 1960.1, Title 13, California Code of Regulations), or to certify a retrofit system for emission reduction credits.

PROPOSED AMENDMENTS
TO ARTICLE 5, CHAPTER 1, DIVISION 3, TITLE 13
OF THE CALIFORNIA CODE OF REGULATIONS
AND SECTION 2031 OF ARTICLE 5

Approval of Systems Designed to Convert Motor Vehicles to Use Fuels Other Than the Original Certification Fuel or to Convert Motor Vehicles for Emission Reduction Credit

Note: Changes to the text last amended May 7, 1993 are indicated by strike-out (deletion) and underline (addition).

Adopted: June 2, 1983
Amended: May 7, 1993
Amended: [insert date of amendment]

Article 5. Approval of Systems Designed to Convert Motor Vehicles to Use Fuels Other Than the Original Certification Fuel or to Convert Motor Vehicles for Emission Reduction Credit

2031. Alcohol or Alcohol/Gasoline Fuels Retrofit Systems.

a) Applicable Standards and Test Procedures.

The standards and test procedures for approval of systems designed to convert 1993 and earlier model year motor vehicles to use alcohol or alcohol/gasoline fuels in lieu of the original certification fuel system are contained in "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels," adopted by the State Board April 28, 1983, as amended March 11, 1993. The standards and test procedures for approval of systems designed to convert 1994 and subsequent model year motor vehicles to use alcohol or alcohol/gasoline fuels are contained in "California Certification and Installation Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years and for all Model Year Motor Vehicle Retrofit Systems Certified for Emission Reduction Credit," adopted by the State Board March 11, 1993, as amended [insert date of amendment]. At the option of the retrofit system manufacturer, the standards and test procedures for approval of systems designed to convert 1994 and subsequent model year motor vehicles to use alcohol or alcohol/gasoline fuels may be used for approval of systems designed to convert 1993 and earlier model year motor vehicles to use alcohol or alcohol/gasoline fuels in lieu of the "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels."

b) Implementation Phase-In Schedule.

Notwithstanding subsection (a), a retrofit system manufacturer may apply "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels" to certify retrofit systems for 1994 and 1995 model-year vehicles in accordance with the following implementation phase-in schedule. Each manufacturer may certify a maximum of 85 percent of its total 1994 model-year engine family retrofit systems, and 45 percent of its total 1995 model-year systems, and 45 percent of its total 1996 model-year systems, according to the requirements of these test procedures and the "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Liquefied Petroleum Gas or Natural Gas Fuels," adopted by the State Board on April 16, 1975, as amended March 11, 1993. The remaining percentage of each manufacturer's certified 1994, and 1995, and 1996 model-year engine family retrofit systems and all of 1996 and subsequent model-year engine family retrofit systems shall be certified according to "California Certification and Installation Procedures for Alternative Fuel Retrofit Systems For Motor Vehicles Certified For 1994 and Subsequent Model Years and for all Model Year Motor Vehicle Retrofit Systems Certified for Emission Reduction Credit." The percentages shall be

determined from the total number of retrofit systems certified and shall be met prior to the end of the ~~applicable~~ next respective calendar year. "California Exhaust Emission Standards and Test Procedures for Systems Designed to Convert Motor Vehicles Certified for 1993 and Earlier Model Years to Use Alcohol or Alcohol/Gasoline Fuels" shall not be applied to certify a retrofit system or installation on a transitional low-emission vehicle ("TLEV"), low-emission vehicle ("LEV"), or ultra-low-emission vehicle ("ULEV") or to certify a retrofit system designed to convert a vehicle to TLEV, LEV, or ULEV emission standards (as defined in Section 1960.1, Title 13, California Code of Regulations), or to certify a retrofit system for emission reduction credits.

ATTACHMENT E

PROPOSED OPTIONAL EXHAUST EMISSION STANDARDS FOR RETROFITTED HEAVY-DUTY ENGINES

PROPOSED

SECTION 1956.9, TITLE 13, CCR

Optional Exhaust Emission Standards for Retrofitted Heavy-Duty Engines

Note: This is a proposed new regulation. All text is original and has not been presented in underline format for purposes of clarity.

Adopted: [insert date of adoption]

PROPOSED

SECTION 1956.9, TITLE 13, CCR

Adopt Title 13, California Code of Regulations, Section 1956.9 as follows:

§ 1956.9 Optional Exhaust Emission Standards for Retrofitted Heavy-Duty Engines

1973 and later model-year heavy-duty engines that have been retrofitted to produce emissions less than the original certification emission level may be certified to optional emission standards as follows:

(a)(1) Total Hydrocarbons

(X - n x 0.2) grams per brake horsepower-hour

where X = 0.75 x new engine total hydrocarbon standard for the engine's model year, with the further requirement that X is rounded down to the nearest lower 0.2 grams per brake horsepower-hour increment; and where n is an integer such that n x 0.2 is greater than or equal to zero. For diesel engines, X = 0.75 x original emission certification value for the engine's model year. For engines originally certified to a combined hydrocarbon plus oxides of nitrogen standard, X = 0.75 x original engine certification standard pro-rated by the hydrocarbon portion of the original emission certification level. If the original emission certification levels are not available, the hydrocarbon baseline standard shall be pro-rated by the hydrocarbon and oxides of nitrogen values of the next later model year with separate hydrocarbon and oxides of nitrogen standards.

(a)(2) Non-methane Hydrocarbons

For engines originally certified to an optional non-methane hydrocarbon standard,

(X - n x 0.2) grams per brake horsepower-hour

where X = 0.75 x new engine non-methane hydrocarbon standard for the engine's model year, with the further requirement that X is rounded down to the nearest lower 0.2 grams per brake horsepower-hour increment; and where n is an integer such that n x 0.2 is greater than or equal to zero. For diesel engines, X = 0.75 x original emission certification value for the engine's model year.

(b) Carbon Monoxide

(X - n x 5.0) grams per brake horsepower-hour

where X = 0.75 x new engine carbon monoxide standard for the engine's model year, with the further requirement that X is rounded down to the nearest lower 5 grams per brake horsepower-hour increment; and where n is an integer such that n x 5.0 is greater than or equal to zero. For diesel engines, X = 0.75 x original emission certification value for the engine's model year.

(c) Oxides of Nitrogen

(X - n x 0.5) grams per brake horsepower-hour

where X = 0.75 x new engine oxides of nitrogen standard for the engine's model year, with the further requirement that X is rounded down to the nearest lower 0.5 grams per brake horsepower-hour increment; and where n is an integer such that n x 0.5 is greater than or equal to zero. For engines originally certified to a combined hydrocarbon plus oxides of nitrogen standard, X = 0.75 x original engine certification standard, pro-rated by the oxides of nitrogen portion of the original emission certification level. If the original emission certification levels are not available, the oxides of nitrogen baseline standard shall be pro-rated by the hydrocarbon and oxides of nitrogen values of the next later model year with separate hydrocarbon and oxides of nitrogen standards.

(d) Particulate Matter

(X - n x 0.05) grams per brake horsepower-hour

where X = 0.75 x new diesel engine particulate matter standard for the engine's model year, with the further requirement that X is rounded down to the nearest lower 0.05 grams per brake horsepower-hour increment; and where n is an integer such that n x 0.05 is greater than or equal to zero. For diesel engines that were not originally certified to a particulate matter emission standard, X = 0.75 x 0.6 grams per brake horsepower-hour. Gasoline engines may not be certified to an optional exhaust emission standard for particulate matter.

(e) 1972 and earlier model year engines may be certified to credit standards as described in (a)(1), (b), (c), and (d) using 1973 model year new engine emission standards as the basis for calculating "X."

(f) The test procedures for determining compliance with an optional standard shall be the test procedure used to originally certify the engine. To certify to an optional emission standard, a retrofitted engine must meet all of the requirements of "California Certification and Installation Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years and for all Model Year Motor Vehicle Retrofit Systems Certified for Emissions Reduction Credit," adopted March 11, 1993, as amended [insert date of amendment], which is incorporated by reference herein.

Note: Authority cited: Health and Safety Code sections 43701 (b) and (c).

ATTACHMENT F

ANALYSIS OF GREENHOUSE GAS EMISSIONS FROM ALTERNATIVE FUEL BUS RETROFITS

Analysis of Greenhouse Gas Emissions from Alternative Fuel Bus Retrofits

There is increasing concern today about the environmental effects of greenhouse gas, primarily carbon dioxide (CO2) and methane (CH4), emissions. This appendix considers the changes in these greenhouse gas emissions from urban transit buses as a result of conversions from diesel fuel to the alternative fuels methanol and compressed natural gas (CNG). Table 1 presents estimated CO2 emissions. This table conservatively assumes that all the carbon in the fuel is completely oxidized to CO2.

Table 1

CO2 Emissions Over 500,000 Mile Lifetime

	Diesel/Trap	Methanol	CNG
Fuel Economy	3.3 mile/gallon	1.4 mile/gallon	0.026 mile/scf[b]
CO2 (total C conversion)[a]	1660 tons	1520 tons	1170 tons
CO2 Change vs. Diesel	------	-8%	-27%

Note a: CO2 Emissions from CNG bus calculated by assuming total carbon conversion and subtracting CO2 equivalent of CH4 emissions.

Note b: scf = standard cubic feet

Table 2 examines the effects of methane emissions from natural gas-fueled buses. The results assume that methane is not oxidized by catalytic converters. The calculations are based on reported CNG engine test data indicating a total hydrocarbon emission rate of 5.5 grams per brake horsepower-hour (g/bhp-hr), of which 85 percent is methane.

Table 2

Consideration of CNG Methane Emissions of 500,000 Mile Lifetime

Typical CH4 Emissions	11 tons
Effective CO2 Emissions[a]	220 tons
Total Effective CO2[b]	1390 tons
Change vs. Diesel	-16%

Note a: Due to CH4, assuming CH4 has 20 times the greenhouse effect of CO2 on a weight basis.
Note b: Includes direct CO2 emissions of 1170 tons.

Tables 1 and 2 indicate that low-emission CNG and methanol-fueled buses have lower greenhouse gas exhaust emission rates than standard diesel buses. Therefore, the possibility of accelerating the global warming effect by substituting alternative fuels for diesel is minimal.

Vehicle Evaporative Emissions

It is important for air quality purposes to avoid an increase in evaporative emissions when credit-generating alternative-fueled buses are used in lieu of standard diesel buses.

Diesel vehicles have traditionally been considered to have negligible evaporative emissions, due primarily to the relatively low Reid Vapor Pressure (RVP) of diesel fuel. Consequently, diesel buses currently are not required to utilize evaporative emissions control equipment. Buses fueled with CNG require no evaporative emission controls since they use closed fuel systems to contain the pressurized gas. However, methanol buses use an open fuel system. Therefore, methanol-fueled vehicles could have significant evaporative emissions in the absence of adequate control equipment.

At present, all light-, medium-, and heavy-duty vehicles are required to meet a two gram per test diurnal evaporative emission standard. Effective in 1995, all vehicles will be required to control running loss evaporative emissions to a level of 0.05 grams/mile or less of ROG. Utilizing these figures, and assuming one diurnal test represents one day of bus operation, a methanol powered bus would have evaporative emissions of about 0.04 tons ROG or 0.02 tons "organic material hydrocarbon equivalent" (OMHCE) over its lifespan. Therefore, evaporative emissions from methanol-fueled buses can be assumed to be negligible (compared to the exhaust emission levels) as long as the evaporative control equipment functions properly.

Distribution System Evaporative Emissions

Use of alternative-fueled buses will result in an increase in losses from the respective statewide alternative fuel distribution systems. Losses are estimated for both CNG and methanol.

Natural gas distribution utilizes a sealed pressurized system. ARB emission inventory data indicate that escaped ROG attributable to the transport of CNG fuel for one CNG bus would amount to less than 0.1 tons over the lifetime of the bus.

Methanol is a liquid that is stored in tanks and, during storage and transfer, it is subject to evaporative losses. To estimate methanol distribution system losses, it is assumed that the losses can be scaled to gasoline distribution system losses on a per gallon of fuel basis. Estimated gasoline distribution system losses were taken from ARB's emission inventory. These were adjusted for the lower RVP of methanol and the expected gallons used per bus. The results were put in terms of OMHCE. ARB staff estimates losses of about 0.2 tons OMHCE per bus over the bus lifetime. Therefore, increases in CNG and methanol fuel distribution system losses can be considered negligible, relative to the exhaust emissions of the bus.

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