Zero Emission Vehicle (ZEV) Demonstration Project

Phase I Report



Mendocino Council of Governments

Renewable Energy Revelopment Institute

Zero Emission Vehicle (ZEV) Demonstration Project - Phase I

1996/97 Overall Work Program - Work Element 15

Final Report

Prepared by

Renewable Energy Development Institute (REDI)
Consultant

Submitted to

Mendocino Council of Governments (MCOG)

October 15, 1997

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PLACEHOLDER

ADDENDUM Cover

FINAL REGULATION ORDER[1]

Sections 1900, 1960.1 and 1976, Title 13, CCR

1. Amend title 13, California Code of Regulations, section 1900 to read as follows:

§1900. Definitions.

[Subsections (a)(1) through (14) -- No change]

(a)(15) ~~"Zero-emission vehicle" (or "ZEV") means any vehicle which is certified by the Executive Officer to produce zero emissions of any criteria pollutants under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40 degrees Fahrenheit and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions.~~ *[Reserved]*

[Subsection (a)(16) -- No change]

Note: Authority cited: Sections 39600, 39601, 43013, 43018, 43101 and 43104, Health and Safety Code. Reference: Sections 39002, 39003, 39010, 39500, 40000, 43000, 43013, 43100,

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[1] In this document Universal font is used to provide explanatory text for the regulation order and to identify the sections of the regulations or test procedures amended. The amendments as adopted affect sections 1900, 1960.1 and 1976 of title 13 of the California Code of Regulations. The amendments also affect the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," which are incorporated by reference in section 1960.1(k), title 13, California Code of Regulations. The amendments are shown in *italics* to indicate additions to and ~~strikeout~~ to indicate deletions from the regulations as published or incorporated in the California Code of Regulations.

Note: Amendments to section 1960.1 and the incorporated standards and test procedures that have been previously approved by the Board in a separate rulemaking proceeding (the LDV/MDV rulemaking action heard by the Board September 28, 1995) and that are expected to be submitted to the Office of Administrative Law for review and filing with the Secretary of State prior to adoption of the amendments proposed herein are incorporated in the underlying text of this document.

43101, 43101.5, 43102, 43103, 43104, 43106 and 43204, Health and Safety Code; and section 27156, Vehicle Code.

2. Amend title 13, California Code of Regulations, section 1960.1 to read as follows:

§1960.1. Exhaust Emission Standards and Test Procedures - 1981 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles.

[Subsections (a) through (f) -- No Change]

(g)(1) The exhaust emissions from new 1992 and subsequent model-year light-duty transitional low-emission vehicles, low-emission vehicles, and ultra-low emission vehicles, *and new 2003 and subsequent model-year light-duty zero-emission vehicles* shall not exceed:

EXHAUST EMISSION STANDARDS FOR TRANSITIONAL LOW-EMISSION VEHICLES, LOW-EMISSION VEHICLES, ~~AND~~ ULTRA-LOW-EMISSION VEHICLES *AND ZERO-EMISSION VEHICLES* IN PASSENGER CAR AND LIGHT-DUTY TRUCK VEHICLE CLASSES[6,7,8,9,10]
[grams per mile (or "g/mi")]

Vehicle Type[1]	*Loaded Vehicle Weight (lbs)*	*Durability Vehicle Basis (mi)*	*Vehicle Emission Category*[2]	*Non-Methane OrganicGases*[3,4]	*Carbon Monoxide*	*Oxides of Nitrogen*[5]
PC and LDT	All 0-3750	50,000	TLEV	0.125 (0.188)	3.4 (3.4)	0.4 (0.4)
			LEV	0.075 (0.100)	3.4 (3.4)	0.2 (0.3)
			ULEV	0.040 (0.058)	1.7 (2.6)	0.2 (0.3)
			ZEV[2.1]	--	--	--
		100,000	TLEV	0.156	4.2	0.6
			LEV	0.090	4.2	0.3
			ULEV	0.055	2.1	0.3
			ZEV[2.1]	--	--	--
LDT	3751-5750	50,000	TLEV	0.160 (0.238)	4.4 (4.4)	0.7 (0.7)
			LEV	0.100 (0.128)	4.4 (4.4)	0.4 (0.5)
			ULEV	0.050 (0.075)	2.2 (3.3)	0.4 (0.5)
			ZEV[2.1]	--	--	--
		100,000	TLEV	0.200	5.5	0.9
			LEV	0.130	5.5	0.5
			ULEV	0.070	2.8	0.5
			ZEV[2.1]	--	--	--

(1) "PC" means passenger cars.

"LDT" means light-duty trucks.
"LVW" means loaded vehicle weight.
"Non-Methane Organic Gases" or "NMOG" means the total mass of oxygenated and non-oxygenated hydrocarbon emissions.

(2) "TLEV" means transitional low-emission vehicle.
"LEV" means low-emission vehicle.
"ULEV" means ultra-low-emission vehicle.
"ZEV" means zero-emission vehicle.

(2.1) *a. The Executive Officer shall certify as ZEVs vehicles that produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40°F and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions.*

b. Prior to the 2003 model year a manufacturer that voluntarily produces vehicles that meet the ZEV emission standards applicable to 2003 and subsequent model year vehicles may certify those vehicles as ZEVs for the purposes of calculating fleet average NMOG exhaust emission values under section (g)(2), note (4) or (5); NMOG credits under section (g)(2), note (7); and ZEV credits under section (g)(2), note (9)a.

[Notes (3) through (10) -- No change]

[Section (g)(2), table and notes (1) through (8) -- No change]

(9) **ZEV Requirements.** While meeting the fleet average requirements, each manufacturer shall certify, produce and deliver for sale in California at least ~~2% ZEVs each model year from 1998 through 2000, 5% ZEVs in 2001 and 2002, and~~ 10% ZEVs in 2003 and subsequent model years. These percentages shall be applied to the manufacturer's total production of PCs and LDTs 0-3750 lbs. LVW delivered for sale in California.

a. **Calculation of ZEV Credits.** Manufacturers ~~which~~ *that* produce for sale in California more ZEVs than required in a given model year shall earn ZEV credits, which shall be expressed in units of g/mi NMOG. The amount of ZEV credits earned shall be equal to the number of ZEVs required to be produced and delivered for sale in California for the model year subtracted from the number of ZEVs produced and delivered for sale in California by the manufacturer for the model year and then multiplied by the fleet average *NMOG* requirement for PCs and LDTs 0-3750 lbs. LVW for the model year.
In calculating the number of ZEV credits under this note (9)a, each ZEV produced and delivered for sale prior to the 2003 model year may be counted as follows:

1. ZEV Credits based on vehicle range:

Number of ZEVs	*Vehicle Range (miles)*		
	Model Years 1996 and 1997	*Model Years 1998 and 1999*	*Model Years 2000, 2001 and 2002*
2	*any*	*≥ 100*	*≥ 140*
3	*≥70*	*≥ 130*	*≥ 175*

Range shall be determined in accordance with section 9.f.(2)(a) of the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles," incorporated by reference in section 1960.1(k).

2. ZEV Credits based on the specific energy of the battery:

Number of ZEVs	*Specific Energy of Battery (w-hr/kg)*		
	Model Years 1996, 1997 and 1998	*Model Years 1999 and 2000*	*Model Years 2001 and 2002*
2	*any*	*≥ 50*	*≥ 60*
3	*≥40*	*≥ 60*	*≥ 90*

For model years 1999 through 2002, additional ZEV credits will be determined by linear interpolation between the values shown in the above schedule. Battery specific energy shall be determined in accordance with section 9.g. of the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles," incorporated by reference in section 1960.1(k).

3. For purposes of calculating ZEV credits, a ZEV may be counted according to note (9)a.1. or (9)a.2. above, but not both.

4. For purposes of calculating manufacturer's fleet average NMOG value under note (4) or (5), each ZEV shall be counted as one vehicle.

All ZEV credits earned prior to the ~~1998~~ *2003* model year shall be treated as if earned in the ~~1998~~ *2003* model year and shall be discounted in accordance with notes (7)c.

b. **Submittal of ZEV Credits.** A manufacturer may meet the ZEV requirements in any given model year by submitting to the Executive Officer a commensurate amount of ZEV

credits. These credits may be earned previously by the manufacturer or acquired from another manufacturer. The amount of ZEV credits required to be submitted shall be calculated by subtracting the number of ZEVs produced and delivered for sale in California by the manufacturer for the model year from the number of ZEVs required to be produced by the manufacturer for the model year and then multiplying by the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for that model year.

c. **Requirement to Make Up a ZEV Deficit.** Manufacturers ~~which~~ *that* certify, produce, and deliver for sale in California fewer ZEVs than required in a given model year shall make up the deficit by the end of the next model year by submitting to the Executive Officer a commensurate amount of ZEV credits. The amount of ZEV credits required to be submitted shall be calculated by subtracting the number of ZEVs produced and delivered for sale in California by the manufacturer for the model year from the number of ZEVs required to be produced by the manufacturer for the model year and then multiplying by the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for the model year in which the deficit is incurred.

d. **Penalty for Failure to Meet ZEV Requirements.** Any manufacturer ~~which~~ *that* fails to produce and deliver for sale in California the required number of ZEVs or submit an appropriate amount of ZEVs credits and does not make up ZEV deficits within the specified time period shall be subject to the Health and Safety Code section 43211 civil penalty applicable to a manufacturer ~~which~~ *that* sells a new motor vehicle that does not meet the applicable emission standards adopted by the state board. The cause of action shall be deemed to accrue when the ZEV deficits are not balanced by the end of the specified time period. For the purposes of Health and Safety Code section 43211, the number of vehicles not meeting the state board's standards shall be calculated according to the following equation: (No. of ZEVs required to be produced and delivered for sale in California for the model year) - (No. of ZEVs actually produced and delivered for sale in California for the model year) - [(Amount of ZEV credits submitted for the model year) / (the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for the model year)].

e. **ZEV Credits for MDVs and LDTs 3751 -5750 LVW.** ZEVs classified as MDVs or as LDTs 3751-5750 lbs. LVW may be counted toward the ZEV requirement for PCs and LDTs 0-3750 lbs LVW and included in the calculation of ZEV credits as specified in (9)a., if the manufacturer so designates.

f. Small volume manufacturers *as defined in note (6)* shall not be required to meet the percentage ZEV requirements. However, small volume manufacturers may earn and market credits for ZEVs they produce and deliver for sale in California.

~~g. Intermediate volume manufacturers as defined in section 1960.1(o) shall not be required to meet the percentage ZEV requirements before the 2003 model year.~~

[Subsection (h)(1) -- No Change]

(h)(2) The exhaust emissions from new 1992 and subsequent model-year medium-duty low-emission vehicles, ultra-low-emission vehicles and super ultra-low-emission vehicles, *and new 2003 and subsequent model-year medium-duty zero-emission vehicles* shall not exceed:

EXHAUST EMISSION STANDARDS FOR LOW-EMISSION VEHICLES, ULTRA-LOW-EMISSION VEHICLES, ~~AND~~ SUPER ULTRA-LOW-EMISSION VEHICLES *AND ZERO-EMISSION VEHICLES* IN THE MEDIUM-DUTY VEHICLE WEIGHT CLASSES[6,9,10,11,12,13,14,15,16]

[grams per mile (or "g/mi")]

Test Weight (lbs)[1]	*Durability Vehicle Basis (mi)*	*Vehicle Emission Category*[2]	*Non-Methane Organic Gases*[3,4]	*Carbon Monoxide*	*Oxides of Nitrogen*[5]	*Particulates*[6,7]
			0.125			n/a
0-3750	50,000	LEV	0.075	3.4	0.4	n/a
		ULEV	--	1.7	0.2	--
		ZEV[2.1]	0.180	--	--	0.08
	120,000	LEV	0.107	5.0	0.6	0.04
		ULEV	--	2.5	0.3	--
		ZEV[2.1]	0.160	--	--	n/a
3751-5750	50,000	LEV	0.100	4.4	0.4	n/a
		ULEV	0.050	4.4	0.4	n/a
		SULEV	--	2.2	0.2	--
		ZEV[2.1]	0.230	--	--	0.10
	120,000	LEV	0.143	6.4	0.6	0.05
		ULEV	0.072	6.4	0.6	0.05
		SULEV	--	3.2	0.3	--
		ZEV[2.1]	0.195	--	--	n/a
5751-8500	50,000	LEV	0.117	5.0	0.6	n/a
		ULEV	0.059	5.0	0.6	n/a
		SULEV	--	2.5	0.3	--
		ZEV[2.1]	0.280	--	--	0.12
	120,000	LEV	0.167	7.3	0.9	0.06
		ULEV	0.084	7.3	0.9	0.06
		SULEV	--	3.7	0.45	--
		ZEV[2.1]	0.230	--	--	n/a
8501-10,000	50,000	LEV	0.138	5.5	0.7	n/a
		ULEV	0.070	5.5	0.7	n/a
		SULEV	--	2.8	0.35	--
		ZEV[2.1]	0.330	--	--	0.12
	120,000	LEV	0.197	8.1	1.0	0.06
		ULEV	0.100	8.1	1.0	0.06
		SULEV	--	4.1	0.5	--
		ZEV[2.1]	0.300	--	--	n/a
10,001-14,000	50,000	LEV	0.180	7.0	1.0	n/a
		ULEV	0.09	7.0	1.0	n/a
		SULEV	--	3.5	0.5	--
		ZEV[2.1]	0.430	--	--	0.12
	120,000	LEV	0.257	10.3	1.5	0.06
		ULEV	0.130	10.3	1.5	0.06
		SULEV	--	5.2	0.7	--
		ZEV[2.1]		--	--	

(1) "Test Weight" (or "TW") shall mean the average of the vehicle's curb weight and gross vehicle weight.

"Non-Methane Organic Gases" or "NMOG" means the total mass of oxygenated and non-oxygenated hydrocarbon emissions.

(2) "LEV" means low-emission vehicle.
"ULEV" means ultra-low-emission vehicle.
"SULEV" means super-ultra-low-emission vehicle.
"ZEV" means zero-emission vehicle.

(2.1) a. The Executive Officer shall certify as ZEVs vehicles that produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40°F and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions.

b. Prior to the 2003 model year a manufacturer that voluntarily produces vehicles that meet the ZEV emission standards applicable to 2003 and subsequent model year vehicles may certify those vehicles as ZEVs for the purposes of calculating ZEV credits under section (g)(2), note (9)a. and (9)e.

[Notes (3) through (16) and subsections (i) and (j) -- No change]

(k) The procedures for determining compliance with these standards are set forth in "California Exhaust Emission Standards and Test Procedures for 1981 through 1987 Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," adopted by the state board on November 23, 1976, as last amended May 20, 1987, and in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," adopted by the state board on May 20, 1987, as last amended ~~September 22, 1994~~ *[insert date of adoption]*, both of which are incorporated herein by reference.

[Subsection (l) through (p) -- No change]

Note: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43104 and 43105, Health and Safety Code. Reference: Sections 39002, 39003, 39667, 43000, 43009.5, 43013, 43018, 43100, 43101, 43101.5, 43102, 43103, 43104, 43105, 43106, 43107, 43204, 43205.5, Health and Safety Code.

3. Amend the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" as follows:[2]

(a) Revise the title page and the first page of the Table of Contents of the test procedures to read as follows:

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[2] The material that follows includes excerpts from the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles" incorporated by reference in section 1960.1(k), title 13, California Code of Regulations, with the amendments approved as part of the currently pending LDV/MDV rulemaking action. Only those sections of the test procedures amended in this proceeding are shown in this document. All other sections of the test procedures are unchanged.

Upon approval by the Office of Administrative Law, the full test procedure document with the amendments adopted as part of this rulemaking action will be available from the ARB by writing to the Air Resources Board, 9528 Telstar Avenue, El Monte, California 91731 in accordance with 13 CCR 1902, or from the ARB Information System (ARBIS) electronic bulletin board (via modem at 916-322-2826 [choose "Low Emission Vehicle Program" from "Mobile Source Programs" under the "System Features" menu] or via the Internet at "http://www.arb.ca.gov/ [choose "LEV Program" under "CARB Programs" from the main menu].

State of California
AIR RESOURCES BOARD

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1988 AND SUBSEQUENT MODEL PASSENGER CARS, LIGHT-DUTY TRUCKS, AND MEDIUM-DUTY VEHICLES

Adopted:	May 20, 1987
Amended:	December 20, 1989
Amended:	January 22, 1990
Amended:	December 26, 1990
Amended:	July 12, 1991
Amended:	August 12, 1992
Amended:	October 23, 1992
Amended:	May 28, 1993
Amended:	September 17, 1993
Amended:	September 22, 1993
Amended:	September 22, 1994
Amended:	[insert date LDV/MDV amendments adopted]
Amended:	*[insert date of adoption]*

NOTE: The regulatory amendments proposed in this rulemaking are shown in *italics* to indicate additions and ~~strikeout~~ to indicate deletions from the version of the test procedures adopted on [insert date LDV/MDV amendments are adopted].

The numbering convention employed in this document, in order of priority, is: 1.a.1.i.A. Any references within specific sections in the Code of Federal Regulations are denoted in order of priority as: (a)(1)(i)(A) - the same numbering system employed in the Code of Federal Regulations.

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(b) In section 1 of the test procedures, amend subsection (a) to read as follows:

a. These test procedures are applicable to 1988 and subsequent model gasoline, gaseous, diesel, and, beginning in 1993, alcohol passenger cars, light-duty trucks, and medium-duty vehicles. Procedures specific to transitional low-emission, low-emission, ultra-low-emission, and super-ultra-low-emission vehicles are applicable to 1992 and subsequent model-year gasoline and diesel, and to 1993 and subsequent model-year alternate fuel and hybrid electric passenger cars, light-duty trucks, and medium-duty vehicles. Procedures specific to zero-emission vehicles are applicable to ~~1992~~ *2003* and subsequent model-year passenger cars, light-duty trucks and medium-duty vehicles. References to "light-duty trucks" in 40 CFR 86 shall apply both to "light-duty trucks" and "medium-duty vehicles" in these procedures.

(c) In section 2 of the test procedures, amend the definition of "All-Electric Range Test" and "Zero-emission vehicle" to read as follows:

"**All-Electric Range Test**" means a test sequence used to determine the range of an electric vehicle or of a hybrid electric vehicle without the use of its auxiliary power unit. The All-Electric Range Test cycle consists of ~~alternating~~ the Highway Fuel Economy Schedule and the Urban Dynamometer Driving Schedule (see 9.f. of these test procedures).

"**Zero-emission vehicle**" or "**ZEV**" means any vehicle ~~which is~~ certified ~~by the Executive Officer to produce zero emissions of any criteria pollutants under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40° F and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions~~ *to* zero-emission standards.

(d) In section 3 of the test procedures, make the following changes:

(i) Amend note (11) of subsection f to read:

(11) Each manufacturer shall certify PCs or LDTs to the exhaust emission standards of Sections 3.f. and 3.g. of these test procedures~~, or as Zero-Emission Vehicles,~~ such that the manufacturer's fleet average NMOG values for California-certified PCs and LDTs from 0-3750 lbs. Loaded Vehicle Weight (or "LVW"), and LDTs from 3751-5750 lbs. LVW produced and delivered for sale in California are less than or equal to the requirement for the corresponding Model Year, Vehicle Type, and LVW Class in section 3.h. of these test procedures.

(ii) Amend the table and note (2) of and add a note (2.1) to subsection g to read:

g. The exhaust emissions from new 1992 and subsequent model-year transitional low-emission vehicles, low-emission vehicles and ultra-low-emission vehicles, *and new 2003 and*

subsequent model-year zero-emission vehicles shall not exceed:

EXHAUST MASS EMISSION STANDARDS
FOR TRANSITIONAL LOW-EMISSION VEHICLES, LOW-EMISSION VEHICLES,
~~AND~~ ULTRA-LOW-EMISSION VEHICLES *AND ZERO-EMISSION VEHICLES* IN
PASSENGER CAR AND LIGHT-DUTY TRUCK VEHICLE CLASSES[6,7,8,9,10]
["grams per mile" (or "g/mi")]

Vehicle Type[1]	Loaded Vehicle Weight (lbs)	Durability Vehicle Basis (mi)	Vehicle Emission Category[2]	Non-Methane OrganicGases[3,4]	Carbon Monoxide	Oxides of Nitrogen[5]
	All					
PC and	0-3750	50,000	TLEV	0.125	3.4	0.4
LDT			LEV	0.075	3.4	0.2
			ULEV	0.040	1.7	0.2
			ZEV[2.1]	--	--	--
		100,000	TLEV	0.156	4.2	0.6
			LEV	0.090	4.2	0.3
			ULEV	0.055	2.1	0.3
	3751-5750		*ZEV*[2.1]	--	--	--
LDT		50,000	TLEV	0.160	4.4	0.7
			LEV	0.100	4.4	0.4
			ULEV	0.050	2.2	0.4
			ZEV[2.1]	--	--	--
		100,000	TLEV	0.200	5.5	0.9
			LEV	0.130	5.5	0.5
			ULEV	0.070	2.8	0.5
			ZEV[2.1]	--	--	--

(1) "PC" means passenger cars.
"LDT" means light-duty trucks.
"LVW" means loaded vehicle weight.
"Non-Methane Organic Gases" or "NMOG" means the total mass of oxygenated and non-oxygenated hydrocarbon emissions.

(2) "TLEV" means transitional low-emission vehicle.
"LEV" means low-emission vehicle.
"ULEV" means ultra-low-emission vehicle.
"ZEV" means zero-emission vehicle.

(2.1) *a. The Executive Officer shall certify as ZEVs vehicles that produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40°F and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions.*

b. Prior to the 2003 model year a manufacturer that voluntarily produces vehicles that meet the ZEV emission standards applicable to 2003 and subsequent model year vehicles may certify those vehicles as ZEVs for the purposes of calculating fleet average NMOG exhaust emission values under note (4) or (5), section h.3. of these test procedures; NMOG credits under section h.3., note(7); and ZEV credits under section h.3., note (9)a.

(iii) Amend note (9) of subsection h to read:

(9) **ZEV Requirements**. While meeting the fleet average requirements, each manufacturer shall certify, produce, and deliver for sale in California at least ~~2% ZEVs each model year from 1998 through 2000, 5% ZEVs in 2001 and 2002, and~~ 10% ZEVs in 2003 and subsequent model years. These percentages shall be applied to the manufacturer's total production of PCs and LDTs 0-3750 lbs. LVW delivered for sale in California.

a. **Calculation of ZEV Credits**. Manufacturers that produce for sale in California more ZEVs than required in a given model year shall earn ZEV credits, which shall be expressed in units of g/mi NMOG. The amount of ZEV credits earned shall be equal to the number of ZEVs required to be produced and delivered for sale in California for the model year subtracted from the number of ZEVs produced and delivered for sale in the model year and then multiplied by the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for that model year.

In calculating the number of ZEV credits under this note (9)a, each ZEV produced and delivered for sale prior to the 2003 model year may be counted as follows:

1. ZEV Credits based on vehicle range:

Number of ZEVs	*Vehicle Range (miles)*		
	Model Years 1996 and 1997	*Model Years 1998 and 1999*	*Model Years 2000, 2001 and 2002*
2	*any*	*≥ 100*	*≥ 140*
3	*≥70*	*≥ 130*	*≥ 175*

Range shall be determined in accordance with section 9.f.(2)(a) of these procedures.

2. ZEV Credits based on the specific energy of the battery:

Number of ZEVs	*Specific Energy of Battery (w-hr/kg)*		
	Model Years 1996, 1997 and 1998	*Model Years 1999 and 2000*	*Model Years 2001 and 2002*
2	*any*	*≥ 50*	*≥ 60*
3	*≥40*	*≥ 60*	*≥ 90*

For model years 1999 through 2002, additional ZEV credits will be determined by linear interpolation between the values shown in the above schedule. Battery specific energy shall be determined in accordance with section 9.g. of these procedures.

3. For purposes of calculating ZEV credits, a ZEV may be counted according to note (9)a.1. or (9)a.2. above, but not both.

4. For purposes of calculating manufacturer's fleet average NMOG value under note (4) or (5), each ZEV shall be counted as one vehicle.

All ZEV credits earned prior to the ~~1998~~ *2003* model year shall be treated as if earned in the ~~1998~~ *2003* model year and shall be discounted in accordance with note (7)c.

b. **Submittal of ZEV Credits**. A manufacturer may meet the ZEV requirements in any given model year by submitting to the Executive Officer a commensurate amount of ZEV credits. These credits may be earned previously by the manufacturer or acquired from another manufacturer. The amount of ZEV credits required to be submitted shall be calculated by subtracting the number of ZEVs produced and delivered for sale in California by the manufacturer for the model year from the number of ZEVs required to be produced by the manufacturer for the model year and then multiplying by the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for that model year.

c. **Requirement to Make Up a ZEV Deficit**. Manufacturers that certify, produce,

and deliver for sale in California fewer ZEVs than required in a given model year shall make up the deficit by the end of the next model year by submitting to the Executive Officer a commensurate amount of ZEV credits. The amount of ZEV credits required to be submitted shall be calculated by subtracting the number of ZEVs produced and delivered for sale in California by the manufacturer for the model year from the number of ZEVs required to be produced by the manufacturer for the model year and then multiplying by the fleet average requirements for PCs and LDTs 0-3750 lbs. LVW for the model year in which the deficit is incurred.

d. **Penalty for Failure to Meet ZEV Requirements**. Any manufacturer that fails to produce and deliver for sale in California the required number of ZEVs or submit an appropriate amount of ZEV credits and does not make up ZEV deficits within the specified time period shall be subject to the Health and Safety Code § 43211 civil penalty applicable to a manufacturer that sells a new motor vehicle that does not meet the applicable emission standards adopted by the state board. The cause of action shall be deemed to accrue when the ZEV deficits are not balanced by the end of the specified time period. For the purposes of Health and Safety Code § 43211, the number of vehicles not meeting the state board's standards shall be calculated according to the following equation: (No. of ZEVs required to be produced and delivered for sale in California for the model year) - (No of ZEVs actually produced and delivered for sale in California for the model year) - [(Amount of ZEV credits submitted for the model year) / (the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for the model year)].

e. **ZEV Credits for MDVs and LDTs 3751-5750 lbs. LVW**. ZEVs classified as MDVs or as LDTs 3751-5750 lbs. LVW may be counted toward the ZEV requirement for PCs and LDTs 0-3750 lbs. LVW and included in the calculation of ZEV credits as specified in note (9)a., if the manufacturer so designates.

f. Small volume manufacturers *as defined in note (6)* shall not be required to meet the percentage ZEV requirements. However, small volume manufacturers may earn and market credits for ZEVs they produce and deliver for sale in California.

~~g. Intermediate volume manufacturers shall not be required to meet the percentage ZEV requirements before the 2003 model year.~~

(iv) Amend the table and note (2) of and add a note (2.1) to subsection j:

j. The exhaust emission levels from new 1992 and subsequent model-year medium-duty low-emission vehicles, ultra-low-emission vehicles~~;~~ and super-ultra-low-emission vehicles, *and new 2003 and subsequent model-year medium-duty zero-emission vehicles* shall not exceed:

EXHAUST EMISSION STANDARDS FOR LOW-EMISSION VEHICLES, ULTRA-LOW-EMISSION VEHICLES, ~~AND~~ SUPER-ULTRA-LOW-EMISSION VEHICLES *AND ZERO-EMISSION VEHICLES* IN THE MEDIUM-DUTY VEHICLE WEIGHT CLASS[8,9,10,11,12,14,15,16]

[grams per mile (or "g/mi")]

Test Weight (lbs.)[1]	Durability Vehicle Basis (mi)	Vehicle Emission Category[2]	Non-Methane OrganicGases[1,3,4]	Carbon Monoxide	Oxides of Nitrogen[5]	Particulates[6,7]
0-3750						
	50,000	LEV	0.125	3.4	0.4	n/a
		ULEV	0.075	1.7	0.2	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.180	5.0	0.6	0.08
		ULEV	0.107	2.5	0.3	0.04
3751-5750		*ZEV*[2.1]	--	--	--	--
	50,000	LEV	0.160	4.4	0.4	n/a
		ULEV	0.100	4.4	0.4	n/a
		SULEV	0.050	2.2	0.2	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.230	6.4	0.6	0.10
		ULEV	0.143	6.4	0.6	0.05
		SULEV	0.072	3.2	0.3	0.05
5751-8500		*ZEV*[2.1]	--	--	--	--
	50,000	LEV	0.195	5.0	0.6	n/a
		ULEV	0.117	5.0	0.6	n/a
		SULEV	0.059	2.5	0.3	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.280	7.3	0.9	0.12
		ULEV	0.167	7.3	0.9	0.06
		SULEV	0.084	3.7	0.45	0.06
8501-10,000		*ZEV*[2.1]	--	--	--	--
	50,000	LEV	0.230	5.5	0.7	n/a
		ULEV	0.138	5.5	0.7	n/a
		SULEV	0.070	2.8	0.35	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.330	8.1	1.0	0.12
		ULEV	0.197	8.1	1.0	0.06
10,001-		SULEV	0.100	4.1	0.5	0.06
14,000		*ZEV*[2.1]	--	--	--	--
	50,000	LEV	0.300	7.0	1.0	n/a
		ULEV	0.180	7.0	1.0	n/a
		SULEV	0.09	3.5	0.5	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.430	10.3	1.5	0.12
		ULEV	0.257	10.3	1.5	0.06
		SULEV	0.130	5.2	0.7	0.06
		ZEV[2.1]	--	--	--	--

(1) "Test Weight" (or "TW") shall mean the average of the vehicle's curb weight and gross vehicle weight.
"Non-Methane Organic Gases" (or "NMOG") means the total mass of oxygenated and non-oxygenated hydrocarbon emissions.

(2) "LEV" means low-emission vehicle.
"ULEV" means ultra-low-emission vehicle.
"SULEV" means super ultra-low-emission vehicle.
"ZEV" means zero-emission vehicle.

(2.1) *a. The Executive Officer shall certify as ZEVs vehicles that produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40°F and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions.*

b. Prior to the 2003 model year a manufacturer that voluntarily produces vehicles that meet the ZEV emission standards applicable to 2003 and subsequent model year vehicles may certify those vehicles as ZEVs for the purposes of calculating ZEV credits under h.3., note(9)(a) and (e).

(e) In section 5 of the test procedures, amend subsection a.1.2.(i)(A)(10)(b) to read as follows:

> (b) The manufacturer shall equip the vehicle with a useful life indicator for the battery system consisting of a light that shall illuminate the first time the battery system is unable to achieve an all-electric operating range (staring from a full state-of-charge) that is at least 75% of the range determined for the vehicle in the All-Electric Range-*Urban* (see section 9.f. *(2)(a)* of these test procedures) and submitted in the certification application.

(f) In section 9 of the test procedures, make the following changes:

(i) Amend subsection f.(2) to read:

> (2) Driving schedule.
>
> (a) **Determination of All-Electric Range-*Urban.*** *At the end of the cold soak period, the vehicle shall be placed, either driven or pushed, onto a dynamometer and operated through an Urban Dynamometer Driving Schedule, 40 CFR., Part 86, Appendix I, until the vehicle is no longer able to maintain within 5 miles per hour of the speed requirements or within 2 seconds of the time requirements of the driving schedule. For hybrid*

electric vehicles this determination shall be performed without the use of the auxiliary power unit.

(b) ***Determination of All-Electric Range-Highway.*** At the end of the cold soak period, the vehicle shall be placed, either driven or pushed, onto a dynamometer and operated through a Highway Fuel Economy Driving Schedule, found in *40 CFR,* Part 600, Appendix I ~~of the CFR, followed immediately by an Urban Dynamometer Driving Schedule, found in Part 86, Appendix I of the CFR, followed by another Highway Fuel Economy Driving Schedule and an Urban Dynamometer Driving Schedule. This sequence of driving schedules shall be repeated~~ until the vehicle is no longer able to maintain within 5 miles per hour of the speed requirements or within 2 seconds of the time requirements of the driving schedules ~~in the case of a ZEV, or unable to maintain within 5 miles per hour of the speed requirements or within 2 seconds of the time requirement of the driving schedules without the use of the auxiliary power unit in the case of a hybrid electric vehicle~~. *For hybrid electric vehicles this determination shall be performed without the use of the auxiliary power unit.*

(ii) Redesignate existing subsection g as h and add a new subsection g to read:

g. ***Determination of Battery Specific Energy for ZEVs.***

Determine the specific energy of batteries used to power a ZEV in accordance with the U.S. Advanced Battery Consortium's Electric Vehicle Battery Procedure Manual (January 1996), Procedure No. 2, "Constant Current Discharge Test Series," using the C/3 rate. The weight calculation must reflect a completely functional battery system as defined in Appendix of the Manual, including pack(s), required support ancillaries (e.g., thermal management), and electronic controller.

h. **Calculations; exhaust emissions**

4. Amend title 13, California Code of Regulations, section 1976 to read as follows:

§1976. Standards and Test Procedures for Motor Vehicle Fuel Evaporative Emissions.

[Subsections (a), (b)(1)(A) through (C) -- No change]

(b)(1)(D) Zero-emission vehicles shall produce zero fuel evaporative emissions under any and all possible operational modes and conditions.

[Subsections (c) through (f) -- No change]

Note: Authority cited: Sections 39600, 39601, 39667, 43013, 43018, 43101, 43104 and 43107, Health and Safety Code. Reference: Sections 39003, 39500, 39667, 43000, 43013, 43018, 43101, 43102, 43104 and 43107, Health and Safety Code.

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER AMENDMENTS TO THE ZERO-EMISSION VEHICLE REQUIREMENTS FOR PASSENGER CARS AND LIGHT-DUTY TRUCKS

The Air Resources Board (ARB or "Board") will conduct a public hearing at the time and place noted below to consider adoption of amendments to California regulations that require zero-emission vehicles.

DATE: March 28, 1996

TIME: 9:30 a.m.

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

This item will be considered at a two-day meeting of the Board, which will commence at 9:30 a.m., March 28, 1996, and may continue at 8:30 a.m., March 29, 1996. This item may not be considered until March 29, 1996. Please consult the agenda for the meeting, which will be available at least 10 days before March 28, 1996, to determine the day on which this item will be considered.

INFORMATIVE DIGEST OF PROPOSED ACTION/PLAIN ENGLISH POLICY STATEMENT OVERVIEW

Sections Affected: Amend title 13, California Code of Regulations (CCR), section 1960.1.

I. Summary of Proposed Changes

The Board adopted the Low-Emission Vehicle regulations in September 1990. These regulations established four new categories of emission standards for passenger cars (PCs) and light-duty trucks (LDTs): Transitional Low-Emission Vehicle (TLEV), Low-Emission Vehicle (LEV), Ultra-Low-Emission Vehicle (ULEV) and Zero-Emission Vehicle (ZEV). The regulations established a progressively more stringent fleet average emission requirement for non-methane organic gases (NMOG), which manufacturers can meet by producing any combination of TLEVs, LEVs, ULEVs and ZEVs. In addition to meeting the fleet average emission requirement, the seven largest manufacturers are required to produce and offer for sale in California ZEVs in amounts equal to two percent of their total sales of PCs and LDTs weighing less than 3750 pounds loaded vehicle weight beginning with the 1998 model year, rising to five percent in the 2001 model year and ten percent in the 2003 model year.

The staff conducted a series of public forums during 1995 to discuss all aspects of the ZEV program, including hybrid-electric vehicles, consumer marketability, infrastructure, fleet issues, technology, benefits and costs. The staff also established a Battery Technology Advisory Panel ("Battery Panel") to evaluate the status of batteries for the 1998 implementation of ZEVs. Based on information gathered through the public forums and the Battery Panel, the staff is proposing to amend the LEV regulations to eliminate the percentage ZEV requirements for model years 1998 through 2002. The ten percent requirement for the 2003 model year would remain unchanged. This modification would allow auto manufacturers more time to develop and demonstrate ZEVs powered by advanced batteries and flexibility to determine the best time to introduce this new technology to the market. To encourage the early production of advanced ZEVs, the staff is also proposing to add a provision to allow multiple credits for longer-range ZEVs produced prior to the 2003 model year. These ZEV credits could be applied to a manufacturer's 2003 and subsequent model year requirements.

To ensure that no emission reductions are lost by suspending the ZEV requirements, the staff is recommending that the Board enter into memoranda of agreement (MOAs) with each of the seven auto manufacturers that are subject to the 1998 through 2002 model year percentage ZEV requirements. These MOAs would formalize commitments by the auto manufacturers to achieve the air quality benefits of the percentage ZEV requirements, continue investing in advanced batteries, produce ZEVs powered by advanced batteries for demonstration purposes and ramp up to large-volume ZEV production in the 2003 model year.

II. Comparison with Similar Federal Requirements

Under Title II of the Federal Clean Air Act (FCAA), the U.S. Environmental Protection Agency has promulgated comprehensive regulations to control emissions from new motor vehicles (see 40 CFR Part 86). However, both state law and section 209 of the FCAA allow California to establish its own standards that are different from the federal standards. While both the federal and California automotive emission standards are similar in purpose and scope, California has adopted standards that are generally more stringent and effective in order to address the severity of California's air pollution problem. California's Low-Emission Vehicle regulations, which establish emission standards for light- and medium-duty vehicles, are more stringent than the federal requirements. The Low-Emission Vehicle regulations are essential to attain the national and state ozone standards, and to fulfill the requirements of state and federal law.

There is no federal requirement for ZEVs. The amendments proposed in this rulemaking would eliminate the California requirement for ZEVs for the 1998 through 2002 model years.

AVAILABILITY OF DOCUMENTS AND CONTACT PERSON

The staff has prepared a Staff Report which includes the initial statement of reasons for the proposed action and a summary of the environmental and economic impacts of the proposal. Copies of the Staff Report and the full text of the proposed regulatory language may be obtained from the Board's Public Information Office, 2020 L Street, Sacramento, California 95814, (916) 322-2990. These documents are also available on the Air Resources Board Information

System (ARBIS) electronic bulletin board. The documents may be accessed via modem by calling (916) 322-2826 and choosing "Mobile Source Programs" and "Zero-Emission Vehicle Program" from the "System Features" menu. The documents are also available on the Internet at http://www.arb.ca.gov/ (choose "CARB Programs" from the main menu and then "ZEV Program"). If you have any questions regarding access to the ARBIS, please contact the Business Assistance Hot Line at 1-800-ARB-HLP2 (in California) or (916) 323-3336.

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 contained in the Staff Report.

Inquiries regarding this matter should be directed to Sue de Witt, Mobile Source Division, P.O. Box 2815, Sacramento, California 95812, (916) 322-6975. Inquiries regarding Appendix B of the Staff Report should be directed to Mark Carlock, Mobile Source Division, 9420 Telstar Avenue, El Monte, California 91731, (818) 575-6608.

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 the local agencies.

In developing this regulatory proposal, the ARB staff evaluated the potential economic impacts on private persons and businesses. The proposed regulatory action would eliminate an existing requirement for large auto manufacturers to produce ZEVs beginning in 1998. This action is expected to result in savings for auto manufacturers, which in turn could translate into savings for consumers.

Because the proposed regulatory action does not place any requirements on individuals or California businesses, in accordance with Government Code section 11346.3 the Executive Officer has 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, or on directly affected private persons.

The Board's Executive Officer has also determined, pursuant to Government Code section 11346.5(a)(3)(B), that the regulation will affect small businesses. Some small businesses in California's advanced transportation industry may be adversely affected by this action because it may result in fewer ZEVs being produced from 1998 through 2002. This may reduce investments and lower the demand for goods and services from California's advanced transportation businesses in the near-term. However, the proposed regulatory action is expected to increase the success of ZEVs over the long-term, which would be beneficial to these California businesses.

The Executive Officer has also determined that this regulatory action will not have a significant or any long-term affect on the creation or elimination of jobs within California, the creation of new businesses and the elimination of existing businesses within California, or the expansion of businesses currently doing business within the State of California. A more detailed assessment of the economic impacts of the proposed regulatory action can be found in the Staff Report.

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, California 95812, no later than 12:00 noon, March 27, 1996, 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 the authority granted in Health and Safety Code sections 39600, 39601, 43013, 43018, 43101 and 43104. This action is proposed to implement, interpret and make specific Health and Safety Code sections 39002, 39003, 43000, 43013, 43018, 43100, 43101, 43102 and 43104.

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

Tom Cackette for

James D. Boyd
Executive Officer

Date: January 30, 1996

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF RULEMAKING

PROPOSED AMENDMENTS TO THE ZERO-EMISSION VEHICLE REQUIREMENTS FOR PASSENGER CARS AND LIGHT-DUTY TRUCKS

Date of Release: February 9, 1996

Mobile Source Division
9528 Telstar Avenue
El Monte, California 91781

This report has been reviewed by the staff of the California Air Resources Board. Publication does not signify that the contents necessarily reflect the views and policies of the Air Resources Board.

EXECUTIVE SUMMARY

The Low-Emission Vehicle (LEV) regulations, adopted by the California Air Resources Board ("ARB" or "Board") in 1990, are a critical element of California's plan to meet federal and state health-based ambient air quality standards. The zero-emission vehicle (ZEV) requirement is an integral part of the LEV program and is intended to secure increasing air quality benefits for California over the long-term. Under the ZEV regulation, beginning in 1998 two percent of the vehicles produced and delivered for sale in California by the seven largest auto manufacturers must be ZEVs. That percentage increases to five percent in 2001 and ten percent in 2003.

When the ZEV requirement was adopted the Board acknowledged that many ZEV-related issues, including questions regarding the cost of developing the technology necessary to produce ZEVs and the marketability of these new vehicles, would have to be addressed prior to the 1998 implementation date. The Board committed to biennial reviews of the LEV program, including the ZEV requirement, to provide a forum for answering these questions. Thus as the Board took this bold step forward, there was a clear recognition that it might be necessary to make interim course adjustments to find the best and surest track to the ultimate destination -- cleaner air for California.

The proposal in this report is the result of the third biennial review of the LEV program. In preparation for this review, the ARB held a series of public forums during 1995 to solicit comments on virtually all aspects of the ZEV requirement, and retained an independent panel of experts to report on the readiness of electric vehicle battery technology for the 1998 model year implementation.

Based on the results of the review process, the staff proposes amendments to the LEV regulations to eliminate the percentage ZEV requirements through the 2002 model year. This proposal is intended to preserve, not abandon the ZEV program. In fact several manufacturers have indicated that they will introduce ZEVs for sale in California by 1998. By suspending the percentage requirements for five years, staff seeks to capitalize on these efforts and ensure the successful launch of a sustainable ZEV market that will provide air quality benefits in California through 2010 and beyond. The current ten percent ZEV production requirement in the 2003 model year would remain unchanged. Staff has concluded that this action will not have a long-term adverse economic impact on California.

The staff further recommends the ARB enter into memoranda of agreement, or MOAs, with each of the seven major automakers subject to pre-2003 ZEV requirements. The MOAs formalize the automakers' enforceable commitments to introduce low-emission vehicles nationwide in 2001, three years earlier than could be required under federal law. The emission reductions associated with this commitment will offset the emission reductions associated with the 1998-2002 ZEV requirements plus a premium, ensuring California's commitments under the state implementation plan.

The MOAs also formalize the manufacturers commitment to participate in a Technology Development Partnership. Under the MOAs the automakers will carry out demonstration projects designed to validate advanced technology batteries consistent with the recommendations of the battery panel and will continue funding of ZEV-related technology research and development.

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1.0 INTRODUCTION

1.1 Air Quality -- The Big Picture

Air quality in California has improved dramatically over the past 25 years, largely due to state and federal initiatives to control pollution from motor vehicles. However, in several areas of the state, air quality still does not meet health-based ambient air quality standards. Mobile sources are responsible for well over half the ozone-forming emissions in California. Passenger cars and small trucks, or light-duty vehicles, are responsible for a significant portion of mobile source emissions.

State and federal law require the implementation of emission control strategies to attain the ambient air quality standards as expeditiously as practicable. The 1990 amendments to the Federal Clean Air Act (FCAA) require attainment of the ozone standard in all areas of the state no later than 2010. Under the FCAA, states are required to produce a state implementation plan to ensure attainment of the federal standards by specified deadlines.

In November 1994, the California Air Resources Board (ARB or "Board") adopted a comprehensive set of amendments to the California State Implementation Plan for Ozone (SIP) that demonstrate early and continuing progress toward attainment of the ozone standard as required by the 1990 FCAA amendments. The SIP rate-of-progress and attainment plans for various local air quality management districts take into account emission reductions from existing regulatory programs for stationary and mobile sources. The SIP includes new measures focused on light-duty vehicles, such as accelerated vehicle scrappage and implementation of advanced technologies, as well as measures targeting heavy-duty vehicles and off-road equipment. Even with these new measures, however, the SIP includes a shortfall that will require the ARB to obtain additional emission reductions from as yet unspecified measures, or so called "black box" measures.

1.2 Low-Emission Vehicle Program

The Low-Emission Vehicle (LEV) program adopted by the Board in 1990 is a cornerstone of the SIP, and is essential for California to achieve attainment status. California's LEV program has been the impetus for a number of technological advances, including the rapid acceleration of developments in zero-emission vehicle (ZEV) technology.

The LEV program establishes an increasingly stringent fleet-average emission requirement for non-methane organic gases (NMOG) beginning with the 1994 model year. To meet the fleet average emission requirement, manufacturers can choose to produce any mix of vehicles from four vehicle classes: transitional low-emission vehicles (TLEVs), low-emission vehicles (LEVs), ultra-low-emission vehicles (ULEVs) and

ZEVs. The seven largest auto manufacturers must also produce and deliver for sale two percent of their 1998 model year light-duty fleet as ZEVs. This percentage increases to five percent in the 2001 model year and ten percent in the 2003 model year. Manufacturers are provided the flexibility of purchasing ZEV credits from other manufacturers or producing extra ZEVs and banking the credits for future use. The only technology currently capable of meeting the ZEV standard is the battery-powered electric vehicle (EV), although other technologies are being rapidly developed.

1.3 The History of the ARB's Zero-Emission Vehicle Program

From its inception, the ZEV requirement has been highly controversial, not only because it is technology forcing, but also because the requirement for ZEVs was perceived to be qualitatively different from other mobile source regulations, such as the standards that were set in the 1970's which essentially required catalytic converters on all new vehicles. It was clear to the Board, however, that with increasing numbers of cars on the road, each driving more and more miles every year, ZEVs would be essential to obtaining the long-term emission reductions needed from the mobile source sector.

When the Board adopted the ZEV requirement in 1990 it was not certain when or to what extent the technology necessary to meet the requirement would be available. There were questions about the cost of developing the technology and the readiness of the consumer market. With these concerns in mind, the ARB included the ZEV requirement in the LEV program with the understanding that it could be modified at a later date if necessary. In order to remain fully aware of the technological and implementation status of new vehicle technologies, the ARB directed staff to present biennial progress reviews to the Board. Thus, at the time the Board adopted the ZEV regulation, there was a clear recognition that it might be necessary to revisit this requirement as more was learned about its implementation and to make alterations if necessary to ensure that the requirement would in fact result in the emission reductions necessary to benefit air quality in California.

1.4 Benefits of the ZEV Program

The benefits to be realized from the introduction and long-term use of ZEVs in California are substantial, particularly when considered within the context of all the SIP measures needed to approach attainment in California's most severe air quality regions. The full ZEV program would provide direct exhaust, evaporative and marketing emission reductions of 14 tons per day oxides of nitrogen (NOx) and nonmethane organic gases (NMOG) in the South Coast Air Basin (SCAB) in 2010. An unique emissions benefit that EVs provide above and beyond strategies to make gasoline cars cleaner is their guarantee of no future emission increases because, unlike gasoline-fueled vehicles, EVs do not have emission control systems that can deteriorate over time. Furthermore, EVs do not emit cancer-causing toxic air contaminants such as benzene and formaldehyde.

Consequently, EVs provide the best safeguard against increased air pollution as California continues to strive to attain and maintain acceptable air quality, even as the number of vehicles and the miles they travel continues to grow. Finally, unlike most other emission reduction strategies, incremental costs of EVs are expected to eventually fall to zero as the product becomes fully commercialized. To realize these benefits, however, the successful launch of a sustainable and growing EV market is critical.

1.5 Setting the Course for the Future

The ZEV program has been effective to date; it has successfully driven substantial progress in the development of EV technologies as well as the development of the infrastructure necessary to support widespread EV use in California. Certainly the requirements can be credited with fostering significant business investment and development, creating "high-tech" jobs in California and placing the state in a position of leadership in an emerging global technology.

Now that the ZEV requirement has succeeded in pushing technology to near-commercialization, however, the ARB faces a growing body of information that indicates program modifications are needed. At this juncture the ARB must address difficult questions regarding the program's future: Has the current requirement served its salutary purposes? Is now the right time to step back and let the market more fully shape the outcome? The ARB recognizes that this is a critical moment to act on the above questions because vehicle manufacturers will be making commitments regarding production of 1998 model year ZEVs within the next few months.

In considering potential changes to the existing ZEV program, the ARB staff has been guided by the following principles:

- Alterations to the ZEV requirement should ensure the successful introduction and proliferation of EVs in California through 2010 and beyond by allowing industry flexibility as to the timing and numbers in which ZEVs are introduced.

- Any modifications of the existing requirements must be tailored to ensure ongoing improvement in the quality of EVs and promote consumer acceptance of ZEVs.

- The modifications must not jeopardize approval of the SIP. To this end, all emission reductions attributable to the ZEV program plus a "clean air premium" must be achieved.

- o The modifications should make maximum use of competitive forces and other market-based strategies to promote the development and application of advanced technologies through the least costly and most practicable strategy.

- o Any change to the ZEV requirement must send clear signals to technology developers regarding the ARB's strong commitment to ZEVs. A sure and steady course is critical to retaining investment in ZEV technologies.

The staff proposal meets these objectives. It provides automakers with an additional five years in which to continue battery related research and development and to refine market development and launch strategies while retaining the ten percent ZEV requirement for 2003 and subsequent model years. By establishing a credit system to reward the early introduction of ZEVs and formalizing automaker commitments to a voluntary early market launch of EVs, the proposal recognizes and respects the commitment of businesses that have made investments which rely on the current regulation. Finally the staff proposal will ensure that elimination of the ZEV requirement in 1998 through 2002 will not cause California to fail to meet its obligations under the 1994 SIP because it provides for emission reductions from the production of cleaner cars nationwide that will offset the reductions to be realized from implementation of the ZEV requirement during that period.

2.0 PROCESS

2.1 Public Meetings

At the time the LEV program was adopted, the Board resolved to conduct periodic reviews of the progress in implementing the regulations, including the requirement for introducing ZEVs in California in 1998. Given the far-reaching nature of the ZEV program, these reviews were intended to monitor progress made and to ensure that any necessary mid-course changes were made in a timely manner. Since 1990, the Board has held two biennial reviews (June 1992 and May 1994) to discuss the status of technology development. At the end of the Board's May 1994 review, the Board directed the staff to pursue a number of implementation issues raised during the hearing and bring any significant matters to the Board for its consideration. To address these issues, the ARB staff held a number of public forums during 1995 to solicit information on essentially all aspects of the ZEV program. Table 1 provides a list of the forum topics and the dates the forums were held.

Table 1. Zero-Emission Vehicle Public Forum Schedule

Topic	Date
Hybrid-Electric Vehicles	May 9, 1995
Consumer Marketability	June 28, 1995
Infrastructure	July 12, 1995
Hybrid-Electric Vehicles	August 9, 1995
Fleet Issues	September 13, 1995
Technology Review	October 11, 1995
Benefits and Costs	November 8, 1995

Through the public forum process the ARB staff heard over 200 statements from representatives of industry, government and the public. The testimony presented arguments on both sides of the ZEV issue.

- At the Hybrid-Electric Vehicle (HEV) forums, hybrid technology developers argued that HEVs could achieve benefits beyond those possible from pure EVs. Auto manufacturers were pessimistic about the chances for near-term commercialization of HEVs and concerned that changes to the existing HEV provisions may discourage investment in promising long-term technologies.

- At the Consumer Marketability forum, auto manufacturers presented market research that indicated the market for EVs, given 1998 technology, is less than one percent of total light-duty vehicle sales. A study conducted by the University of California at Davis indicates a market large enough to meet both the two percent and five percent requirements using today's technology.

- At the Infrastructure forum, utilities and government agencies described the progress made to date in developing EV infrastructure. Auto manufacturers expressed concern that the infrastructure would not be ready for 1998. Emergency response providers expressed concern that more EV-specific training is needed.

- At the Fleet Issues forum, several private fleet operators stated that EVs would not be practical or cost-effective for fleets due to limited range and high vehicle prices. Several government and utility fleets stated that they have used EVs successfully, citing very low operating and maintenance expenses.

- At the Technology Review forum, auto manufacturers argued that advanced batteries are not ready for 1998, and will be necessary to ensure a successful market launch of ZEVs. Lead-acid battery manufacturers stated that they have made significant advancements in recent years, and that currently available lead-acid batteries could provide the vehicle range needed by many consumers.

- At the Benefits and Costs forum, Sierra Research presented results of their study which calculated the ZEV requirement will cost California $20 billion through 2010. Representatives of taxpayer groups said the ZEV program would result in insignificant emission reductions and the costs would be too high. Bevilacqua-Knight found the cost-effectiveness of the program could range from a savings of $2000 per ton to a cost of around $10,000 per ton, which is well within the range of other air quality measures.

Clearly, the forums provided the ARB staff with a full range of data and opinion regarding the key aspects of the ZEV program.

2.2 Battery Technology Advisory Panel

In August 1995, the ARB provided funding to establish a Battery Technology Advisory Panel ("Battery Panel"). The purpose of this four person panel, which was comprised of individuals with extensive experience in science and battery technology development, was to evaluate the readiness of battery technology for the 1998 implementation of the ZEV program. To fulfill its mission, the Battery Panel visited nine battery manufacturers and solicited written information from eleven others involved in the development of advanced batteries. The Battery Panel focused on the development and commercialization of advanced batteries (those that can provide a range over 100 miles and a battery life of around five years, such as nickel-metal hydride and lithium-ion) because vehicles using these batteries have the potential for greater consumer acceptance than vehicles using currently available lead-acid batteries. The Battery Panel also held discussions with automobile manufacturers subject to the ZEV requirement in 1998 to better understand the issues related to vehicle production and timing. Based on the information received, the Battery Panel first presented its draft findings at the October 11, 1995 forum to review battery and vehicle technology. The Battery Panel subsequently presented their draft conclusions to the Board at the October 26, 1995 public meeting, and produced a final report dated December 11, 1995. The main conclusions are:

- The ZEV regulation has substantially accelerated investment and progress in developing advanced EV batteries.

- Lead-acid batteries will be available for use in EVs in 1998, however, automakers believe that limited range will restrict these vehicles to a market share less than the objectives of the current regulations.

- Advanced batteries are on the immediate horizon --- in-vehicle prototypes have been evaluated with promising results. Pilot quantities are expected by 1998 and, barring unexpected development problems, production quantities could be available in the 2000 to 2001 time frame.

The Battery Panel noted that two key steps are needed before commercialization of advanced batteries. First is pilot-scale production of advanced batteries in numbers sufficient to prove out and refine production processes in terms of economics and product quality. Second is the evaluation of performance, reliability, safety and life of these batteries as mechanically and electrically integral components of EVs under representative driving conditions.

The Battery Panel concluded that in the most optimistic scenario (i.e. no technical or decision delays in any of the testing, production planning and production implementation phases by either battery or car manufacturers), EVs with commercial-production, advanced batteries could become available in the 2000 to 2001 time frame. The Battery Panel also noted that with ten or more strong efforts currently in progress, chances appear reasonable that at least a few of them will reach commercialization in the 2000 to 2001 time period.

2.3 Consideration of ZEV Program Modifications

As a result of the Battery Panel's draft findings and the testimony heard throughout the series of forums, the ARB staff held a meeting with the primary stakeholders on October 24, 1995. The purpose of the meeting was to discuss, within the context of the Battery Panel's findings, how the ZEV program could best be implemented and to determine what changes might be needed to ensure that the long-term benefits of ZEVs in California are realized. At the conclusion of the meeting, all stakeholders were asked to submit proposals on how to modify the program.

The staff provided an informational update to the Board on October 26, 1995 summarizing the major findings of the public forums held to that date. At the November 16, 1995 public meeting, the staff reported back to the Board on the results of the Benefits and Cost forum held on November 8, 1995.

After evaluating the information received from the public forums, the Battery Panel and the meetings with interested parties, the ARB staff concluded that modifications to the ZEV portion of the LEV program could increase the long-term success of the program. This conclusion is based in large part on the uncertainties

surrounding the near-term market for ZEVs, which can be attributed to many factors including, but not limited to, the state of battery technology development. While currently available lead-acid batteries, when used in a well-designed efficient vehicle, can appeal to many consumers with range needs of less than 100 miles, advanced batteries providing longer range will substantially increase the market for this new technology. Results from the Battery Panel indicate that small quantities of advanced technology batteries will be available for use in demonstration programs beginning in 1998, and that production quantities could be available shortly after the turn of the century. Although advanced battery technology will not address or solve all marketability issues, the staff believes that regulatory modifications which would delay the large-scale introduction of ZEVs until advanced batteries are available provide a window of opportunity in which consumer awareness can be heightened, while ensuring more battery choices for consumers when ZEVs are ultimately introduced in large volumes. It is important for early consumer experiences with all types of ZEVs to be positive in order to gain long-term success with the ZEV program.

At the November 16, 1995 public meeting, the Board directed the staff to conduct a forum to discuss the proposals received for modifying the ZEV requirement and to solicit additional proposals.

2.4 Evaluation of Three Concepts

The staff held a public forum on December 6, 1995 to discuss three main concepts representing different perspectives on the direction the ZEV program could assume in the future (Concepts A, B, and C). Forty witnesses provided comments. At the subsequent December 14, 1995 Board meeting, the staff presented these three concepts to the Board and received comments from thirty-nine witnesses.

Concept A suggested that the existing requirements be eliminated and the program rely solely on performance standards and market forces to bring ZEVs to California. Concept B relied on a combination of market forces and regulatory requirements, with a suspension of the percentage ZEV requirements through the 2003 model year coupled with commitments by the affected automakers to continued ZEV research and development, introduction of increasing numbers of ZEVs powered by advanced batteries in the near-term, and a ramp-up to volume production in the 2004 model year. Concept C suggested maintaining the percentage ZEV requirements, with a slower phase-in of ZEVs than required by the current program, combined with advanced technology incentives for pre-1998 model year ZEV sales.

Through a continuation of the December 14, 1995 Board meeting, on December 21 the staff proposed a concept to the Board recommending ZEV program modifications largely based on Concept B. The staff's rationale for pursuing a program resembling Concept B is described below. Upon approval by the Board to pursue the

staff's recommended approach, the concept put forth evolved into the detailed regulatory package described in this report.

2.5 Rationale for Pursuing Concept B

Concept A's sole reliance on market forces is attractive in theory, but staff does not believe that performance-based standards alone can achieve ARB's long-term air quality goals for the ZEV program. Achieving these goals requires a substantial number of vehicles to have zero or near-zero emissions. Long-term equivalent emission reductions would be difficult to achieve due to the fact that the ARB is already counting on virtually all available alternative emission reduction measures to attain the SIP goals. Stakeholders almost unanimously agree that absent the ZEV program EV technology would not have advanced as rapidly as it has to date, and that elimination of the ZEV requirements could greatly decrease industry investment in the technology. Finally, Concept A does not provide any certainty that ZEVs will be produced, which would make it difficult to prepare the needed infrastructure.

Concept C does not fully address the need for implementation flexibility. Automakers believe producing large numbers of EVs with current technology would be too costly. Automakers are also concerned that a 1998 EV launch relying solely on lead-acid battery technology could "poison the well" for future sales if consumer perceptions of low-range EVs and battery replacement needs are negative. While Concept C encourages incentives for advanced battery EVs prior to 1998, it does not allow additional time for manufacturers to ensure this technology is ready. The ARB staff places a high priority on engaging automakers in a partnership to ensure a successful introduction and proliferation of ZEV technology. Concept C would not facilitate such a partnership.

Concept B became the working concept of choice primarily because it promotes the positive effects of a market-based launch while maintaining a regulatory push for technology development by retaining a percentage ZEV requirement. Both of these factors are needed for a successful outcome to the ZEV program. Concept B allows the flexibility offered in Concept A for manufacturers to choose near-term alternatives to meet ZEV-equivalent emission reductions without compromising the long-term technology push provided through Concept C's retention of a percentage ZEV requirement. Concept B would promote partnership and commitment between the ARB and automakers to move EV technology forward, make EVs available for near-term demonstration in California, and provide a ramp-up to volume production. The potential success of this approach is reinforced by the commitment of several manufacturers to introduce ZEVs in California by 1998.

3.0 PROPOSED CHANGES

The staff proposes to amend the LEV regulations to eliminate the percentage ZEV requirements contained in the California Code of Regulations (CCR), title 13, section 1960.1 (g)(2) note (9), for the 1998 through 2002 model years. The 10 percent ZEV requirement would be retained for the 2003 and subsequent model years. The requirements for intermediate-volume manufacturers would remain unchanged. The staff proposes to add a provision that allows manufacturers to earn multiple ZEV credits for producing longer range vehicles or vehicles that use advanced batteries prior to the 2003 model year. The staff also proposes to make a number of nonsubstantive changes to the regulations establishing the ZEV requirements to improve clarity.

The staff further recommends the ARB enter into memoranda of agreement (MOAs) with each of the seven auto manufacturers subject to the 1998 through 2002 model year ZEV requirements. The MOAs formalize commitments by the automakers (1) to enter into a Technology Development Partnership with the ARB to ensure continuation of advances in battery technology and (2) to provide emission reductions for California from the production and sale of cleaner cars to ensure that approval of the SIP and attainment of the federal ozone ambient air quality standard is not jeopardized. A master MOA, which provides an example of the MOAs specific to each manufacturer, is included in Appendix C.

Specifically, the MOAs include an enforceable commitment by the automakers to certify, produce and sell cleaner cars nationwide beginning with the 2001 model year, three years before the U.S. Environmental Protection Agency (U.S. EPA) could require introduction of these cleaner vehicles under federal law. This commitment will provide emission reductions equivalent to those attributable to the ZEV requirements for 1998 through 2002, plus a premium.

The technology partnership provisions of the MOAs will: 1) promote the development and demonstration of EVs powered by advanced batteries; 2) provide for continued automaker funding of advanced battery technology research and development; and 3) ensure manufacturers plan for an appropriate ramp-up in production to meet the ten percent ZEV requirement in 2003 and subsequent model years. The MOAs promote the development of advanced batteries because the staff believes these batteries will need to be available before ZEVs can be successfully introduced in numbers that equal or exceed the 2003 requirement. The staff believes lead-acid batteries do not need this added development and demonstration push, except perhaps in the near-term, because they are already at or very near the commercialization stage, as evidenced by the publicly stated plans of several manufacturers to introduce ZEVs by 1998. In order to encourage the commercialization of advanced batteries, the Battery Panel concluded it is important to have an orderly, stable program to "encourage the next phase of investments required

for pilot plant battery production and fleet testing...." The staff believes the MOAs would provide the order and stability needed for this purpose.

3.1 Proposed Changes to Existing Regulations

The staff proposes to make two changes to the existing ZEV requirements contained in 13 CCR §1960.1(g)(2) note (9). The staff proposes to delete the language containing the percentage ZEV requirements in note (9) for the 1998 through 2002 model years. Beginning with the 2003 model year, manufacturers would be required to certify, produce and deliver for sale in California ZEVs in amounts equal to at least 10 percent of their new passenger cars (PCs) and light-duty trucks (LDTs) less than 3750 pounds loaded vehicle weight (LVW) produced for California, as required by the current regulation.

The staff also proposes to add a provision to note (9)a that would grant multiple ZEV credits for vehicles produced prior to the 2003 model year, to encourage the development of vehicles with greater range. Credits would be based directly on range capabilities or on the specific energy of the battery. These multiple ZEV credits would be available for vehicles produced *in excess of the ZEVs placed in demonstration projects under the Technology Development Partnership provisions of the MOAs.* They could be used to meet the percentage ZEV requirements in the 2003 and subsequent model years. Multiple credits would not be applicable to the NMOG fleet average emission requirements. Credits would be granted as indicated in Table 2 or Table 3, but not both.

Table 2. Proposed Multiple ZEV Credits -- Range

Number of ZEV Credits	Vehicle Range (miles)		
	Model Years 1996 and 1997	Model Years 1998, 1999 and 2000	Model Years 2001 and 2002
2	any	≥ 100	≥ 120
3	≥70	≥ 120	≥ 150

Vehicle range would be determined using the Federal Urban Dynamometer Driving Schedule contained in Part 86, Appendix I of the Code of Federal Regulations.

Table 3. Proposed Multiple ZEV Credits -- Specific Energy

Number of ZEV Credits	Specific Energy of Battery (w-hr/kg)		
	Model Years 1996, 1997 and 1998	Model Years 1999 and 2000	Model Years 2001 and 2002
2	any	≥ 50	≥ 60
3	≥ 40	≥ 60	≥ 90

The specific energy of the battery would be determined in accordance with the "Constant Current Discharge Test Series," developed by the U.S. Advanced Battery Consortium, using the C/3 rate, with the weight calculation reflecting a completely functional battery system.

Credits would be treated as if they were earned in the 2003 model year, that is, they would not be discounted during the 1998 through 2003 time frame. Consistent with the provisions in the existing regulations that describe credit discounting (which would remain unchanged), these multiple ZEV credits would actually retain their full value through the 2004 model year. If not used by the end of the 2004 model year, they would be discounted by 50 percent. If not used by the end of the 2005 model year, they would be discounted to 25 percent of their original value. After the 2006 model year, any remaining credits from 2003 or earlier years would have no value.

The purpose of providing multiple ZEV credits is to encourage the early production of high-quality ZEVs. Providing multiple credits for either long vehicle range or high specific energy batteries is consistent with the staff's belief that, while advanced batteries need to be available to fully develop the consumer ZEV market, well-designed vehicles powered by lead-acid batteries can provide longer ranges and therefore could meet the needs of many consumers. Larger vehicles (e.g. trucks and vans) that provide greater utility in certain applications would be fairly rewarded if they use an advanced battery but have a shorter range due to their inherently higher vehicle weight.

By producing ZEVs prior to the 2003 model year, manufacturers could earn extra credits that would retain their full value and could be applied toward the ten percent ZEV requirement in 2003 and subsequent model years. It is important to note that even if a manufacturer markets vehicles that do not qualify for multiple credits, it is to their advantage to produce and sell ZEVs as early as the market will accept them, as ZEV credits earned in earlier years are worth more than credits earned in later years. For example, a 1998 model year ZEV earns 0.157 g/mi NMOG credit, while a 2003 model year ZEV earns 0.062 g/mi NMOG credit (due to the decreasing fleet average NMOG requirement over time).

It should be noted also that manufacturers have expressed concerns that assessments of the viability of the market for ZEVs in 2003 could be artificially influenced by credits generated under the proposal described above. Staff is also sensitive to this concern and, therefore, would not, in making any evaluation of the feasibility of the ZEV program, rely on a market assessment that is biased by the effects of multiple credits. To do otherwise would undercut ARB's goal of assuring that the ZEV program results in a successful launch of a sustainable market for ZEVs in California to provide long-term air quality benefits for the state.

Finally, staff proposes to incorporate the numerical component of the ZEV standard from section 1900(a)(15), title 13, CCR, into the standards table in section 1960.1 as a formatting change to clarify the regulation.

3.2 Memoranda of Agreement (MOAs)

The staff proposes that ARB enter into MOAs with each of the seven large-volume auto manufacturers. The MOAs will ensure that California will meet its commitments under the California SIP by providing emission reductions equivalent to the reductions attributable to the 1998 through 2002 ZEV requirements plus a premium. The MOAs will also ensure the successful launch of a sustainable market for ZEVs through technology improvements to be realized under a Technology Development Partnership between the ARB and automakers. The MOAs would be in effect through the 2002 model year.

The principle elements of the MOAs are described below:

3.2.1 Cleaner Cars Nationwide: This section commits the manufacturers to certify, produce and sell nationwide cleaner light-duty vehicles beginning with the 2001 model year, a full three years before such vehicles could be required by the U.S. Environmental Protection Agency (U.S. EPA) under federal law. Under this "49-state" program manufacturers would opt-in to the voluntary National LEV (NLEV) program proposed by the U. S. EPA in their October 10, 1995 Notice of Proposed Rulemaking, or alternatively produce "50-state" vehicles (i.e., vehicles certified by ARB as meeting California LEV standards and certified by U.S. EPA as meeting the applicable federal standards) for sale in any state that has not adopted the California LEV program. Under the NLEV program proposed by the U.S. EPA, manufacturers would voluntarily agree to be subject to an alternative set of federal exhaust emission standards in lieu of the federal Tier 1 exhaust emission standards. This alternative set of standards would be equivalent to the California Tier 1, TLEV, LEV, ULEV and ZEV exhaust emission standards. Manufacturers would be required to produce and deliver for sale a combination of vehicles that complies with a nationwide annual fleet average NMOG value, which would be equal to 0.075 g/mi NMOG for PCs and LDTs 0-3750 lbs. LVW, and 0.1 g/mi NMOG for LDTs 3751-5750 lbs. LVW beginning with the 2001 model year. Manufacturers

would also be required to install on-board diagnostic systems (OBD II) consistent with California regulations on all NLEVs. This section would allow manufacturers to use an alternative means to providing the same level of emission reductions to be realized from the 49-state program subject to approval of the Executive Officer.

The purpose of this element is to ensure that the emission reductions lost by eliminating the ZEV requirements for the 1998 through 2002 model years will not jeopardize approval of the California SIP by providing substitute emission reductions from control strategies not already included in or encumbered by the SIP. (See discussion under 3.2.6 below.)

3.2.2 Market-Based ZEV Launch and ZEV Product Plans: To provide an early market-based ZEV launch, these sections provide that manufacturers will offer ZEVs for sale according to their estimate of market readiness. Confidential and proprietary business information regarding each manufacturer's annual capacity to produce ZEVs for the 1996 through 2002 model years has previously been received by the ARB. Manufacturers will also submit to the ARB ZEV product plans for model years through 2004. These plans are to be held in confidence by the ARB in accordance with state law. The purpose of the plans is to show how the manufacturer will transition between producing the numbers of ZEVs being sold in years prior to 2003, including those ZEVs required to be placed in demonstration projects under the Technology Development Partnership and the 2003 model year requirement for 10 percent ZEVs.

The purpose of these elements is to demonstrate that the manufacturer is committed to developing the market for ZEVs during the 1996 through 2002 time frame, and to provide information for business and regulatory planning purposes and for infrastructure development and funding. ZEV market development is necessary to ensure that the requirement for ten percent ZEVs can be met beginning with the 2003 model year.

3.2.3 Technology Development Partnership: This element commits the manufacturer to continued ZEV research and development, and to production of the manufacturer's pro rata share of 750 advanced battery-powered ZEVs in 1998, and 1500 advanced battery-powered ZEVs in each of the years 1999 and 2000. The Technology Development Partnership is intended to promote the development and demonstration of advanced battery technologies in real-world applications. The ARB staff believes this element would address the need outlined by the Battery Panel for "...pilot-scale production of advanced batteries in numbers sufficient to prove out production processes in terms of product quality and process economics, and to permit the evaluation of the performance, reliability, safety, and life of these batteries as mechanically and electrically integral components of EVs under representative driving conditions." This element is important also because ongoing EV-related research and development together with provisions for a market-based launch of EVs by 1998 and EV ramp-up planning will

provide assurance to technology developers in the emerging EV industry that ARB looks to the ZEV program as a critical component of the state's long-term strategy to attain and maintain air quality standards.

For the purposes of the MOA, "advanced battery" means a battery with a specific energy of at least 40 watt-hours per kilogram (w-hr/kg) for the 1998 calendar year and at least 50 w-hr/kg for 1999 and subsequent calendar years, as determined by the United States Advanced Battery Consortium (USABC) "Constant Current Discharge Test Series" (which takes into account battery packaging, including thermal management systems). This definition was chosen because batteries with a specific energy less than 40 w-hr/kg are already commercialized and do not need the added development and demonstration push that would be provided by the partnership. Batteries with a specific energy between 40 and 50 w-hr/kg are very close to being commercialized and would be given a boost by qualifying for the partnership in the 1998 calendar year.

The ZEVs produced under the partnership would be placed in California by means of either selling, leasing or otherwise transferring the vehicles to consumers who will use the vehicle on a frequent, regular basis for the duration of the MOA and provide feedback to the manufacturer. Each manufacturer's share of the total ZEVs to be placed under this element is presented in Table 4.

Table 4. Manufacturer Commitments for Placing Vehicles

Calendar Year	Number of Vehicles (Based on Average Market Share)						
	General Motors	Ford	Toyota	Honda	Nissan	Chrysler	Mazda
1998	182	181	135	101	70	51	28
1999	365	363	271	202	141	103	55
2000	366	363	271	203	141	103	55

Manufacturers may reduce the total number of ZEVs required to be placed in demonstration projects if the batteries used in the vehicles have a specific energy over 50 w-hr/kg. This "extra credit" is only available for ZEVs produced to meet the requirements of the partnership. Such vehicles would receive credit based on a linear interpolation between the values shown in Table 5.

Table 5. Placement Credits for Advanced Battery Vehicles

Vehicles powered by a battery with a specific energy of:	Shall be credited as:
40 w-hr/kg (1998 only)* 50 w-hr/kg (1999 and 2000)	One ZEV
60 w-hr/kg	Two ZEVs
90 w-hr/kg	Three ZEVs

* no interpolation allowed between 40 and 50 w-hr/kg

It is important to note the vehicles produced to meet the requirements of the partnership would not earn ZEV credits under 13 CCR §1960.1(g)(2), note (9)a. This is because the vehicles required under the partnership are for demonstration purposes, and may not be fully commercialized vehicles. Any vehicles placed by a manufacturer in excess of the number required to be placed under the partnership could be transferred to another manufacturer to satisfy their partnership obligations, or could be used toward the 2003 and subsequent model year ZEV requirements.

3.2.4 Annual Report: This element requires the manufacturers to file reports with the ARB Executive Officer within 90 days after the close of each calendar year. The annual reports would provide information regarding ZEVs placed in California and the United States during the previous calendar year, information regarding the purchase of advanced battery prototypes prior to 1998, and information regarding the placement of ZEVs under the partnership.

3.2.5 ARB's Obligations: The ARB would commit to working with state and local governments and others to help ensure the development of ZEV infrastructure and the removal of barriers to ZEV introduction. The purpose of this element is to specify the ARB's role in developing the market for ZEVs. Specifically, the ARB would commit to:

- Facilitate the purchase of ZEVs in state fleets
- Address insurance issues with the California Department of Insurance
- Address financing issues with the California Department of State Banking
- Ensure the availability of battery recycling by working with the Department of Toxic Substance Control, the Integrated Waste Management Board and the Office of Environmental Health Hazard Assessment
- Work with local governments, as needed, on planning and permitting charging stations

- o Ensure adequate training for installation and maintenance of EV charging systems by working with utilities and electrical contractor trade groups
- o Continue to support the efforts of the Infrastructure Working Council
- o Continue to work with the State Fire Marshal and other emergency response officials and towing companies to create a comprehensive ZEV emergency response training program
- o Maintain the commitment to observe the activities of the USABC regarding the development of advanced technology batteries
- o Support the development and implementation of reasonable incentive programs that enhance the near-term marketability of ZEVs

3.2.6 SIP Credits: The purpose of this element is to provide the basis for ARB's determination that the emission reductions lost by eliminating the 1998 through 2002 model year percentage ZEV requirements will be made up by manufacturers through the production of cleaner light-duty vehicles to ensure approvability of the California SIP under federal law.

The ARB staff has determined that by the year 2010, implementing a NLEV program for the 2001 to 2003 model years would provide emission reductions in the SCAB in excess of those provided by the 1998 through 2002 model year percentage ZEV requirements. (For 2004 model years and beyond, it is assumed the U.S. EPA will adopt Tier II national emission standards on a mandatory basis, as allowed by the federal Clean Air Act. Thus, emission reductions from the production of these vehicles will no longer be available as manufacturer-generated offsets.) These 2001 to 2003 model year NLEVs would create emission benefits in California when out-of-state residents move and register their vehicles in California because they would be much cleaner than the current federal fleet. The SCAB emission benefits of a NLEV program are compared to the emission benefits of the 1998 through 2002 model year percentage ZEV requirements in Table 6. These emission benefits were determined using ARB's emission inventory model EMFAC 7F, updated to account for OBD II and enhanced inspection and maintenance programs. A detailed description of the methodology and assumptions used is provided in Appendix B.

Table 6. Comparison of SCAB Emission Benefits (1998 through 2002 Model Year ZEVs versus NLEV)

Year	SCAB NOx plus NMOG Emission Benefits (tons per day)	
	1998-2002 MY ZEVs	2001-2003 NLEV
2004	2.0	0.5
2010	1.6	3.2

The emission benefits of the NLEV program are lower than the emission benefits of the 1998 through 2002 model year ZEVs in 2004 because the migration of newer federal cars into California is initially small. However, by 2010, the emission benefits of the NLEV program exceed the benefits of ZEVs by a factor of two, as greater numbers of NLEVs register in California. An analysis of the cumulative emission benefits of each program through 2010 is presented in Table 7. The results show that in 2010, the NLEV program achieves the cumulative emission benefits of the ZEV program.

Table 7. Cumulative SCAB Emission Benefits Through 2010

Program	Cumulative NOx plus NMOG Benefits (tons per day)
1998 through 2002 MY ZEVs	13
2001 through 2003 NLEV	13

3.2.7 Review: This element commits the ARB to continue conducting biennial reviews of the ZEV program, including the status of battery technology development.

3.2.8 Enforcement: The benefits of the MOAs will only be achieved if all signatory manufacturers strictly adhere to the provisions of the agreements. Any failure to comply with these requirements will compromise the overall effectiveness of the MOAs and significantly impair the purposes for which the agreements were created. In light of these facts, the MOAs establish significant consequences for noncompliance as an enforcement mechanism. The primary consequence of a failure to comply is a monetary payment in the form of liquidated damages. The amounts specified in the agreements for failure to implement a 49-state LEV program, failure to place vehicles in demonstration projects, failure to continue ZEV-related research and development, or

failure to submit reports as required under the agreements are set at levels commensurate with the full range of the harm done by the manufacturer's noncompliance. The amounts established are sufficient to ensure that manufacturers will meet these requirements. Any amounts paid under these provisions would go to a third-party escrow holder approved by ARB and be used to fund projects to develop a sustainable market for ZEVs. Although we anticipate full compliance by each of the manufacturers, the MOAs include a further provision acknowledging that if a manufacturer fails to meet its commitments, the ARB may both pursue liquidated damages as provided in the MOA and exercise its regulatory authority to reinstate a percentage ZEV requirement as to the noncomplying manufacturer.

4.0 ISSUES

4.1 Marketability

The ultimate success of the ZEV program depends upon consumer acceptance of a new technology. The modifications proposed by staff will promote the development of a strong market for ZEVs by providing the flexibility manufacturers believe is necessary to ensure that initial consumer experience with ZEVs is positive.

During the course of the public forums, the staff reached two main conclusions regarding marketability. First, EVs have market potential because they offer distinct characteristics not available with gasoline vehicles. Second, negative consumer perceptions of EVs are primarily based on comparisons between currently available non-optimized, short-range EVs; and the long-range gasoline vehicles with which consumers are most familiar.

Staff believes that the differences between EVs and gasoline vehicles are likely to become their strongest attraction. For example, the laptop computer offered significantly less storage memory than desktop computers when first marketed, yet it also offered something new -- the convenience of flexible use. Likewise, while early market EVs may not offer ranges comparable to gasoline vehicles, they will offer the new convenience of home recharging (no trips to the gas station), along with other differences that make them unique, such as a quiet motor, long life, less maintenance (e.g. no oil changes or tune-ups), reliable and durable electronic components, and peppy in-city acceleration, as well as the clean air benefits of zero tailpipe and in-use emissions. These benefits will be especially attractive to today's new car buyers, who typically own at least one other vehicle, and therefore may be interested in a vehicle with these advantages even if it does not offer the range of a gasoline car.

By modifying the existing ZEV program to allow a voluntary market launch of ZEVs over the next seven years, the staff believes consumers will have an opportunity to

gain the real-world experience necessary to overcome doubts about this new technology. Current market research shows many consumers, even after they have participated in a demonstration program or have closely examined their driving patterns, are still concerned about the limited ranges offered by currently available lead-acid batteries. Auto manufacturers suggest, and the staff agrees, that it is extremely important for the experiences of early EV purchasers to be positive. Lead-acid batteries typically provide EVs with less than 100 miles of driving range and are expected to require more replacements over the vehicle life, as compared to advanced batteries. Even though consumers' perception of EV performance may not accurately reflect the performance of well-designed lead-acid battery-powered EVs, the ARB staff does not believe it prudent to rely upon a large scale introduction of lead-acid battery EVs to launch the consumer ZEV market. As consumers become familiar with how EVs can meet their travel needs, lower-range lead-acid battery vehicles may in fact become a popular choice among EV purchasers if they offer a cost advantage. Also during this period continued development of advanced technology batteries including pilot project placements of vehicles with these batteries will result in ZEVs that come closer to matching the benefits of gasoline-fueled vehicles while retaining the additional benefits of EVs.

4.2 Costs

The proposed modifications will address issues regarding the costs of ZEVs by strengthening the marketability of ZEVs. The two primary issues regarding EV costs presented to the ARB staff at the public forums include: 1) the concern that early market EVs will have high initial purchase prices compared to gasoline cars, requiring manufacturers to recover their costs by raising prices on other California cars, and 2) the concern that EV manufacturing costs will remain higher than gasoline car costs indefinitely.

New, innovative products require significant investment and are more costly than existing products when first introduced to the market in small volumes. This is a business reality. No matter how the program is modified, early market EVs will cost more than gasoline cars which have already achieved economies of scale. But manufacturers are not likely to risk substantial losses of market share by raising prices significantly on all of their major California product lines. They will probably recover costs in such a way that minimizes company losses and maximizes the future market potential of the product. It is likely that successful battery and component manufacturers will realize economies of scale through exports to other states and foreign countries. Manufacturers may also realize indirect benefits, such as a corporate "environmental", or "technology leadership" image, and carry-over of EV technology into other product lines. Furthermore, similar to other innovative products introduced to the market in small volumes, EVs may merit a longer time frame for cost recovery. Manufacturers are more apt to allow this when the technology has a better chance for market success.

Staff believes that in time EV costs will match or even be lower than the costs of gasoline vehicles. Based on precedents set by other electronic and battery products, it is likely that EV technology will undergo cost decreases through economies of scale and optimization of technology. The crucial question is whether EVs are inherently more expensive to produce and operate than gasoline vehicles, and whether the market for EVs will eventually be large enough for manufacturing economies of scale to be realized. While there is always a degree of uncertainty surrounding cost estimates, the staff believes the life-cycle costs of EVs may ultimately be equal to or less than the life-cycle costs of gasoline vehicles, due to fewer parts, lower maintenance, lower operating costs, and longer component life. ZEVs are an air quality program that may eventually pay for itself, and could even create additional savings for manufacturers and consumers through avoided costs of emission control equipment, Smog Checks, emission control system failures and potential emissions-related vehicle recalls.

4.3 Hybrids and Equivalent Zero-Emission Vehicles

The primary question with regard to hybrid-electric vehicles (HEVs) and other clean car technologies which have potential to emit fewer pollutants than ULEVs is whether these vehicles should receive credit as ZEVs. HEVs offer driving ranges similar to gasoline vehicles while using an electric drive system at least part of the time. This enhances their capability to serve a wider variety of functions than a pure EV. Equivalent zero-emission vehicles (EZEVs) are defined as vehicles having exhaust, evaporative and refueling emissions equivalent to the power plant emissions associated with EVs. However, HEVs and EZEVs are not yet available for real-world testing of their emissions benefits, making it difficult to evaluate how much credit they should receive under the ZEV regulation.

While not specifically incorporated into the current ZEV program modifications, the ARB staff is evaluating HEVs and EZEVs and will prepare a separate proposal addressing these issues for the Board in late 1996. The ARB staff believes that a delay in presenting an HEV/EZEV proposal to the Board will not hurt the prospects of HEVs in the California market. There is significant interest at the federal level in funding HEV technology research and development, matched by private contributions from auto manufacturers. It is widely perceived among industry experts that HEVs have strong market potential. A relatively short delay in presenting an HEV proposal, allowing the ARB staff additional time to address important HEV issues, is unlikely to affect this, especially since the technology is still several years away from pilot production. In the end, the ARB seeks to encourage commercialization of this technology as a means of expanding the market for clean technologies and achieving healthful air quality.

4.4 Infrastructure

Infrastructure for EVs includes commonly discussed items such as EV recharging systems as well as less apparent tasks such as modifying building codes and training emergency personnel to respond to incidents involving EVs. In their efforts to address infrastructure issues, stakeholders have faced a "chicken and egg" dilemma. While it is important to ensure that infrastructure for EVs is ready by the time the vehicles are produced and sold, it is difficult to secure commitments to accomplish this without an immediate need for infrastructure availability and use. The modifications to the ZEV program would allow auto manufacturers more flexibility regarding how soon and how many EVs they introduce, which could exacerbate the uncertainty surrounding infrastructure development.

For this reason it is critical, now more than ever, that stakeholders work together to develop the necessary infrastructure. State and local governments, utilities, auto manufacturers, battery manufacturers, environmental groups and others will need to coordinate efforts to modify codes, develop training programs for emergency response personnel and EV service personnel, ensure that adequate battery recycling is available, ensure that consumers can easily finance, insure and register their EVs, establish recharging stations, and develop safety standards. Many efforts are already underway to accomplish these goals, and they cannot be set aside now. By formalizing commitments between the automakers and the ARB, the staff believes the MOAs provide the maximum certainty regarding the pace and timing of ZEV introduction while also allowing needed market flexibility. While all infrastructure stakeholders are not signatories to the MOAs, the ARB staff will work to assume their continued involvement in preparing California for ZEVs is of the utmost importance.

4.5 Partnerships

The proposed modifications to the ZEV program are designed to foster partnerships among stakeholders to successfully implement the program on all levels.

California state agencies such as the Energy Commission, Department of General Services, and Trade and Commerce Agency have all assumed leadership positions to promote EVs in California. The ARB staff will work with these agencies in their continued efforts to secure purchase commitments for EVs in public and private sector fleets, assist in EV demonstrations, and provide valuable support on infrastructure and economic development issues. California air quality districts and local governments also have important roles in adopting local incentives for EV purchase and use (as has already been done in the South Coast Air Basin), assisting in local infrastructure preparations and securing purchase commitments from local government fleets.

Electric utilities have demonstrated their commitment to providing the necessary infrastructure for EVs in California. Utilities are leading efforts to ensure that EV buyers have any necessary wiring upgrades for home recharging within a few days of purchase, establish convenience recharging sites where feasible, and address issues related to load management, connector standards, and charger safety standards. California business groups are integral to spurring interest among business communities to invest in EVs, through both private purchase commitments and research funds. And, environmental groups can actively promote EVs in California by providing educational materials for consumers on EVs and their air quality benefits.

Two good examples of existing public-private partnerships include a rental car demonstration program jointly sponsored by the Department of General Services, Honda, National Rent-A-Car and the Sacramento Municipal Utility District, and an EV-incentive program sponsored by the South Coast Air Quality Management District (SCAQMD) with the participation of Southern California Edison and local authorities. The rental car program will allow state employees an opportunity to rent an EV from the Sacramento airport, while the SCAQMD "quick charge" program provides a $5,000 incentive per EV purchase to reward early users of the technology. The success of these types of partnerships depends on cooperation between automakers, utilities, other companies and government agencies, and will undoubtedly enhance the successful launch of ZEVs in California.

5.0 ENVIRONMENTAL AND ECONOMIC IMPACTS

5.1 Environmental Impact Analysis

The staff is proposing amendments to the LEV regulations to eliminate the percentage ZEV requirements contained in 13 CCR §1960.1(g)(2) note (9) for the 1998 through 2002 model years. Under staff's proposal during this period the ARB and the seven automakers subject to the ZEV requirements in 1998 will enter into a Technology Development Partnership formalized by MOAs to ensure the successful launch of a sustainable market for ZEVs. To ensure the emission reductions associated with the percentage ZEV requirements are still realized, the MOAs will require auto manufacturers to achieve the NMOG and NOx emission reductions through the production of cleaner light-duty vehicles. This approach ensures there will be no double counting of emission reductions already included in the SIP, since the only measures in the SIP that apply to light-duty vehicles are vehicle scrapping (Measure 1) and improved control technology (Measure 2, which would not become effective until the 2004 to 2005 time frame).

The total NOx and NMOG emission benefits of the 1998 through 2002 model year percentage ZEV requirements has been determined using the ARB's mobile source

emission inventory model EMFAC 7F, modified to account for OBD II and enhanced inspection and maintenance programs. The ARB staff has determined that, by 2010, voluntary compliance by manufacturers with a NLEV program for model years 2001 to 2003 would provide NMOG and NOx emission benefits for the SCAB that are equivalent to the emission benefits of the 1998 through 2002 model year percentage ZEV requirements. The results of the staff's analysis are presented in section 3.2.6 of this report, and a detailed description of the methodology and assumptions used is provided in Appendix B.

In addition to reducing emissions of ozone precursors, ZEVs will reduce emissions of carbon monoxide (CO) and toxic pollutants when compared to gasoline vehicles. As with NMOG and NOx, equivalent CO and toxic emission benefits may not be achieved in the early years. However, the staff believes that the long term success of the ZEV program can only be assured if auto makers are allowed flexibility during the introductory years of the program. Thus, the staff believes it is appropriate to forego a small portion of the total program benefits during the early years, since the long-term benefits of a successful ZEV program are so significant.

5.2 Economic Impact Analysis

This section evaluates the potential economic impact that the proposed modifications to the ZEV program may have on individuals and business enterprises in California. Section 11346.3 of the Government Code requires that, in proposing to adopt or amend any administrative regulation, state agencies assess the potential for adverse economic impact on California business enterprises and individuals, as well as the ability of California businesses to compete with businesses in other states. This section also requires state agencies to assess the potential impact of their regulations on California jobs and on business expansion, elimination, or creation.

ZEV technologies have the potential to boost California's economy by creating jobs in advanced technology industries that supply components to EV manufacturers and services to EV purchasers, and by increasing exports of high-technology products to an emerging global industry. For this reason, it is important to maintain the momentum of the program. Toward this end the staff has proposed establishing MOAs with the automakers which will formalize commitments of the ARB and manufacturers to develop a long-term market for ZEVs in California. The ARB staff believes the MOAs will assure investors that research and development will continue on ZEVs and that California's commitment to ZEVs is strong. Also, maintaining the 2003 model year ZEV requirement signals investors that the program is still on track.

The Board's Executive Officer has determined, pursuant to Government Code section 11346.5(a)(3)(B), the proposed regulatory action will affect small business. If manufacturers produce fewer ZEVs in the near term, economic growth in California's

advanced transportation industries may be slowed. However, the staff believes that, in its current form, the ZEV program may not result in a successful ZEV launch, which could slow the growth of these businesses, if not eliminate them altogether. The staff's proposal is designed to promote a positive market launch of ZEVs and ramp-up the number of ZEVs in California's vehicle fleet, which is intended to sustain the growth of advanced transportation industries in the long run.

The proposed modifications to the ZEV regulation are likely to have beneficial impacts on California consumers. By providing added flexibility regarding when and how ZEVs are introduced to the California market, the proposed modifications could reduce total program costs by allowing manufacturers to:

1) **Avoid the production costs of near-term technologies:** Auto manufacturers will be able to invest in longer-term technology that has the potential for broader market success, thereby avoiding the production development costs associated with technology that could be quickly outdated.

2) **Improve manufacturing processes:** Auto manufacturers and EV component and battery suppliers will have additional time to move further along the learning curve in developing their manufacturing processes. This could lower the costs of EVs for manufacturers and consumers.

3) **Prove out new systems:** Manufacturers will have additional time to conduct on-road tests of their EVs in order to prevent system failures that could be costly to both manufacturers and EV purchasers.

4) **Achieve greater economies of scale:** The market demand will be greater for higher-performance EVs than for the EVs that would be available for sale under the current regulation in 1998. This will encourage manufacturers to spread their costs over production of more units domestically and internationally, enabling lower prices for California buyers.

However, the modifications may lower or, at a minimum, delay for a few years the expected economic benefits of the ZEV program as reflected in business creation or expansion and job growth. This is because some California companies have made business plans based on the current regulation, and the modifications raise the risk of making significant investments in the near-term. Small California companies without the financial capability to withstand an investment delay may lose the ability to compete in this market, thereby losing the investments they have made to date in the expectation of a two percent EV market penetration in 1998. Nonetheless, the long-term potential for economic benefits and job growth still exists, and should be more certain due to the increased market potential of higher-performing EVs. Therefore, even though it is possible that certain small businesses may be adversely affected by the proposed

regulatory action in the short-term, the staff anticipates no broad negative impacts on employment and the viability and competitiveness of California businesses overall.

6.0 REFERENCES

ARB Public Forums

"Public Forum to Discuss Hybrid-Electric Vehicles," May 9, 1995, El Monte, California.

"Public Forum to Discuss Consumer Marketability of Zero-Emission Vehicles," June 28, 1995, El Monte, California.

"Public Forum to Discuss the Status of Electric Vehicle Infrastructure Development," July 12, 1995, El Monte, California.

"Public Forum to Discuss Proposed Revisions to the Low-Emission Vehicle Regulations," August 9, 1995, El Monte, California.

"Public Forum to Discuss Issues Regarding the Implementation of Electric Vehicles in Fleet Applications," September 13, 1995, El Monte, California.

"Public Forum to Discuss Technological Progress of Zero-Emission Vehicles," October 11, 1995, Los Angeles, California.

"Public Forum to Discuss the Benefits and Costs of Zero-Emission Vehicles," November 8, 1995, Los Angeles, California.

"Public Forum to Discuss Potential Modifications to the Zero-Emission Vehicle Program," December 6, 1995, El Monte, California.

Board meetings

"Public Meeting to Update the Board on the Technological Progress of Zero-Emission Vehicles," Item 95-11-3, October 26, 1995, Sacramento, California.

"Public Meeting to Update the Board on the Technological Progress of Zero-Emission Vehicles," Item 95-12-4, November 15, 1995, Sacramento, California.

"Public Meeting to Update the Board on the Zero-Emission Vehicle Program," Item 95-13-4, December 14, 1995, Sacramento, California.

"Continuation of Public Meeting to Update the Board on the Zero-Emission Vehicle Program," Item 95-13-4, December 21, 1995, Sacramento, California.

Reports

F. R. Kalhammer, A. Kozawa, C. B. Moyer, B. B. Owens, "Performance and Availability of Batteries for Electric Vehicles: A Report of the Battery Technical Advisory Panel," prepared for the California Air Resources Board, El Monte, California, December 11, 1995.

Turrentine, Tom and Kurani, Kenneth, "The Household Market for Electric Vehicles," UCD-ITS-RR-95-5, Institute of Transportation Studies, University of California, Davis, May 12, 1995.

"The Electric Vehicle Marketing Challenge: Special Report for the California Motor Car Dealers Association," J.D. Power and Associates, 1995.

"DSM - Electric Vehicle Evaluation Program: SCE Conversion and Preproduction Electric Vehicle Trials Program (March 1993 - December 1994)," Technical Paper VT-002, Southern California Edison, February 22, 1995.

M. Delucchi, A. Burke, M. Miller, T. Lipman, "An Electric Vehicle Design, Performance, and Life-Cycle Cost Model: Work in progress," (slides presented at the Public Forum to Discuss the Benefits and Costs of Zero-Emission Vehicles, November 8, 1995), Institute of Transportation Studies, University of California, Davis, November 1995.

M. Coates, R. Cogan, D. Gautreau, S. McGillivray, "Pricing for Success: Using Auto Industry Models to Review Electric Vehicle Costing and Pricing," Green Car Media, November 1995.

APPENDIX A

Proposed Amendments to Title 13, CCR, Sections 1900 and 1960.1

PROPOSED REGULATION ORDER

Sections 1900 and 1960.1, Title 13, CCR

1. Amend title 13, California Code of Regulations, section 1900 to read as follows:

§1900. Definitions.

[Subsections (a)(1) through (14) -- No change]

(a)(15) ~~"Zero-emission vehicle" (or "ZEV") means any vehicle which is certified by the Executive Officer to produce zero emissions of any criteria pollutants under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40 degrees Fahrenheit and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions.~~ *[Reserved]*

[Subsection (a)(16) -- No change]

Note: Authority cited: Sections 39600, 39601, 43013, 43018, 43101 and 43104, Health and Safety Code. Reference: Sections 39002, 39003, 39010, 39500, 40000, 43000, 43013, 43100, 43101, 43101.5, 43102, 43103, 43104, 43106 and 43204, Health and Safety Code; and section 27156, Vehicle Code.

2. Amend title 13, California Code of Regulations, section 1960.1 to read as follows:[1]

§1960.1. Exhaust Emission Standards and Test Procedures - 1981 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles.

[Subsections (a) through (f) -- No Change]

(g)(1) The exhaust emissions from new 1992 and subsequent model-year light-duty transitional low-emission vehicles, low-emission vehicles, and ultra-low emission vehicles, *and new 2003 and subsequent model-year light-duty zero-emission vehicles* shall not exceed:

[1] The proposed amendments are shown in italics to indicate additions to and strikeout to indicate deletions from the California Code of Regulations (CCR). This proposal does not reflect the amendments to section 1960.1 approved by the Board in September of 1995. Those amendments have not yet been formally adopted and submitted to the Office of Administrative Law for review and filing with the Secretary of State and inclusion in the CCR. The amendments proposed here will have no effect on those amendments.

EXHAUST EMISSION STANDARDS FOR TRANSITIONAL LOW-EMISSION VEHICLES, LOW-EMISSION VEHICLES, ~~AND~~ ULTRA-LOW-EMISSION VEHICLES *AND ZERO-EMISSION VEHICLES* IN PASSENGER CAR AND LIGHT-DUTY TRUCK VEHICLE CLASSES[6,7,8,9,10]

[grams per mile (or "g/mi")]

Vehicle Type[1]	Loaded Vehicle Weight (lbs)	Durability Vehicle Basis (mi)	Vehicle Emission Category[2]	Non-Methane OrganicGases[3,4]	Carbon Monoxide	Oxides of Nitrogen[5]
PC and	All	50,000	TLEV	0.125 (0.188)	3.4 (3.4)	0.4 (0.4)
LDT	0-3750		LEV	0.075 (0.100)	3.4 (3.4)	0.2 (0.3)
			ULEV	0.040 (0.058)	1.7 (2.6)	0.2 (0.3)
			ZEV[2.1]	--	--	--
		100,000	TLEV	0.156	4.2	0.6
			LEV	0.090	4.2	0.3
			ULEV	0.055	2.1	0.3
			ZEV[2.1]	--	--	--
LDT	3751-5750	50,000	TLEV	0.160 (0.238)	4.4 (4.4)	0.7 (0.7)
			LEV	0.100 (0.128)	4.4 (4.4)	0.4 (0.5)
			ULEV	0.050 (0.075)	2.2 (3.3)	0.4 (0.5)
			ZEV[2.1]	--	--	--
		100,000	TLEV	0.200	5.5	0.9
			LEV	0.130	5.5	0.5
			ULEV	0.070	2.8	0.5
			ZEV[2.1]	--	--	--

(1) "PC" means passenger cars.
"LDT" means light-duty trucks.

(2) "TLEV" means transitional low-emission vehicle.
"LEV" means low-emission vehicle.
"ULEV" means ultra-low-emission vehicle.
"ZEV" means zero-emission vehicle.

(2.1) a. The Executive Officer shall certify as ZEVs vehicles that produce zero exhaust or evaporative emissions of any criteria pollutant (or precursor pollutant) under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40 degrees Fahrenheit and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions.

b. Prior to the 2003 model year a manufacturer that voluntarily produces vehicles that meet the ZEV emission standards applicable to 2003 and subsequent model year vehicles may certify those vehicles as ZEVs for the purposes of calculating fleet average NMOG exhaust emission values under section (g)(2), note (4) or (5); NMOG credits under section (g)(2), note(7); and ZEV credits under section (g)(2), note (9)a.

[Notes (3) through (10) -- No change]

[Section (g)(2), table and notes (1) through (8) -- No change]

(9) While meeting the fleet average requirements, each manufacturer shall certify, produce and deliver for sale in California at least ~~2% ZEVs each model year from 1998 through 2000, 5% ZEVs in 2001 and 2002, and~~ 10% ZEVs in 2003 and subsequent model years. These percentages shall be applied to the manufacturer's total production of PCs and LDTs 0-3750 lbs. LVW delivered for sale in California.

a. Manufacturers ~~which~~ *that* produce for sale in California more ZEVs than required in a given model year shall earn ZEV credits, which shall have units of g/mi NMOG. The amount of ZEV credits earned shall be equal to the number of ZEVs required to be produced and delivered for sale in California for the model year subtracted from the number of ZEVs produced and delivered for sale in California by the manufacturer for the model year and then multiplied by the fleet average *NMOG* requirement for PCs and LDTs 0-3750 lbs. LVW for the model year.

In calculating the number of ZEV credits under this note (9)a, each ZEV produced and delivered for sale prior to the 2003 model year may be counted as follows:

1. ZEV Credits based on vehicle range:

Number of ZEVs	*Vehicle Range (miles)*		
	Model Years 1996 and 1997	*Model Years 1998 and 1999*	*Model Years 2000, 2001 and 2002*
2	*any*	*≥ 100*	*≥ 140*
3	*≥70*	*≥ 130*	*≥ 175*

Range shall be determined using the Federal Urban Dynamometer Driving Schedule, Part 86, Appendix I, Code of Federal Regulations.

2. ZEV Credits based on the specific energy of the battery:

Number of ZEVs	*Specific Energy of Battery (w-hr/kg)*		
	Model Years 1996, 1997 and 1998	*Model Years 1999 and 2000*	*Model Years 2001 and 2002*
2	*any*	*≥ 50*	*≥ 60*
3	*≥40*	*≥ 60*	*≥ 90*

For model years 1999 through 2002, additional ZEV credits will be determined by linear interpolation between the values shown in the above schedule. "Specific energy" of batteries will be the specific energy as determined in accordance with the US Advanced Battery Consortium's Electric Vehicle Battery Procedure Manual (January 1996), Procedure No. 2, "Constant Current Discharge Test Series," using the C/3 rate. The weight calculation must reflect a completely functional battery system as defined in Appendix F of the Manual, including pack(s), required support ancillaries (e.g., thermal management), and electronic controller.

3. For purposes of calculating ZEV credits, a ZEV may be counted according to (9)a.1. or (9)a.2. above, but not both.

4. For purposes of calculating manufacturer's fleet average NMOG value under note (4) or (5), each ZEV shall be counted as one vehicle.

All ZEV credits earned prior to the ~~1998~~ *2003* model year shall be treated as if earned in the ~~1998~~ *2003* model year and shall be discounted in accordance with notes (7)c and 7(d).

b. A manufacturer may meet the ZEV requirements in any given model year by submitting to the Executive Officer a commensurate amount of ZEV credits. These credits may be earned previously by the manufacturer or acquired from another manufacturer. The amount of ZEV credits required to be submitted shall be calculated by subtracting the number of ZEVs produced and delivered for sale in California by the manufacturer for the model year from the number of ZEVs required to be produced by the manufacturer for the model year and then multiplying by the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for that model year.

c. Manufacturers ~~which~~ *that* certify, produce, and deliver for sale in California fewer ZEVs than required in a given model year shall make up the deficit by the end of the next model year by submitting to the Executive Officer a commensurate amount of ZEV credits. The amount of ZEV credits required to be submitted shall be calculated by subtracting the number of ZEVs produced and delivered for sale in California by the manufacturer for the model year from the the number of ZEVs required to be produced by the manufacturer for the model year and then multiplying by the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for the model year in which the deficit is incurred.

d. Any manufacturer ~~which~~ *that* fails to produce and deliver for sale in California the required number of ZEVs or submit an appropriate amount of ZEVs credits and does not make up ZEV deficits within the specified time period shall be subject to the Health and Safety Code section 43211 civil penalty applicable to a manufacturer ~~which~~ *that* sells a new motor vehicle that does not meet the applicable emission standards adopted by the state board. The cause of action shall be deemed to accrue when the ZEV deficits are not balanced by the end of the specified time period. For the purposes of Health and Safety Code section 43211, the number of vehicles not meeting the state board's standards shall be calculated according to the following equation: (No. of ZEVs required to be produced and delivered for sale in California for the model year) - (No. of ZEVs actually produced and delivered for sale in California for the model year) - [(Amount of ZEV credits submitted for the model year) / (the fleet average requirement for PCs and LDTs 0-3750 lbs. LVW for the model year)].

e. ZEVs classified as MDVs or as LDTs 3751-5750 lbs. LVW may be counted toward the ZEV requirement for PCs and LDTs 0-3750 lbs LVW and included in the calculation of ZEV credits as specified in (9)a., if the manufacturer so designates.

f. Small volume manufacturers *as defined in note (6)* shall not be required to meet the percentage ZEV requirements. However, small volume manufacturers may earn and market credits for ZEVs they produce and deliver for sale in California.

~~g. Intermediate volume manufacturers as defined in section 1960.1(o) shall not be required to meet the percentage ZEV requirements before the 2003 model year.~~

[Subsection (h)(1) -- No Change]

(h)(2) The exhaust emissions from new 1992 and subsequent model-year medium-duty low-emission vehicles and ultra-low-emissions vehicles, *and new 2003 and subsequent model-year medium-duty zero-emission vehicles* shall not exceed:

EXHAUST EMISSION STANDARDS FOR LOW-EMISSION VEHICLES, ~~AND~~ ULTRA-LOW-EMISSION VEHICLES *AND ZERO-EMISSION VEHICLES* IN THE MEDIUM-DUTY VEHICLE WEIGHT CLASSES[8,9,10,11,12,13,14,15,16]
[grams per mile (or "g/mi')]

Test Weight (lbs.)[1]	Durability Vehicle Basis (mi)	Vehicle Emission Category[2]	Non-Methane OrganicGases[3,4]	Carbon Monoxide	Oxides of Nitrogens	Particulates [6,7]
0-3750	50,000	LEV	0.125 (0.188)	3.4 (3.4)	0.4 (0.4)	n/a
		ULEV	0.075 (0.100)	1.7 (2.6)	0.2 (0.3)	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.180	5.0	0.6	0.08
		ULEV	0.107	2.5	0.3	0.04
		ZEV[2.1]	--	--	--	--
3751-5750	50,000	LEV	0.160 (0.238)	4.4 (4.4)	0.7 (0.7)	n/a
		ULEV	0.100 (0.128)	2.2 (3.3)	0.4 (0.5)	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.230	6.4	1.0	0.10
		ULEV	0.143	3.2	0.5	0.05
		ZEV[2.1]	--	--	--	--
5751-8500						
	50,000	LEV	0.195 (0.293)	5.0 (5.0)	1.1 (1.1)	n/a
		ULEV	0.117 (0.156)	2.5 (3.8)	0.6 (0.8)	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.280	7.3	1.5	0.12
		ULEV	0.167	3.7	0.8	0.06
8501-10,000		*ZEV*[2.1]	--	--	--	--
	50,000	LEV	0.230 (0.345)	5.5 (5.5)	1.3 (1.3)	n/a
		ULEV	0.138 (0.184)	2.8 (4.2)	0.7 (1.0)	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.330	8.1	1.8	0.12
		ULEV	0.197	4.1	0.9	0.06
10,001-14,000		*ZEV*[2.1]	--	--	--	--
	50,000	LEV	0.300 (0.450)	7.0 (7.0)	2.0 (2.0)	n/a
		ULEV	0.180 (0.240)	3.5 (5.3)	1.0 (1.5)	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.430	10.3	2.8	0.12
		ULEV	0.257	5.2	1.4	0.06
		ZEV[2.1]	--	--	--	--

(1) "Test Weight" (or "TW") shall mean the average of the vehicle's curb weight and gross vehicle weight.

(2) "LEV" means low-emission vehicle.
"ULEV" means ultra-low-emission vehicle.
"ZEV" means zero-emission vehicle.

(2.1) a. The Executive Officer shall certify as ZEVs vehicles that produce zero exhaust or evaporative emissions of any criteria pollutant (or precurson pollutant) under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40 degrees Fahrenheit and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions.

b. Prior to the 2003 model year a manufacturer that voluntarily produces vehicles that meet the ZEV emission standards applicable to 2003 and subsequent model year vehicles may certify those vehicles as ZEVs for the purposes of calculating ZEV credits under section (g)(2), note (9)a. and (9)e.

[Notes (3) through (16) and subsections (i) through (p) -- No change]

Note: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43104 and 43105, Health and Safety Code. Reference: Sections 39002, 39003, 39667, 43000, 43009.5, 43013, 43018, 43100, 43101, 43101.5, 43102, 43103, 43104, 43105, 43106, 43107, 43204, 43205.5, Health and Safety Code.

APPENDIX B

Methodology for the Quantification of the Benefits of a National Low Emission Vehicle Program on California Air Quality

Methodology for the Quantification of the Benefits of a National Low Emission Vehicle Program on California Air Quality

Introduction

California's Low Emission Vehicle standards call for progressively more stringent fleet average non-methane organic gas (NMOG) emission standards for on-road motor vehicles between 1998 and 2003. The Air Resources Board (ARB) staff has suggested a plausible implementation schedule whereby a combination of three specific low-emission vehicle categories referred to as transitional low-emission vehicles (TLEVs), low-emission vehicles (LEVs), and ultra low-emission vehicles (ULEVs), might be produced in order to comply with these standards. In addition, vehicles having no tailpipe emissions, zero-emission vehicles (ZEVs), were required to be produced for sale beginning in 1998 as two percent of passenger cars and light-duty truck production, increasing to five percent in 2001, and ten percent in 2003.

For reasons set forth in the staff report, the staff is proposing to eliminate the ZEV production requirement for the 1998 through 2002 model years. The 10 percent production requirement in 2003 and subsequent model years would be retained.

In the Memoranda of Agreement (MOA) being developed with affected manufacturers, each manufacturer would agree to meet the fleet average NMOG tailpipe standard even in the absence of ZEV production. While this assumes no increase in tailpipe emissions of NMOG, reductions in exhaust emissions of oxides of nitrogen (NOx) and evaporative emission of hydrocarbons (HC) may be lost due to the delay of the introduction of ZEVs.

An analysis has been performed to quantify the emission benefits lost due to a delay in the introduction of ZEVs in California from 1998 through 2002, and to quantify the potential benefits of a proposal by vehicle manufacturers to voluntarily produce a National Low Emission Vehicle (NLEV) beginning in 2001, which for the years 2001 through 2003, has the objective of offsetting this potential loss of benefits.

ZEV Benefit Calculation

The benefits of ZEVs were calculated by establishing a baseline in which the ARB staff suggested a plausible implementation schedule for TLEVs, LEVs and ULEVs, and the required production of ZEVs. This calculation is used to establish a ton-per-day inventory for the South Coast Air Basin for the evaluation years of 2004 and 2010 (See Table 1).

This ton per day estimate was contrasted to an alternative implementation schedule in which the fleet average exhaust emission rate of NMOG is maintained without ZEVs (See Table 2). Because both LEVs and ULEVs have NOx and evaporative emissions, a

disbenefit will be realized when more of these vehicles are produced in lieu of ZEVs in order to comply with the NMOG fleet average tailpipe emission standard. ZEVs, which have no NOx or evaporative emissions, do have NOx emissions resulting from power generation to charge their batteries of one tenth the NOx emissions of a ULEV.

The category specific emission factors used in this analysis are from EMFAC7F modified for enhanced I/M and changes to OBDII, and are listed in Table 3. The ton per day estimates were derived through the use of EMFAC7F and are listed in Table 4.

TABLE 1
BASELINE IMPLEMENTATION ASSUMED PRODUCTION MIX (Fraction)
(To Comply with Average NMOG Tailpipe Standard)

Model Year	Tier I	TLEV	LEV	ULEV	ZEV
1998	0.48	0	0.48	0.02	0.02
1999	0.23	0	0.73	0.02	0.02
2000	0	0	0.96	0.02	0.02
2001	0	0	0.90	0.05	0.05
2002	0	0	0.85	0.10	0.05
2003+	0	0	0.75	0.15	0.10

TABLE 2
ALTERNATIVE IMPLEMENTATION
ASSUMED PRODUCTION MIX (Fraction)
(No ZEVs - But Maintain Same Average NMOG Tailpipe Standard)

Model Year	Tier I	TLEV	LEV	ULEV	ZEV
1998	0.48	0	0.46	0.06	0.00
1999	0.23	0	0.71	0.06	0.00
2000	0	0	0.94	0.06	0.00
2001	0	0	0.85	0.15	0.00
2002	0	0	0.80	0.20	0.00
2003+	0	0	0.75	0.15	0.10

TABLE 3
CATEGORY SPECIFIC BASIC EMISSION RATES
EMFAC7F (Adjusted to Reflect Enhanced I/M & OBDII)

Category	Pollutant	Zero Mile	Deterioration*
0.25	HC	0.1453	0.0152
TLEV	HC	0.0992	0.0093
LEV	HC	0.0351	0.0055
ULEV	HC	0.0219	0.0028
ZEV	HC	0	0
0.25	NOx	0.2846	0.0208
TLEV	NOx	0.3588	0.0167
LEV	NOx	0.1694	0.0089
ULEV	NOx	0.1694	0.0089
ZEV	NOx	0	0

*Grams/Mile/10,000 miles

TABLE 4
BENEFIT OF ZEV REQUIREMENT 1998 - 2002 (LIGHT-DUTY VEHICLES)
SCAB EMISSIONS IN TONS PER DAY

Scenario		A	B	(B-A)		A	B	(B-A)
Year			2004				2010	
TOG								
Diurnal Evaporation	15.18	15.25	0.07		12.26	12.33	0.07	
Hot Soak Evaporation		9.42	9.47	0.05		7.10	7.15	0.05
Running Losses		44.96	45.00	0.04		33.62	33.83	0.21
Resting Losses		6.78	6.80	0.02		4.00	4.01	0.01
Total Evap		76.34	76.52	0.18		56.98	57.32	0.34
NOx								
Running Exhaust		100.55	101.34	0.79		76.47	76.92	0.45
Cold Start		27.85	28.13	0.28		21.80	21.92	0.12
Hot Start		10.07	10.16	0.09		7.54	7.59	0.05
Total NOx Emissions		138.47	139.63	1.17		105.81	106.43	0.62

TABLE 5
BENEFIT OF ZEV REQUIREMENT 1998 - 2002 (LIGHT-DUTY TRUCKS)
SCAB EMISSIONS IN TONS PER DAY

Scenario		A	B	(B-A)		A	B	(B-A)
Year			2004				2010	
TOG								
Diurnal Evaporation	3.06	3.07	0.01		2.25	2.27	0.02	
Hot Soak Evaporation		1.65	1.66	0.01		1.11	1.13	0.02
Running Losses		9.65	9.66	0.01		6.34	6.40	0.06
Resting Losses		1.30	1.31	0.01		0.64	0.65	0.01
Total Evap		15.66	15.70	0.04		10.34	10.45	0.11
NOx								
Running Exhaust		35.06	35.39	0.33		29.39	29.69	0.30
Cold Start		8.38	8.47	0.09		7.00	7.06	0.06
Hot Start		2.94	2.97	0.03		2.40	2.42	0.02
Total NOx Emissions		46.38	46.83	0.45		38.79	39.17	0.38

Scenario A - With ZEVs

Scenario B - Without ZEVs

Calculation of the NLEV Benefit

To offset the loss of benefit attributable to the delay of the ZEV production requirement, a strategy has been suggested by which a national low emission vehicle, or NLEV, could be introduced nationally in the year 2001. It is assumed, based upon United States Environmental Protection Agency (U.S. EPA) existing authorities, that an NLEV program will be instituted by regulation in the year 2004, therefore, no benefit can be attributed to an NLEV strategy for purposes of offsets beyond the 2003 model year.

Through the early introduction of NLEVs, model year 2001 through 2003 vehicles migrating into California from other states would be certified to LEV rather than Tier I (0.25) levels. The lower emissions of the migrant fleet are evaluated to determine if they offset the emission shortfall of a delay in ZEV production.

The EMFAC model was again used to quantify the relative tons-per-day emissions in the years 2004 and 2010 for a Tier I and NLEV scenario. In carrying out this analysis the following assumptions were made:

1) 18 percent of all new registration transactions in California between the years 2001 and 2003 were assumed to be associated with vehicles which originate from outside of California. This is the average of the percentage migration for 1980 to 1994, which ranged from 14 percent to 22 percent.

2) In the baseline assumption, all 2001 to 2003 model year vehicles originating from outside of the state were assumed to be certified to Tier I levels.

3) In the alternative analysis, all 2001 to 2003 model year vehicles originating from outside of the state were assumed to be certified to a LEV standard.

4) Vehicles certified to similar standards were assumed to emit identically once in California regardless of their origin (EMFAC7F emission rates were used for both migrating and native fleets)

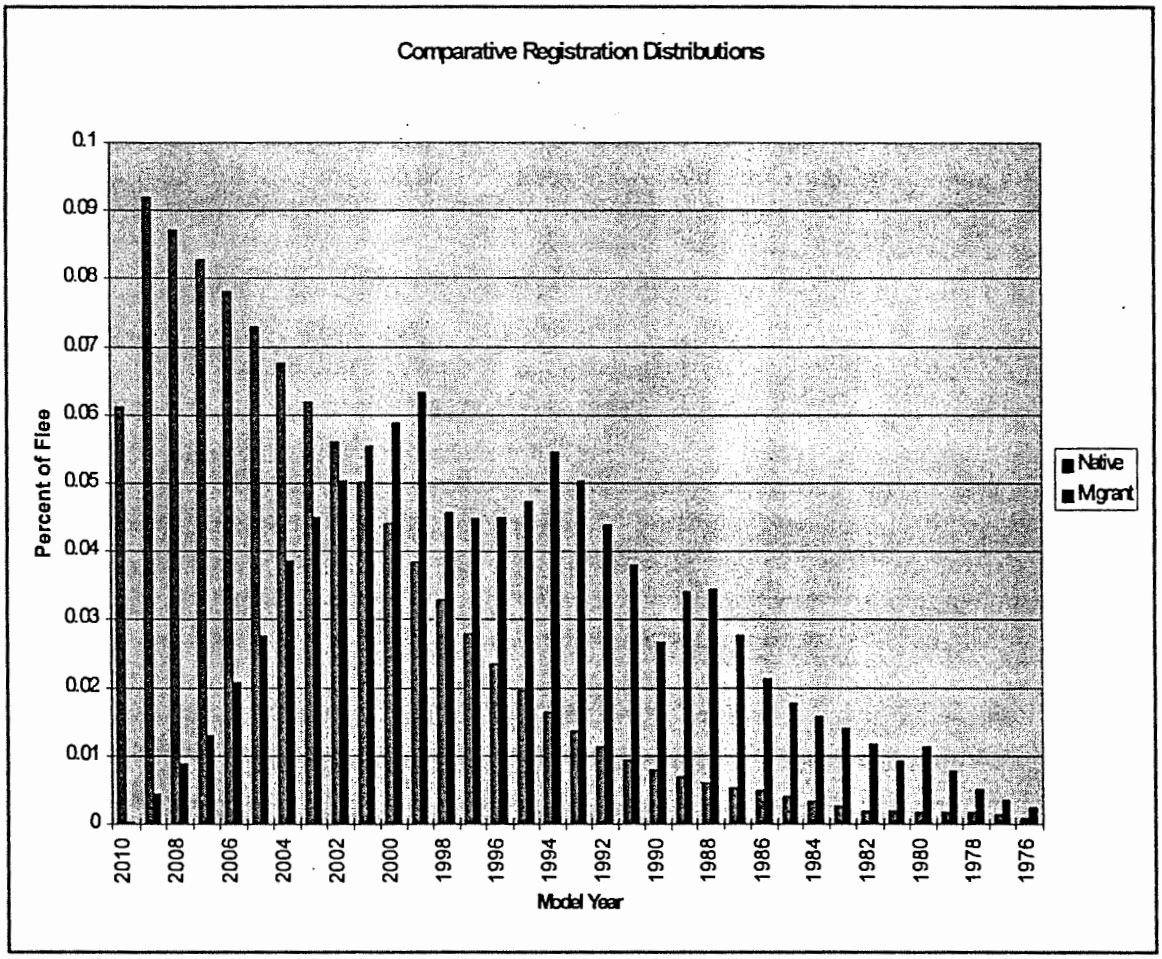
5) Vehicles of the same vintage display identical use patterns regardless of origin (BURDEN activity data was used for both migrating and native fleets).

Modification of Activity Assumptions

Concerned that the relatively small benefits associated with perturbing three model years within the migrant fleet may be lost in the analysis of all vehicles within the South Coast Air Basin, the activity assumptions used in the inventory model were modified to reflect only the activity and emissions of the migrant fleet.

Using data supplied by the California Department of Motor Vehicles, an analysis of 1,700,000 registration records was performed to determine the current age distribution of vehicles which were originally registered outside of California. Figure 1 contrasts the California native and migrant registration age distributions. As can be seen, the migrant fleet is considerably older on average than the California native fleet, and a marked delay is seen in the appearance of new vehicles in the migrant fleet. This model year distribution was used for the migrant fleet in the calculating the NLEV benefit.

Figure 1



In addition to adjusting the registration distribution to reflect the migrant fleet in California, it was also necessary to adjust the vehicle population, daily vehicle miles of travel (VMT) and total trips. These adjustments were derived outside of the models and were used to overwrite the default assumptions in BURDEN. For additional information, see Table 6 and the data provided at the end of this appendix.

TABLE 6
COMPARISON OF
SCAB NATIVE AND MIGRANT FLEETS
(Catalyst Equipped Passenger Cars in 2010)

Activity	Combined Fleet	Migrant Fleet Only
Average Age	7.31 years	14.68 years
Population	9,425,536	1,625,339
VMT	301,337,000	32,284,252
Total Trips	34,320,646	4,204,593
2001-2003 Population	1,583,584 (16.8%)	245,295 (15.09%)
2001-2003 VMT	46,418,714 (15.4%)	6,230,960 (19.3%)

Once the activity had been properly adjusted, the analysis was completed by substituting either the Tier I or LEV emission rates (listed earlier) for model years 2001 to 2003 and the EMFAC/BURDEN models were run to produce inventories for the SCAB for 2004 and 2010. The results of this analysis are shown in Tables 7 and 8.

TABLE 7
LIGHT DUTY AUTOMOBILE NLEV BENEFIT
SCAB EMISSIONS IN TONS PER DAY

Scenario	A	B	(A-B)	A	B	(A-B)
	2004			2010		
TOG						
Running Exhaust	0.10	0.03	0.07	0.96	0.29	0.67
Cold Start	0.21	0.06	0.15	1.13	0.35	0.78
Hot Start	0.02	0.01	0.01	0.10	0.03	0.07
Total TOG Emissions	0.33	0.10	0.23	2.19	0.67	1.52
NOx						
Running Exhaust	0.40	0.23	0.17	2.69	1.41	1.28
Cold Start	0.17	0.10	0.07	0.87	0.46	0.41
Hot Start	0.05	0.03	0.02	0.30	0.16	0.14
Total NOx Emissions	0.62	0.36	0.26	3.87	2.03	1.83

TABLE 8
LIGHT DUTY TRUCK NLEV BENEFIT
SCAB EMISSIONS IN TONS PER DAY

Scenario	A	B	(A-B)	A	B	(A-B)
TOG	2004			2010		
Running Exhaust	0.04	0.01	0.03	0.28	0.12	0.16
Cold Start	0.05	0.01	0.04	0.24	0.10	0.14
Hot Start	0.00	0.00	0.00	0.02	0.01	0.01
Total TOG Emissions	0.09	0.02	0.07	0.54	0.23	0.31
NOx						
Running Exhaust	0.12	0.06	0.06	0.72	0.35	0.37
Cold Start	0.04	0.02	0.02	0.18	0.09	0.09
Hot Start	0.01	0.01	0.00	0.06	0.03	0.03
Total NOx Emissions	0.17	0.09	0.08	0.96	0.47	0.49

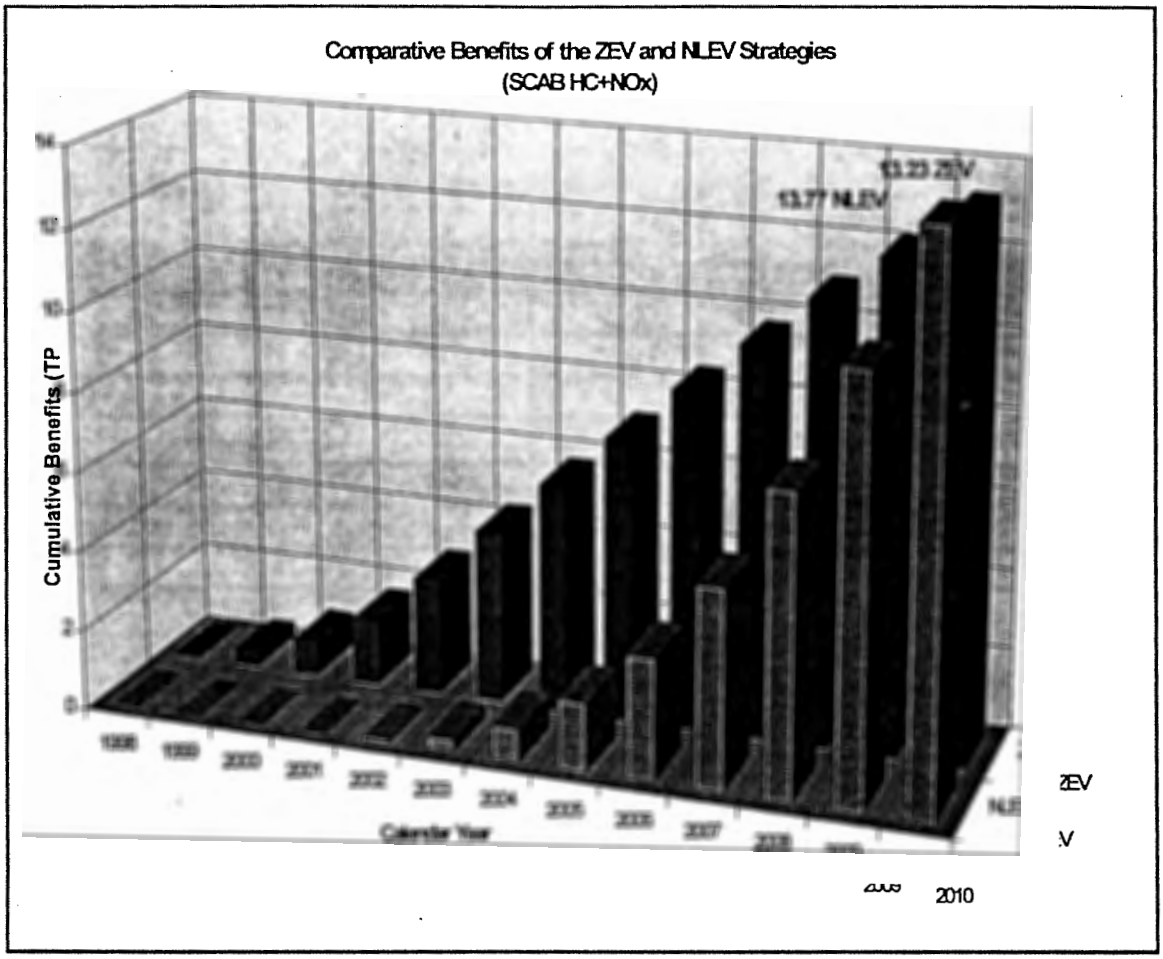
Scenario A - 2001 to 2003 Tier I Scenario B - 2001 to 2003 NLEV

TABLE 9
RELATIVE ZEV AND NLEV BENEFITS
SCAB TONS PER DAY

Year	Vehicle Type	HC Exhaust	HC Evap	Marketing (0.06 g/mi)	Power Plant HC (0.004 g/mi)	NOx Exhaust	Power Plant NOx (0.02 g/mi)	HC + NOx
ZEV Benefit								
2004	PCs		0.18	0.28	-0.02	1.17	-0.09	1.52
	LDTs		0.04	0.05	-0.00	0.45	-0.02	0.52
	Total							**2.04**
2010	PCs		0.34	0.13	-0.01	0.62	-0.04	1.04
	LDTs		0.11	0.03	-0.00	0.39	-0.01	0.52
	Total							**1.56**
NLEV Benefit								
2004	PCs	0.23				0.26		0.49
	LDTs	0.07				0.08		0.15
	Total							**0.64**
2010	PCs	1.52				1.83		3.35
	LDTs	0.31				0.49		0.80
	Total							**4.15**

As can be seen in Table 9, it appears that although the NLEV scenario falls short of achieving the equivalent benefits of ZEVs in the 2004 time frame, the strategy exceeds that of ZEVs by the year 2010. To determine when the entire shortfall associated with a delay in the ZEV requirement may be compensated by an NLEV strategy, the cumulative benefits (summation of the comparative ton per day per year emissions reductions) were also determined. This analysis was performed by calculating each scenario's potential benefit between 1998 and 2010. The results are shown in Figure 2 and show an equivalent cumulative benefit for NLEVs and ZEVs of approximately 13 tons/day for passenger cars in 2010.

Figure 2



The data provided on the following pages was used in the derivation of the activity assumptions for the California migrant fleet.

Base Assumption							
Average Age =			7.31				
Population=			9,425,536				
VMT=			301,337,000				
2001-2003 Populat		16.80%	1,583,584				
2001-2003 VMT		15.40%	46,418,714				
Trips			34,320,646				
	A	B	C	D=A*B	E=Dmy/Dtot	Year*B	F=Trips*E/POP*B
				WEIGHTED			
	ACCRUAL	REG	CUMUL	ACCURAL			
YEAR	RATE	FRACTION	MILES	RATE	TF	AGE	Trips/VD
2010	14169	0.0612	5313	867.143	0.085	123.012	5.056
2009	13563	0.09196	18876	1247.253	0.122	184.748	4.839
2008	12956	0.08717	31832	1129.375	0.111	175.037	4.623
2007	12349	0.08274	44181	1021.756	0.100	166.059	4.406
2006	11742	0.07807	55923	916.698	0.090	156.608	4.190
2005	11135	0.07299	67058	812.744	0.080	146.345	3.973
2004	10528	0.06756	77586	711.272	0.070	135.390	3.757
2003	9921	0.06187	87507	613.812	0.060	123.926	3.540
2002	9314	0.05604	96821	521.957	0.051	112.192	3.323
2001	8707	0.0501	105528	436.221	0.043	100.250	3.107
2000	8101	0.04417	113629	357.821	0.035	88.340	2.891
1999	7597	0.03839	121226	291.649	0.029	76.742	2.711
1998	7164	0.03294	128390	235.982	0.023	65.814	2.556
1997	6788	0.02795	135178	189.725	0.019	55.816	2.422
1996	6457	0.02351	141635	151.804	0.015	46.926	2.304
1995	6214	0.01964	147849	122.043	0.012	39.182	2.217
1994	6071	0.01637	153920	99.382	0.010	32.642	2.166
1993	5940	0.01364	159860	81.022	0.008	27.185	2.119
1992	5819	0.0114	165679	66.337	0.007	22.709	2.076
1991	5707	0.00936	171386	53.418	0.005	18.636	2.036
1990	5603	0.00797	176989	44.656	0.004	15.860	1.999
1989	5505	0.00702	182494	38.645	0.004	13.963	1.964
1988	5414	0.00612	187908	33.134	0.003	12.167	1.932
1987	5328	0.00526	193236	28.025	0.003	10.452	1.901
1986	5247	0.00493	198483	25.868	0.003	9.791	1.872
1985	5170	0.00413	203653	21.352	0.002	8.198	1.845
1984	5098	0.00335	208751	17.078	0.002	6.646	1.819
1983	5029	0.00262	213780	13.176	0.001	5.195	1.794
1982	4963	0.00203	218743	10.075	0.001	4.023	1.771
1981	4901	0.00188	223644	9.214	0.001	3.724	1.749
1980	4842	0.00186	228486	9.006	0.001	3.683	1.728
1979	4785	0.00171	233271	8.182	0.001	3.384	1.707
1978	4730	0.00175	238001	8.278	0.001	3.462	1.688
1977	4678	0.00137	242679	6.409	0.001	2.708	1.669
1976	4628	0.00095	247307	4.397	0.000	1.877	1.651
		1.00002		**10204.9059**	**1**	**2003**	

Migrant Fleet									
Average Age =			14.68						
Population=			1,625,339						
VMT=		10.71%	32,284,252						
2001-2003 Populatio		15.09%	245,295						
2001-2003 VMT		19.30%	6,230,960						
Trips		12.25%	4,204,593						
					E=				
	A	B	C	D=A*B	Dmy/Dtot	Year*B	A*B/365	F	F*B
				WEIGHTED					
	ACCRUAL	REG	CUMUL	ACCURAL				Trips/	
YEAR	RATE	FRACTION	MILES	RATE	TF	AGE	Avg. Mileage	VD	Wt Trips
2010	14169	0.000300602	5313	4.2592	0.0006	0.6042	0.0117	5.0557	0.0015
2009	13563	0.004371613	18876	59.2922	0.0082	8.7826	0.1624	4.8395	0.0212
2008	12956	0.008846289	31832	114.6125	0.0158	17.7633	0.3140	4.6229	0.0409
2007	12349	0.013003186	44181	160.5763	0.0221	26.0974	0.4399	4.4063	0.0573
2006	11742	0.02075872	55923	243.7489	0.0336	41.6420	0.6678	4.1897	0.0870
2005	11135	0.027638213	67058	307.7515	0.0424	55.4146	0.8432	3.9731	0.1098
2004	10528	0.038545773	77586	405.8099	0.0560	77.2457	1.1118	3.7565	0.1448
2003	9921	0.045038778	87507	446.8297	0.0616	90.2127	1.2242	3.5399	0.1594
2002	9314	0.050320785	96821	468.6878	0.0646	100.7422	1.2841	3.3234	0.1672
2001	8707	0.05555985	105528	483.7596	0.0667	111.1753	1.3254	3.1068	0.1726
2000	8101	0.058909416	113629	477.2252	0.0658	117.8188	1.3075	2.8905	0.1703
1999	7597	0.06333256	121226	481.1375	0.0664	126.6018	1.3182	2.7107	0.1717
1998	7164	0.045725868	128390	327.5801	0.0452	91.3603	0.8975	2.5562	0.1169
1997	6788	0.044815473	135178	304.2074	0.0420	89.4965	0.8334	2.4220	0.1085
1996	6457	0.044970069	141635	290.3717	0.0401	89.7603	0.7955	2.3039	0.1036
1995	6214	0.047306176	147849	293.9606	0.0405	94.3758	0.8054	2.2172	0.1049
1994	6071	0.054615101	153920	331.5683	0.0457	108.9025	0.9084	2.1662	0.1183
1993	5940	0.050269254	159860	298.5994	0.0412	100.1866	0.8181	2.1195	0.1065
1992	5819	0.043982376	165679	255.9334	0.0353	87.6129	0.7012	2.0763	0.0913
1991	5707	0.038142107	171386	217.6770	0.0300	75.9409	0.5964	2.0363	0.0777
1990	5603	0.026659109	176989	149.3710	0.0206	53.0516	0.4092	1.9992	0.0533
1989	5505	0.034088274	182494	187.6559	0.0259	67.8016	0.5141	1.9643	0.0670
1988	5414	0.034595003	187908	187.2973	0.0258	68.7749	0.5131	1.9318	0.0668
1987	5328	0.027818574	193236	148.2174	0.0204	55.2755	0.4061	1.9011	0.0529
1986	5247	0.021437221	198483	112.4811	0.0155	42.5743	0.3082	1.8722	0.0401
1985	5170	0.017726933	203653	91.6482	0.0126	35.1880	0.2511	1.8447	0.0327
1984	5098	0.015794491	208751	80.5203	0.0111	31.3363	0.2206	1.8190	0.0287
1983	5029	0.013999468	213780	70.4033	0.0097	27.7609	0.1929	1.7944	0.0251
1982	4963	0.01166336	218743	57.8853	0.0080	23.1168	0.1586	1.7709	0.0207
1981	4901	0.009327253	223644	45.7129	0.0063	18.4773	0.1252	1.7487	0.0163
1980	4842	0.011431467	228486	55.3512	0.0076	22.6343	0.1516	1.7277	0.0198
1979	4785	0.007807065	233271	37.3568	0.0052	15.4502	0.1023	1.7073	0.0133
1978	4730	0.005187533	238001	24.5370	0.0034	10.2609	0.0672	1.6877	0.0088
1977	4678	0.00351275	242679	16.4326	0.0023	6.9447	0.0450	1.6692	0.0059
1976	4628	0.002499291	247307	11.5667	0.0016	4.9386	0.0317	1.6513	0.0041
		1		**7250.0254**	**1.0000**	1995	**19.8631**		**2.5869**

APPENDIX C

Master Memorandum of Agreement

MASTER MEMORANDUM OF AGREEMENT

The California Air Resources Board ("ARB") and [manufacturer] ("Manufacturer") hereinafter collectively referred to as the "Parties," enter into this Memorandum of Agreement ("MOA") to help ensure continued progress toward a successful launch of a sustainable market for zero-emission vehicles in California by using market-based strategies for introduction of zero-emission vehicles.

Whereas, many areas of California exceed the national ambient air quality standard for ozone and virtually all areas of the state exceed the state ozone standard; and

Whereas, ARB has adopted a state implementation plan (SIP) to provide for attainment of the national standards in all areas of the state by the deadlines specified in federal law; and

Whereas, ARB has determined that motor vehicles are the source of significant ozone precursor emissions in California and that light-duty vehicles are major contributors to mobile source emissions; and

Whereas, ARB has adopted a regulation creating the Low Emission Vehicle (LEV) program, which established increasingly more stringent emissions standards for four types of lower emitting passenger cars and light duty trucks 0-3750 lbs. loaded vehicle weight (LVW) (hereinafter "light duty vehicles") and requires manufacturers to meet a production weighted fleet average for non-methane organic gas (NMOG) exhaust emission requirement; and

Whereas, the LEV program adopted by ARB requires certain manufacturers, beginning with the 1998 model year, to produce and deliver for sale in California zero emission vehicles (ZEV) in volumes equal to specific percentages of the total of vehicles produced and delivered for sale in California by that manufacturer ("percentage ZEV requirements"); and

Whereas, the only currently available technology to meet the percentage ZEV requirements in the 1998 through early 2000s time frame is electric vehicles powered by electrochemical batteries; and

Whereas, the current SIP as adopted by ARB includes emission reductions attributable to the LEV program including the percentage ZEV requirements; and

Whereas, the Battery Technology Advisory Panel ("Battery Panel") established by ARB found that improved lead acid batteries will be available for ZEVs in 1998 but that major automakers believed they would be purchased in quantities less than those required to meet the percentage ZEV requirements; and

Whereas, the Battery Panel concluded that given a complete success scenario electric vehicles with commercial-production advanced technology batteries could become available in the 2000-2001 time frame; however, as the Battery Panel further reported, "estimated dates for availability of advanced batteries from commercial-scale production have significant uncertainties;" and

Whereas, ARB and Manufacturer desire to see a smooth and orderly introduction of ZEVs into the market and to foster market acceptance of ZEVs with products that meet customer needs; and

Whereas, ARB and Manufacturer agree that good faith marketing of ZEVs is critical to their initial introduction and long term success and the Parties intend to work together to increase customer awareness to facilitate ZEV introduction, and Manufacturer will make good faith efforts as appropriate to market and promote its ZEV products and ARB will pursue funding for co-sponsored programs; and

Whereas, ARB believes that, if an emissions control program is modified in any way that would reduce the emissions reductions assumed in the SIP, equivalent emission reductions must be obtained to ensure the approvability of California's SIP; and

Whereas, ARB believes that marketability of ZEVs and advanced technology batteries will be promoted by deployment of ZEVs in demonstration fleets and that rapid development of technologies will best be assured if manufacturers continue research and development while investment is being made in ZEV infrastructure planning and development; and

Whereas, the Parties agree that a market-based approach to the introduction of ZEVs in California will provide flexibility and help ensure the best possible product at the least cost; and

Whereas, the Parties intend to enter into this MOA to provide a mechanism to ensure the implementation of demonstration projects necessary to permit the evaluation of the performance, reliability, safety, and life of advanced technology batteries in ZEVs and to support pilot scale production of advanced technology batteries to validate production processes in terms of product quality and process economics, and to permit evaluation of other factors including infrastructure, market incentives and market acceptance;

Now, Therefore the Parties agree to the following:

I. Manufacturer's Obligations.

A. Cleaner Cars Nationwide Manufacturer commits to participate in a 49 state program. For purposes of this MOA, "49 state program" means a voluntary program,

beginning not later than the 2001 model year, entered into by Manufacturer to produce and deliver for sale cleaner light duty vehicles (up to 6000 lbs. GVW), i.e. vehicles certified to standards equivalent to California standards, in the 49 states, excluding states which have adopted the California program through section 177 of the Clean Air Act. Under such a program the fleet average NMOGs, for the 2001 model year and beyond, for passenger cars and light duty trucks up to 3750 lbs. LVW will be 0.075 gpm and for light duty trucks up to 6000 lbs. GVW the fleet NMOG average shall be 0.10 gpm. If a 49 state program as described above is not implemented, then "49 state program" shall also mean other program(s) of choice undertaken by Manufacturer which offer emissions reduction benefits for the State of California equivalent, as determined by the Executive Officer, to those that would have been realized by the State of California under the above described 49 state program as calculated in Exhibit B.

B. Market Based ZEV Launch. In addition to any vehicles produced and placed in a demonstration project under I.D.2 below, Manufacturer commits that it will have the capacity to produce specified numbers of ZEVs that could be sold in California if warranted by customer demand. Capacity numbers for model years 1996 and beyond were previously submitted to ARB on or about November 13, 1995. This submission is attached as Exhibit A and shall continue to be treated as confidential and proprietary business information, and is intended to provide accurate information for business and regulatory planning purposes for infrastructure development and funding.

C. ZEV Product Plans (Ramp-Up/Transition Plans). Prior to November 1 of the year preceding each of the scheduled reviews pursuant to section IV of this MOA, Manufacturer shall submit to ARB confidentially its ZEV product plans for model years through the 2003 model year. ZEV product plans shall include to the extent available projections for model-type(s), vehicle features and specifications, production capacity, prospective battery suppliers, capital allocation, and identification of products that will meet the ZEV regulatory requirement in 2003. Such product plans shall be consistent with approved product plans used by manufacturer for internal funding purposes.

D. Technology Development Partnership. Both ARB and Manufacturer agree to make good faith efforts to promote and develop a market for ZEVs, and to ensure ongoing ZEV-related research and development. Further ARB and Manufacturer agree to discuss and identify barriers to successful launch of a sustainable market for ZEVs in California and to identify ways to overcome these barriers.

1. Research and Development: Manufacturer commits to continuing ZEV and battery research and development throughout the term of this MOA to facilitate the earliest possible commercial introduction of, and a sustainable market for, ZEVs. These research and development activities will include the acquisition and evaluation of advanced technology battery prototypes prior to 1998. [For AAMA members: Specifically Manufacturer commits to contributing funding in the

amount of at least $____[1] million during Phase II of the US Advanced Battery Consortium (USABC) currently scheduled to be completed by 1999, and in any case Manufacturer shall contribute said amount by 2002.

2. Advanced Technology Battery Demonstration Project: (a) Manufacturer commits to placing ZEVs in one or more demonstration projects intended to determine the capabilities and marketability of one or more advanced technology batteries. This commitment shall include some placements to provide sufficient feedback to the Manufacturer as necessary to meet data and information needs regarding consumer use and acceptance, vehicle and battery performance, and market development. The Parties intend that the placed vehicles will remain in use in California for 3 years or more. In any event, Manufacturer shall retain maximum flexibility to move or relocate these vehicles within California or to suspend a project for good cause. If a demonstration project is suspended for good cause, Manufacturer shall submit a report to the Executive Officer indicating the number of vehicles involved and describing the cause of the suspension and whether Manufacturer plans to resume the project.

(i) Manufacturer will place a specified number of new ZEVs with advanced technology batteries into service in California urban areas in accordance with the following table:

Calendar Year	Specified Number of Vehicles
through 1998	
1999	
2000	

The numbers in this table reflect Manufacturer's pro rata share of 750 vehicles through 1998 and Manufacturer's pro rata share of 1500 vehicles annually for 1999 and 2000.[2]

The Executive Officer will adjust these requirements for a calendar year, including extending the program up to one year, if Manufacturer demonstrates that the adjustments being sought would better serve the purposes and policies of the demonstration project than the specified

[1] MOA's for individual manufacturers will reflect the following amounts: Chrysler, $3.34 million; Ford, $6.67 million; and GM, $8.90 million.

[2] MOA's for individual manufacturers will reflect that manufacturer's allocation of the 3750 vehicles based on the manufacturer's pro rata share of the market as set out in the definition section of the agreement (§X.E).

requirements. Unless an extension is granted by the Executive Officer, all cumulative demonstration requirements must be met by the end of the 2000 calendar year.

(ii) Manufacturer may reduce the total number of ZEVs required to be placed in demonstration projects if the batteries in the vehicles have a specific energy of 50 w-hr/kg or more. Vehicles will receive placement credit by linear interpolation between the values shown in the following schedule:

Vehicles powered by a battery with a specific energy of :	Shall be credited As:
50 w-hr/kg*	One ZEV
60 w-hr/kg	Two ZEVs
90 w-hr/kg	Three ZEVs

* Through 1998 calendar year, 40 through 50 w-hr/kg shall receive one ZEV credit with no interpolation between 40 and 50 w-hr/kg.

(iii) For purposes of determining compliance with the volumes specified in (i) above Manufacturer may include advanced technology battery vehicles placed other than through the demonstration projects. Manufacturer may also comply with the volumes specified in (i) by utilizing credits generated by Manufacturer or obtained from other manufacturers pursuant to (d) below.

(b) Vehicles placed through a demonstration project under I.D.2 will be placed in commerce in accordance with regulations issued by the National Highway Traffic Safety Administration.

(c) Manufacturer will provide service and support for ZEVs placed under I.D.2. Such service and support will be available for the term of the demonstration program up to a maximum of three years after a vehicle is placed, unless the program is suspended in accordance with I.D.2(a), or the vehicle is no longer in operation in California.

(d) Manufacturer will not be allowed to earn credits under 13 CCR section 1960.1(g) (2), note (9) for any ZEV produced and delivered as a part of any demonstration project under this paragraph, except to the extent the number of ZEVs placed exceeds the number required to be placed under I.D.2(a) above. Credits earned for vehicles placed in excess of the number required shall be

fully transferable among manufacturers and may be used to satisfy any obligation under I.D.2(a) or under the LEV program.

E. Annual Report. Manufacturer shall file a report with the Executive Officer within 90 days after the close of each calendar year providing the following:

1. Information regarding ZEVs placed in California and the United States in the most recently ended calendar year, including the number and type of vehicles, the MSRP if any, and the type of battery, including major battery specifications, incorporated in the vehicles; and

2. Information regarding the purchase of advanced technology battery prototypes prior to 1998 [For AAMA members: and, for the reports covering 1996-1999, Manufacturer must identify its contribution during the year to Phase II of the USABC program]; and

3. Information concerning the placement of ZEVs under I.D.2 and related feedback.

F. Manufacturer will continue to collaborate with ARB and the State Fire Marshal to develop the curriculum and materials necessary for the comprehensive ZEV safety training program currently under development by the agencies.

G. Not later than three months prior to the biennial review under IV below, the Manufacturer, at ARB's request, shall provide the duly authorized representatives of ARB's Executive Officer on-site review of activities and hardware related to Manufacturer's ZEV program. Such on-site review shall be at a mutually agreeable time.

II. ARB's Obligations. ARB shall work with state and local authorities and others to ensure the development of ZEV infrastructure and the removal of barriers to the introduction of ZEVs. Specifically ARB shall:

A. Facilitate the purchase of ZEVs for appropriate applications in state fleets by working with the California Department of General Services (DGS) and the California Energy Conservation and Development Commission to establish vehicle specifications for the State Bid List and by working with the DGS Office of Fleet Administration to ensure the sale or lease of ZEVs to selected state agencies;

B. Work with the California Department of Insurance to establish reasonable rates for insuring new ZEVs, to promote insurance industry awareness of ZEVs, and to resolve other issues related to insuring ZEVs;

C. Work with the California Department of State Banking to develop risk assessment data to assist in securing financing for the purchase or lease of ZEVs;

D. Work with the Department of Toxic Substance Control, the Integrated Waste Management Board, and the Office of Environmental Health Hazard Assessment to ensure the availability of sufficient battery recycling capacity;

E. Work with local governments to provide assistance in planning and permitting quick charge and public charging stations;

F. Work with utilities and trade groups representing electrical contractors to provide training for installation and maintenance of electric vehicle charging systems;

G. Continue to support the efforts of the Infrastructure Working Council on standardization of power supply, emergency disconnect, standard conductive and inductive charging systems;

H. Continue to work with the State Fire Marshal and other state and local emergency response officials (fire, ambulance, law enforcement) and towing companies to create a comprehensive ZEV training program to ensure preparedness for incidents involving ZEVs;

I. Maintain its commitment to observe the activities of the USABC regarding the development of advanced technology batteries; and

J. Support the development and implementation of reasonable incentive programs that enhance the near-term marketability of ZEVs.

III. SIP Credits. Based on ARB's analysis, which is attached as Exhibit B, ARB finds that if, for the duration of this MOA, Manufacturer meets the current NMOG curve and implements a 49 state program, the emissions reduction benefits are at least equivalent to the benefits attributable to the 1998 through 2002 percentage ZEV requirements in the current SIP.

IV. Review. ARB will hold biennial public hearings, commencing in 1998, to conduct comprehensive reviews of the ZEV program, including the status of battery technology.

V. Enforcement. A. Breach of Manufacturer's obligations for which liquidated damages are prescribed under B below, shall be determined by the Executive Officer, in accordance with the provisions of 1 below, with de novo review by the Board. After Board review, Manufacturer has the right to a de novo review in the Superior Court of California for Sacramento County.

1. If the Executive Officer makes a preliminary determination that a Manufacturer has failed to comply with any requirement of this MOA for which liquidated damages have been prescribed under B below, he or she will notify Manufacturer in writing of the reasons supporting the preliminary determination and provide Manufacturer all information from any source upon which the preliminary determination was based. Within 15 business days of receipt of such a notice, Manufacturer must notify the Executive Officer of the following:

(a) The grounds (if any) on which Manufacturer contends it has fully complied with the requirement identified by the Executive Officer;

(b) The good faith steps (if any) Manufacturer took before the deadline for compliance; and

(c) The subsequent steps (if any) Manufacturer has taken or proposes to take to come into compliance with the requirement.

2. Manufacturer will be in breach of this MOA only if the Executive Officer determines, in good faith, based on the information submitted by Manufacturer and on other relevant information made available to Manufacturer, that Manufacturer has not fully complied with the requirements for which liquidated damages have been prescribed under B below, and that either (a) Manufacturer failed to take good faith steps before the deadline for compliance to verify with ARB the conditions necessary for compliance or (b) Manufacturer is not taking good faith steps that will bring it into compliance with the requirement as quickly as possible and consistent with the principles of this MOA. Where a breach has been found, Manufacturer's obligations, including liquidated damages prescribed under B below, may be waived or lessened as appropriate by the Executive Officer or by the Board. The Executive Officer must give Manufacturer prompt written notice of the determination of breach. Within 30 business days of receipt of notice of the determination, Manufacturer may appeal the determination to the Board.

3. In making the determination regarding Manufacturer's obligations, consideration shall be given to whether the failure to fulfill Manufacturer's obligations was caused by events or circumstances outside Manufacturer's reasonable control not caused by the fault or negligence of the Manufacturer, which causes the Manufacturer to be unable to perform its obligations under this MOA, including but not limited to flood, earthquake, storm, fire and other natural catastrophes, epidemic, war, riot, civic disturbance or disobedience, strikes, labor dispute, sabotage of facilities, any order or injunction made by a court or public agency, or the failure of battery manufacturers to develop, produce and make available viable advanced technology batteries at a

reasonable pilot-level price. If it is found that such condition(s) occurred, then it shall be found that the failure to fulfill the obligations does not constitute a breach of this MOA. In the event such condition(s) occurs, manufacturer must promptly notify ARB and must use its best efforts to resume performance as quickly as possible, and may suspend performance only for such period of time as is necessary as a result of such condition.

B. At the time Parties enter into this MOA they recognize that any harm that results from the Manufacturer's failure to comply with the provisions of the MOA is unknown and extremely difficult to quantify. Therefore, upon advice of legal counsel, Manufacturer agrees to pay liquidated and agreed damages for the Manufacturer's noncompliance, as determined in accordance with A above, in an amount specified in the following table:

1. Failure to implement a 49 state program under I.A either (a), (b) or (c) as appropriate	
(a) for complete failure to implement	pro rata share of $100,000,000
(b) if Manufacturer implements later than required and does not offset the emissions reduction benefit of a 49 state program	$100,000 plus $22,000 per ton of non-offset emissions
(c) if Manufacturer implements later than required and offsets the emissions reduction benefit of a 49 state program	$100,000
2. Failure to submit ZEV product plans as required in I.C	$5,000 *
[For AAMA members: 3. Failure to contribute to research and development as required by I.D.1	$ equal to unpaid portion of funding commitment]
4. Failure to place advanced technology battery ZEVs in California as required by I.D.2(a)	$25,000 per vehicle shortfall
5. Failure to file annual report as provided in I.E	$5,000 *

* per occurrence per day to a maximum of 30 days, unless a notice by ARB of non-compliance has been received by Manufacturer

C. The liquidated damages will be payable by Manufacturer into an account opened by Manufacturer with a third-party escrow holder acceptable to the ARB's Executive Officer. The escrowed funds will be used for projects that are mutually agreeable to the Parties and that will develop a sustainable market for ZEVs. Any unexpended funds shall revert to the Air Pollution Control Fund.

D. If Manufacturer is in breach of this MOA, the ARB may pursue both liquidated damages under this section V and appropriate regulatory action including reinstating the percentage ZEV requirements as to Manufacturer.

VI. Term of the Agreement. Except as provided in V.D above, this MOA shall terminate at the end of the 2002 model year; or, at Manufacturer's option if at any time after 180 days after execution of this MOA, ARB has in effect, with respect to any period of time prior to the 2003 model year, any ZEV related production or sale requirement(s) or other emissions related requirement(s) that Manufacturer can demonstrate would cause or require the production or sale of ZEVs.

VII. Confidentiality. Any information submitted as part of, or in accordance with, this MOA and designated as confidential by the submitter shall be handled in accordance with the confidentiality provisions of the California Public Records Act (Government Code section 6250 *et seq.*) and ARB's implementing regulations (17 CCR section 91000 *et seq).* Manufacturer's failure to comply with any requirement of this MOA may not be claimed to be confidential.

VIII. No alteration or variation of the terms of this MOA may be made, unless the modification is in writing and signed by the Parties. Any changes to similar agreements entered into with other manufacturers will, at Manufacturer's option, be made to this MOA. ARB commits to advising Manufacturer of changes and alterations made to similar agreements with other manufacturers.

IX. Each Party and each signatory to this MOA warrants that it, he or she has the requisite authority to execute, deliver and consummate the actions contemplated by this MOA.

X. Definitions. For purposes of this MOA the following definitions shall apply:

A. "Place", "placement", or "placing" (or any derivative of these terms) means to sell, lease or otherwise transfer a vehicle to a person or entity in California that is expected to use the vehicle on a frequent, regular basis.

B. "Advanced technology battery" means a battery that has a specific energy of at least 40 watt-hours per kilogram (w-hr/kg) for 1998, and of at least 50 w-hr/kg for 1999 and beyond.

C. "Specific energy" of batteries will be the specific energy as determined in accordance with the USABC's January 1996 Electric Vehicle Battery Procedure Manual, Procedure No. 2, "Constant Current Discharge Test Series," using the C/3 rate. The weight calculation must reflect a completely functional battery system as defined in Appendix F of the Manual, including pack(s), required support ancillaries (e.g. thermal management), and electronic controller. [For AAMA members: ARB, with the concurrence of the Technical Advisory Committee of the USABC, will determine the specific battery system elements to be included in the burden calculation in order to achieve uniform specific energy rating methodology for all battery systems. For other Manufacturers: ARB will determine the specific battery system elements to be included in the burden calculation in order to achieve uniform specific energy rating methodology for all battery systems.]

D. "Capacity to produce" means that the manufacturer has available adequate vehicle production facilities either in-house or contractually with others, including the in-house ability or outside contracts sufficient to supply major vehicle parts and components needs. "Capacity to produce" does not obligate the Manufacturer to produce, deliver or sell a specified number of ZEVs.

E. "Pro rata share" means historical share attributable to a manufacturer, based on its share of the California market for passenger cars and light duty trucks up to 3750 lbs. LVW; and for purposes of this MOA shall be as follows: Chrysler-- 6.86%, Ford -- 24.19%, GM -- 24.33%, Honda -- 13.49%, Toyota -- 18.06%, Mazda -- 3.68%, and Nissan -- 9.39%.

XI. Notices. All notices, demands, requests, consents, approvals, or other communications (Collectively, "Notices") required or permitted to be given pursuant to this MOA, or which are given with respect to this MOA, shall be in writing and shall be personally served or deposited in the United States mail, registered or certified, return receipt requested, postage prepaid, or delivered by overnight courier service with charges prepaid, addressed as set forth below, or such other address as such party shall have specified most recently by written notice. Notice shall be deemed given on the date of receipt.

To Manufacturer:

[specify]

with a copy to: [specify]

To ARB:

James D. Boyd
Executive Officer
Air Resources Board
P.O. Box 2815
Sacramento, CA 95812

or: 2020 L Street
Sacramento, CA 95814

with a copy to:

K.D. Drachand, Chief
Mobile Source Division
Air Resources Board
9528 Telstar Avenue
El Monte, CA 91731-2990

Michael P. Kenny
General Counsel
Air Resources Board
P.O. Box 2815
Sacramento, CA 95812

XII. This MOA shall be governed by and construed in accordance with the laws of the State of California.

XIII. Assignment. This MOA and the rights, duties and obligations under it may not be assigned by ARB or Manufacturer without the prior written consent of the other party. Any assignment or delegation of rights, duties, or obligations under the MOA made without the prior written consent of the other party to this MOA hereto shall be void and of no effect.

Dated:

_____

James D. Boyd
Executive Officer
AIR RESOURCES BOARD

Dated:

_____

[name]
[title]
[Manufacturer]

Initialed: _____
[name]
[title]
[Manufacturer]

State of California
AIR RESOURCES BOARD

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1988 AND SUBSEQUENT MODEL PASSENGER CARS, LIGHT-DUTY TRUCKS, AND MEDIUM-DUTY VEHICLES

Adopted: May 20, 1987
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Amended: June 24, 1996
Amended: July 24, 1996

The numbering convention employed in this document, in order of priority, is: 1.a.1.i.A. Any references within specific sections in the Code of Federal Regulations are denoted in order of priority as: (a)(1)(i)(A) -- the same numbering system employed in the Code of Federal Regulations.

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APPENDICES

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II Exhaust Emission-Data Vehicle Selection Criteria
III Determination of Acceptable Durability Test Schedule
IV Determination of Acceptable Exhaust Regeneration Durability Test Schedule
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VI "Blanket" Approval of Running Changes and Field Fixes of Production Vehicles
VII California Statistical Outlier Identification Procedure
VIII Procedure for Determining Vehicle Emission Control Technology Category/Fuel Reactivity Adjustment Factors

CALIFORNIA EXHAUST EMISSION STANDARDS AND TEST PROCEDURES FOR 1988 AND SUBSEQUENT MODEL PASSENGER CARS, LIGHT-DUTY TRUCKS AND MEDIUM-DUTY VEHICLES

The provisions of Subparts A, B, and C, Part 86, Title 40, Code of Federal Regulations as set forth in Appendix I, to the extent they pertain to Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles, are hereby adopted as the California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, with the following exceptions and additions.

1. Applicability

a. These test procedures are applicable to 1988 and subsequent model gasoline, gaseous, diesel, and, beginning in 1993, alcohol passenger cars, light-duty trucks, and medium-duty vehicles. Procedures specific to transitional low-emission, low-emission, ultra-low-emission, and super-ultra-low-emission vehicles are applicable to 1992 and subsequent model-year gasoline and diesel, and to 1993 and subsequent model-year alternate fuel and hybrid electric passenger cars, light-duty trucks, and medium-duty vehicles. Procedures specific to zero-emission vehicles are applicable to 2003 and subsequent model-year passenger cars, light-duty trucks and medium-duty vehicles. References to "light-duty trucks" in 40 CFR 86 shall apply both to "light-duty trucks" and "medium-duty vehicles" in these procedures.

b. Any reference to vehicle sales throughout the United States shall mean vehicle sales in California.

c. Regulations concerning EPA hearings, EPA inspections, specific language on the Certificate of Conformity, evaporative emissions, high-altitude vehicles and testing, particulate and oxides of nitrogen averaging and engine family standards applicable in such averaging, alternative useful life, selective enforcement audit and heavy-duty engines and vehicles shall not be applicable to these procedures, except where specifically noted.

d. Any reference to gasoline-powered vehicles shall also apply to vehicles powered by gaseous fuels.

e. Regulations both herein and in Title 40, CFR Part 86, Subparts A, B, and C, concerning Otto-cycle and diesel-cycle vehicles shall be applicable to alcohol vehicles, except where specifically noted otherwise.

f. Regulations concerning alcohol vehicles shall also be applicable to fuel-flexible vehicles, except where specifically noted otherwise.

g. For engines used in medium-duty vehicles which are not distinctly diesel engines nor derived from such, the Executive Officer shall determine whether the engines shall be subject to diesel or Otto-cycle engine regulations, in consideration of the relative similarity of the engines' torque-speed characteristics and vehicle applications with those of Otto-cycle and diesel engines.

2. Definitions

"**Administrator**" means the Executive Officer of the Air Resources Board (ARB).

"**Alcohol fuel**" means either methanol or ethanol as those terms are defined in these test procedures.

"**All-Electric Range Test**" means a test sequence used to determine the range of an electric vehicle or of a hybrid electric vehicle without the use of its auxiliary power unit. The All-Electric Range Test cycle consists of the Highway Fuel Economy Schedule and the Urban Dynamometer Driving Schedule (see 9.f. of these test procedures).

"**Battery assisted combustion engine vehicle**" means any vehicle which allows power to be delivered to the driven wheels solely by a combustion engine, but which uses a battery pack to store energy which may be derived through remote charging, regenerative braking, and/or a flywheel energy storage system or other means which will be used by an electric motor to assist in vehicle operation.

"**Battery pack**" means any electrical energy storage device consisting of any number of individual battery modules which is used to propel electric or hybrid electric vehicles.

"**Certificate of Conformity**" means Executive Order certifying vehicles for sale in California.

"**Certification**" means certification as defined in Section 39018 of the Health and Safety Code.

"**Certification level**" means the official exhaust or evaporative emission result from an emission-data vehicle which has been adjusted by the applicable mass deterioration factor and is submitted to the Executive Officer for use in determining compliance with an emission standard for the purpose of certifying a particular engine family. For those engine families which are certified using reactivity adjustment factors developed by the manufacturer pursuant to Appendix VIII of these test procedures, the exhaust NMOG certification level shall include adjustment by the ozone deterioration factor.

"**Continually regenerating trap oxidizer system**" means a trap oxidizer system that does not utilize an automated regeneration mode during normal driving conditions for cleaning the trap.

"**Conventional gasoline**" means any certification gasoline which meets the specifications of 40 CFR 86.113-90(a), including the specifications of (a)(1)(i) but excluding the specifications of (a)(1)(ii) as amended by Section 9.a.1. of these test procedures. For the purpose of determining the ozone-forming potential of conventional gasoline vehicle exhaust emissions, gasoline meeting the specifications of Appendix VIII, note (9) of these test procedures shall be used.

"**Dedicated Ethanol Vehicle**" means any ethanol-fueled motor vehicle that is engineered and designed to be operated solely on ethanol.

"**Dedicated Methanol Vehicle**" means any methanol-fueled motor vehicle that is engineered and designed to be operated solely on methanol.

"**Defeat Device**" means an auxiliary emission control device (AECD) that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use, unless (1) such conditions are substantially included in the Federal emission test procedure, (2) the need for the AECD is justified in terms of protecting the vehicle against damage or accident, or (3) the AECD does not go beyond the requirements of engine starting.

"**Diesel-cycle**" means powered by an engine where the primary means of controlling power output is by limiting of the amount of fuel that is injected into the combustion chambers of the engine.

"**Diesel Engine**" means any engine powered with diesel fuel, gaseous fuel, or alcohol fuel for which diesel engine speed/torque characteristics and vehicle applications are retained.

"**Dual-fuel vehicle**" means any motor vehicle that is engineered and designed to be capable of operating on gasoline or diesel and on compressed natural gas or liquefied petroleum gas, with separate fuel tanks for each fuel on-board the vehicle.

"**Electric vehicle**" means any vehicle which operates solely by use of a battery or battery pack. This definition also includes vehicles which are powered mainly through the use of an electric battery or battery pack, but which use a flywheel that stores energy produced by the electric motor or through regenerative braking to assist in vehicle operation.

"**Element of Design**" means any control system (i.e., computer software, electronic control system, emission control system, computer logic), and/or control system calibrations and/or the results of systems interaction, and/or hardware items on a motor vehicle or motor vehicle engine.

"**Ethanol**" means any fuel for motor vehicles and motor vehicle engines that is composed of either commercially available or chemically pure ethanol (CH_3CH_2OH) and gasoline as specified in section 9.a. (Fuel Specifications) of these test procedures. The required fuel blend is based on the type of ethanol-fueled vehicle being certified and the particular aspect of the certification procedure being conducted.

"**Ethanol vehicle**" means any motor vehicle that is engineered and designed to be operated using ethanol as a fuel.

"**Fuel fired heater**" means a fuel burning device which creates heat for the purpose of warming the passenger compartment of a vehicle but does not contribute to the propulsion of the vehicle.

"**Fuel-Flexible Vehicle**" or "**FFV**" means any methanol-fueled or ethanol-fueled motor vehicle that is engineered and designed to be operated using any gasoline-methanol or gasoline-ethanol fuel mixture or blend.

"**Gaseous fuels**" means liquefied petroleum gas, compressed natural gas, or liquefied natural gas fuels for use in motor vehicles.

"**Heavy-duty engine**" means an engine which is used to propel a heavy-duty vehicle.

"**Heavy-duty vehicle**" means any motor vehicle having a manufacturer's gross vehicle weight rating greater than 6000 pounds, except passenger cars.

"**Hybrid electric vehicle**" or "**HEV**" means any vehicle which is included in the definition of a "series hybrid electric vehicle", a "parallel hybrid electric vehicle", or a "battery assisted combustion engine vehicle".

"**Incomplete vehicle**" means any vehicle which does not have the primary load carrying device or container attached. In situations where individual marketing relationships makes the status of the vehicle questionable, the Executive Officer shall determine whether a specific model complies with the definition of incomplete vehicle.

"**Intermediate Temperature Cold Testing**" means testing done pursuant to the driving cycle and testing conditions contained in 40 CFR Part 86 Subpart C, at temperatures between 25° F (-4° C) and 68° F (20° C).

"**Intermediate volume manufacturer**" is any vehicle manufacturer with California sales between 3,001 and 35,000 new light- and medium-duty vehicles per model year based on the average number of vehicles sold by the manufacturer each year from 1989 to 1993; however, for manufacturers certifying for the first time in California, model year sales shall be based on projected California sales.

"**Light-duty truck**" or "**LDT**" means any motor vehicle, rated at 6000 pounds gross vehicle weight or less, which is designed primarily for purposes of transportation of property or is a derivative of such a vehicle, or is available with special features enabling off-street or off-highway operation and use.

"**Loaded Vehicle Weight**" or "**LVW**" means the vehicle curb weight plus 300 pounds.

"**Low-emission vehicle**" or "**LEV**" means any vehicle certified to low-emission standards.

"**Medium-duty vehicle**" or "**MDV**" means any pre-1995 model year heavy-duty vehicle having a manufacturer's gross vehicle weight rating of 8,500 pounds or less, any 1992 and subsequent model-year heavy-duty low-emission, ultra-low-emission, super-ultra-low-emission or zero-emission vehicle having a manufacturer's gross vehicle weight rating of 14,000 pounds or less, or any 1995 and subsequent model year heavy duty vehicle having a manufacturer's gross vehicle weight rating of 14,000 pounds or less.

"**Methane Reactivity Adjustment Factor**" means a factor applied to the mass of methane emissions from natural gas fueled vehicles for the purpose of determining the gasoline equivalent ozone-forming potential of the methane emissions.

"**Methanol**" means any fuel for motor vehicles and motor vehicle engines that is composed of either commercially available or chemically pure methanol (CH_3OH) and gasoline as specified in section 9.a. (Fuel Specifications) of these procedures. The required fuel blend is based on the type of methanol-fueled vehicle being certified and the particular aspect of the certification procedure being conducted.

"**Methanol vehicle**" means any motor vehicle that is engineered and designed to be operated using methanol as a fuel.

"**Natural gas**" means either compressed natural gas or liquefied natural gas.

"**Natural gas vehicle**" means any motor vehicle that is engineered and designed to be operated using either compressed natural gas or liquefied natural gas.

"**Non-methane organic gas**" (or "**NMOG**") means the sum of non- oxygenated and oxygenated hydrocarbons contained in a gas sample as measured in accordance with the "California Non-Methane Organic Gas Test Procedures" as adopted July 12, 1991 and last amended June 24, 1996.

"**Non-regeneration emission test**" means a complete emission test which does not include a regeneration.

"**Organic Material Hydrocarbon Equivalent**" (or "**OMHCE**") means the sum of the carbon mass contributions of non-oxygenated hydrocarbons, methanol, and formaldehyde as contained in a gas sample, expressed as gasoline-fueled vehicle hydrocarbons. In the case of exhaust emissions, the hydrogen-to-carbon ratio of the equivalent hydrocarbon is 1.85:1. In the case of diurnal and hot-soak emissions, the hydrogen-to-carbon ratios of the equivalent hydrocarbons are 2.33:1 and 2.2:1, respectively.

"**Organic material non-methane hydrocarbon equivalent**" (or "**OMNMHCE**") for methanol-fueled vehicles means the sum of the carbon mass contribution of non-oxygenated hydrocarbons (excluding methane), methanol, and formaldehyde as contained in a gas sample, expressed as gasoline-fueled hydrocarbons. For ethanol-fueled vehicles, "organic material non-methane hydrocarbon equivalent" (or "OMNMHCE") means the sum of carbon mass contribution of non-oxygenated hydrocarbons (excluding methane), methanol, ethanol, formaldehyde and acetaldehyde as contained in a gas sample, expressed as gasoline-fueled hydrocarbons.

"**Otto-cycle**" means powered by an engine where the primary means of controlling power output is by limiting the amount of air and fuel which can enter the combustion chambers of the engine. Gasoline-fueled engines are Otto-cycle engines.

"**Ozone deterioration factor**" means a factor applied to the mass of NMOG emissions from TLEVs, LEVs, or ULEVs which accounts for changes in the ozone-forming potential of the NMOG emissions from a vehicle as it accumulates mileage.

"**Parallel hybrid electric vehicle**" means any vehicle which allows power to be delivered to the driven wheels by either a combustion engine and/or by a battery powered electric motor.

"**Passenger car**" or "**PC**" means any motor vehicle designed primarily for transportation of persons and having a design capacity of 12 persons or less.

"**Periodically regenerating trap oxidizer system**" means a trap oxidizer system that utilizes, during normal driving conditions for cleaning the trap, an automated regeneration mode which can be easily detected.

"**Reactivity adjustment factor**" or "**RAF**" means a fraction applied to the mass of NMOG emissions from a vehicle powered by a fuel other than conventional gasoline for the purpose of determining a gasoline-equivalent NMOG emission value. The reactivity adjustment factor is defined as the ozone-forming potential of the exhaust from a vehicle powered by a fuel other than conventional gasoline divided by the ozone-forming potential of conventional gasoline vehicle exhaust.

"**Regeneration**" means the process of oxidizing accumulated particulate matter. It may occur continually or periodically.

"**Regeneration emission test**" means a complete emission test which includes a regeneration.

"**Regeneration interval**" means the interval from the start of a regeneration to the start of the next regeneration.

"**Series hybrid electric vehicle**" means any vehicle which allows power to be delivered to the driven wheels solely by a battery powered electric motor, but which also incorporates the use of a combustion engine to provide power to the battery and/or electric motor.

"**Super-Ultra-Low-Emission Vehicle**" **or** "**SULEV**" means any medium-duty vehicle certified to super-ultra-low-emission standards.

"**Transitional low-emission vehicle**" or "**TLEV**" means any vehicle certified to transitional low-emission standards.

"**Trap oxidizer system**" means an emission control system which consists of a trap to collect particulate matter and a mechanism to oxidize the accumulated particulate.

"**Type A hybrid electric vehicle**" means a hybrid electric vehicle which achieves a minimum range of 60 miles in the All-Electric Range Test, while maintaining minimal speed and time requirements throughout the test and without use of the auxiliary power unit.

"**Type B hybrid electric vehicle**" means a hybrid electric vehicle which achieves a range of 40 to 59 miles in the All-Electric Range Test, while maintaining minimal speed and time requirements throughout the test and without use of the auxiliary power unit.

"**Type C hybrid electric vehicle**" means a hybrid electric vehicle which achieves a range of 0 to 39 miles in the All-Electric Range Test, while maintaining minimal speed and time requirements throughout the test and without use of the auxiliary power unit, or which has been designated by the manufacturer as having a range of less than 40 miles without the use of the auxiliary power unit. This definition shall also apply to any hybrid electric vehicle which allows the operator to control the time or mode of operation of the auxiliary power unit either directly or indirectly (with the exception that a mechanism which allows the operator only to shut off the auxiliary power unit is permissible for Type A and Type B HEVs), to any hybrid electric vehicle which can be operated solely through the use of the auxiliary power unit, to any hybrid electric vehicle which utilizes a climate control system that cannot be operated without using the auxiliary power unit, and all other types of hybrid electric vehicles, excluding Type A and Type B hybrid electric vehicles.

"**Ultra-low-emission vehicle**" or "**ULEV**" means any vehicle certified to ultra-low emission standards.

"**Useful Life**" means a period of use denoted by the emission standards to which a given vehicle is certifying. For those light-duty and medium-duty vehicles certified to optional 100,000 mile standards and those 1993 and subsequent vehicles certified to 100,000 mile emission standards, and those transitional low-emission, low-emission, ultra-low-emission and super-ultra-low-emission vehicles, including hybrid electric vehicles, certified to 100,000 mile emission standards, the useful life shall be 10 years or 100,000 miles, whichever first occurs. For 1995 and subsequent medium-duty vehicles and medium-duty low-emission, ultra-low emission and super-ultra-low-emission vehicles certified to 120,000 mile emission standards, the useful life shall be 11 years or 120,000 miles, whichever first occurs. For light-duty and medium-duty vehicles, certified only to 50,000 miles, the useful life shall be 5 years or 50,000 miles, whichever first occurs.

"**Zero-emission vehicle**" or "**ZEV**" means any vehicle certified to zero-emission standards.

3. Standards

The following standards represent the maximum projected exhaust emissions for the useful life of the vehicle.

a. The exhaust emissions from new 1988 model passenger cars, light-duty trucks, and medium-duty vehicles shall not exceed:

1988 EXHAUST EMISSIONS STANDARDS[5,6]
(grams per mile)

Vehicle Type[1]	Loaded Vehicle Weight (lbs.)	Durability Vehicle Basis (mi)	Non-Methane Hydrocarbons[2]	Carbon Monoxide	Oxides of Nitrogen[3]
PC	All	50,000	0.39 (0.41)	7.0	0.4
PC[4]	All	50,000	0.39 (0.41)	7.0	0.7
PC (Option 1)	All	100,000	0.39 (0.41)	7.0	1.0
PC (Option 2)	All	100,000	0.46	8.3	1.0
LDT,MDV	0-3750	50,000	0.39 (0.41)	9.0	0.4
LDT,MDV[4]	0-3750	50,000	0.39 (0.41)	9.0	1.0
LDT,MDV (Option 1)	0-3750	100,000	0.39 (0.41)	9.0	1.0
LDT,MDV (Option 2)	0-3750	100,000	0.46	10.6	1.0
LDT,MDV	3751-5750	50,000	0.50 (0.50)	9.0	1.0
LDT,MDV (Option 1)	3751-5750	100,000	0.50 (0.50)	9.0	1.5
MDV	5751+	50,000	0.60 (0.60)	9.0	1.5
MDV (Option 1)	5751+	100,000	0.60 (0.60)	9.0	2.0

(1) "PC" means passenger cars.
"LDT" means light-duty trucks.
"MDV" means medium-duty vehicles.

(2) Hydrocarbon standards in parentheses apply to total hydrocarbons. In order to demonstrate compliance with a non-methane hydrocarbon emission standard, hydrocarbon emissions shall be measured in accordance with the "California Non-Methane Hydrocarbon Test Procedures."

(3) The maximum projected emissions of oxides of nitrogen measured on the federal Highway Fuel Economy Test (HWFET; 40 CFR Part 600 Subpart B) shall be not greater than 1.33 times the applicable passenger car standards and 2.00 times the applicable light-duty trucks and medium-duty vehicle standards shown in the table. Both the projected emissions and the HWFET standard shall be rounded in accordance with ASTM E29-67 to the nearest 0.1 g/mi before being compared.

(4) This set of standards for 1988 and later model vehicles is optional. A manufacturer may choose to certify to these optional standards pursuant to the conditions set forth in Section 1960.1.5 of Title 13, California Code of Regulations.

(5) Diesel passenger cars, light-duty trucks, and medium-duty vehicles, except those fueled with methanol, are subject to the following particulate exhaust emission standards: 0.2 g/mi for the 1988 model years. The particulate compliance shall be determined on a 50,000 mile durability vehicle basis.

(6) For gaseous-fueled vehicles the calculation procedures provided in Appendix V shall be used for determining emissions and fuel economy.

b. The exhaust emissions from (i) new 1989 through 1992 model passenger cars and light-duty trucks, except those produced by a small volume manufacturer, (ii) new 1991 through 1994 model passenger cars and light-duty trucks produced by a small volume manufacturer, (iii) new 1989 through 1994 model medium-duty vehicles, except those produced by a small volume manufacturer, and (iv) new 1991 through 1994 model medium-duty vehicles produced by a small volume manufacturer, shall not exceed:

1989 THROUGH 1994 MODEL YEAR EXHAUST EMISSIONS STANDARDS[5,6]
(grams per mile)

Vehicle Type[1]	Loaded Vehicle Weight (lbs.)	Durability Vehicle Basis (mi)	Non-Methane Hydrocarbon[2]	Carbon Monoxide	Oxides of Nitrogen[3,4]
PC	All	50,000	0.39 (0.41)	7.0	0.4
PC[7]	All	50,000	0.39 (0.41)	7.0	0.7
Diesel PC (Option 2)	All	100,000[9]	0.46	8.3	1.0
LDT,MDV	0-3750	50,000	0.39 (0.41)	9.0	0.4
LDT,MDV[7]	0-3750	50,000	0.39 (0.41)	9.0	0.7[8]
Diesel LDT, MDV (Option 2)	0-3750	100,000[9]	0.46	10.6	1.0
LDT,MDV	3751-5750	50,000	0.50 (0.50)	9.0	1.0
LDT,MDV (Option 1)	3751-5750	100,000[9]	0.50 (0.50)	9.0	1.5
MDV	5751+	50,000	0.60 (0.60)	9.0	1.5
MDV (Option 1)	5751 +	100,000[9]	0.60 (0.60)	9.0	2.0

(1) "PC" means passenger cars.
"LDT" means light-duty trucks.
"MDV" means medium-duty vehicles.

(2) Hydrocarbon standards in parentheses apply to total hydrocarbons. In order to demonstrate compliance with a non-methane hydrocarbon emission standard, hydrocarbon emissions shall be measured in accordance with the "California Non-Methane Hydrocarbon Test Procedures." For 1993 through 1994 model methanol-fueled vehicles certifying to these standards, including fuel-flexible vehicles, "Non-Methane Hydrocarbons" shall mean "Organic Material Hydrocarbon Equivalent" (or "OMHCE").

(3) The maximum projected emissions of oxides of nitrogen measured on the federal Highway Fuel Economy Test (HWFET; 40 CFR Part 600 Subpart B) shall be not greater than 1.33 times the applicable passenger car standards and 2.00 times the applicable light-duty trucks and medium-duty vehicle standards shown in the table. Both the projected emissions and the HWFET standard shall be rounded in accordance with ASTM E29-67 to the nearest 0.1 g/mi before being compared.

(4) The standard for in-use compliance for passenger cars, light-duty trucks and medium-duty vehicles certifying to the 0.4 g/mi NOx standard shall be 0.55 g/mi NOx for 50,000 miles. If the in-use compliance level is above 0.4 g/mi NOx but does not exceed 0.55 g/mi NOx, and based on a review of information derived from a statistically valid and representative

sample of vehicles, the Executive Officer determines that a substantial percentage of any class or category of such vehicles exhibits, prior to 50,000 miles or 5 years, whichever occurs first, an identifiable, systematic defect in a component listed in Section 1960.1.5(c)(2), Title 13, California Code of Regulations, which causes a significant increase in emissions above those exhibited by vehicles free of such defects and of the same class or category and having the same period of use and mileage, then the Executive Officer may invoke the enforcement authority under Subchapter 2.5, Title 13, California Code of Regulations, commencing with Section 2111, to require remedial action by the vehicle manufacturer. Such remedial action shall be limited to owner notification and repair or replacement of the defective component. As used in this section, the term "defect" shall not include failures which are the result of abuse, neglect, or improper maintenance. This provision is applicable for the 1989 through 1992 model years only. For small volume manufacturers, this provision is applicable for the 1991 through 1994 model years only.

(5) Diesel passenger cars, light-duty trucks, and medium-duty vehicles certifying to these standards are subject to a particulate exhaust emission standard of 0.08 g/mi for the 1989 and subsequent model years. The particulate compliance shall be determined on a 50,000 mile durability vehicle basis.

(6) For gaseous-fueled vehicles certifying to these standards, the calculation procedures provided in Appendix V shall be used for determining emissions and fuel economy.

(7) This set of standards is optional. A manufacturer may choose to certify to these standards pursuant to the conditions set forth in Section 1960.1.5 of Title 13, California Code of Regulations.

(8) Pursuant to Section 1960.1.5(a)(1)(B), Title 13, California Code of Regulations the optional standard for 1989 model year light-duty trucks and medium-duty vehicles only is 1.0 g/mi NOx.

(9) The optional 100,000 mile certification standards and provisions are not applicable to alcohol vehicles.

c. The exhaust emissions from new 1993 and subsequent model dedicated alcohol vehicles and fuel-flexible vehicles shall meet all the requirements in Sections 3.b., 3.e, and 3.f. of these test procedures with the following modifications and additions:

1993 AND SUBSEQUENT METHANOL-SPECIFIC AND ETHANOL-SPECIFIC FORMALDEHYDE EXHAUST EMISSION STANDARDS

Vehicle Type[1]	Loaded Vehicle Weight (lbs.)[3]	Durability Vehicle Basis (mi)	Formaldehyde (mg/mi) Certification	In-Use Compliance[2]
PC	All	50,000	15	23 (1993-1995) 15 (1996 and later)
LDT,MDV	0-3750	50,000	15	23 (1993-1995) 15 (1996 and later)
LDT,MDV	3751-5750	50,000	18	27 (1993-1995) 18 (1996 and later)
MDV	5751-8500	50,000	22	33 (1993-1995) 22 (1996 and later)
MDV	8501-10,000	50,000	28	36 (1995) 28 (1996 and later)
MDV	10,001-14,000	50,000	36	45 (1995) 36 (1996 and later)

(1) "PC" means passenger cars.
"LDT" means light-duty trucks.
"MDV" means medium-duty vehicles.

(2) If the formaldehyde in-use compliance level is above the respective certification level but does not exceed the in-use compliance level, and based on a review of information derived from a statistically valid and representative sample of vehicles, the Executive Officer determines that a substantial percentage of any class or category of such vehicle exhibits, prior to 50,000 miles or 5 years, whichever occurs first, an identifiable, systematic defect in a component listed in Section 1960.1.5(c)(2), Title 13 California Code of Regulations, which causes a significant increase in emissions above those exhibited by vehicles free of such defects and of the same class or category and having the same period of use and mileage, the Executive Officer may invoke the enforcement authority under subchapter 2.5, Title 13, California Code of Regulations, commencing with Section 2111, to require remedial action by the vehicle manufacturer. Such remedial action shall be limited to owner notification and repair or replacement of the defect component. As used in this section, the term "defect" shall not include failures which are the result of abuse, neglect, or improper maintenance.

(3) For 1995 and subsequent model year medium-duty vehicles certifying to the standards and test procedures specified in Section 1960.1(h)(1), Title 13, California Code of Regulations, "Loaded Vehicle Weight" shall mean "Test Weight", which is the average of the vehicle's curb weight and gross vehicle weight.

d. The exhaust emission levels from 1992 and subsequent model-year transitional low-emission vehicles, low-emission vehicles, ultra-low-emission vehicles, and super-ultra-low-emission vehicles, including fuel-flexible and dual-fuel vehicles, shall meet all the requirements of Sections 3.g and 3.j of these test procedures with the following additions:

FORMALDEHYDE EXHAUST EMISSION STANDARDS IN THE LOW-EMISSION VEHICLES IN THE LIGHT-DUTY AND MEDIUM-DUTY VEHICLE WEIGHT CLASSES[5,6]

["milligrams per mile" (or "mg/mi")]

Vehicle Type[1]	Vehicle Weight (lbs.)[2]	Durability Vehicle Basis (mi)	Vehicle Emission Category[3]	Formaldehyde (mg/mi)[4]
PC and LDT	All 0-3750	50,000	TLEV	15 (23)
			LEV	15 (15)
			ULEV	8 (12)
		100,000	TLEV	18
			LEV	18
			ULEV	11
LDT	3751-5750	50,000	TLEV	18 (27)
			LEV	18 (18)
			ULEV	9 (14)
		100,000	TLEV	23
			LEV	23
			ULEV	13
MDV	0-3750	50,000	LEV	15 (15)
			ULEV	8 (12)
		120,000	LEV	22
			ULEV	12
MDV	3751-5750	50,000	LEV	18 (18)
			ULEV	9 (14)
			SULEV	4 (7)
		120,000	LEV	27
			ULEV	13
			SULEV	6
MDV	5751-8500	50,000	LEV	22 (22)
			ULEV	11 (17)
			SULEV	6 (8)
		120,000	LEV	32
			ULEV	16
			SULEV	8
MDV	8501-10,000	50,000	LEV	28 (28)
			ULEV	14 (21)
			SULEV	7 (10)
		120,000	LEV	40
			ULEV	21
			SULEV	10
MDV	10,001-14,000	50,000	LEV	36 (36)
			ULEV	18 (27)
			SULEV	9 (14)
		120,000	LEV	52
			ULEV	26
			SULEV	13

(1) "PC" means passenger cars.
"LDT" means light-duty trucks.
"MDV" means medium-duty vehicles.

(2) For light-duty or medium-duty vehicles, Vehicle Weight shall mean "Loaded Vehicle Weight" (or "LVW") or "Test Weight" (or "TW"), respectively.

(3) "TLEV" means transitional low-emission vehicle.

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

(4) The standards in parentheses are intermediate in-use compliance standards for 50,000 miles.

a. For PCS and LDTs from 0-5750 lbs. LVW, including fuel-flexible and dual-fuel vehicles, intermediate in-use compliance standards shall apply to TLEVs through the 1995 model year, and LEVs and ULEVs through the 1998 model year. In-use compliance with standards beyond 50,000 miles shall be waived through the 1995 model year for TLEVs, and through the 1998 model year for LEVs and ULEVs.

b. For MDVs from 0-14,000 lbs. TW, including fuel-flexible and dual-fuel vehicles, intermediate in-use compliance standards shall apply to LEVs, ULEVs, and SULEVs through the 1999 model year. In-use compliance with standards beyond 50,000 miles shall be waived through the 1999 model year for LEVs, ULEVs, and SULEVs.

(5) Manufacturers shall demonstrate compliance with the above standards for formaldehyde at 50° F, according to the procedure specified in Section 11k of these test procedures. Hybrid electric, natural gas, and diesel-fueled vehicles shall be exempt from 50°F test requirements.

(6) In-use compliance testing shall be limited to PCS and LDTs with fewer than 75,000 miles and MDVs with fewer than 90,000 miles.

e. The exhaust emissions from new 1993 and 1994 model passenger cars and light-duty trucks, except those produced by a small volume manufacturer, shall not exceed:

1993 AND 1994 MODEL-YEAR PASSENGER CAR AND LIGHT-DUTY TRUCK EXHAUST EMISSIONS STANDARDS[5,6,10]

(grams per mile)

Vehicle Type[1]	Loaded Vehicle Weight (lbs)	Durability Vehicle Basis (mi)	Non-Methane Hydrocarbons[2,8,9]	Carbon Monoxide[8,9]	Oxides of Nitrogen[1,3,4]
PC	All	50,000	0.39 (0.25)	7.0 (3.4)	0.4
PC[7]	All	50,000	0.39 (0.25)	7.0 (3.4)	0.7
PC	All	100,000	(0.31)	(4.2)	n/a
Diesel PC (Option 2)	All	100,000	0.46 (0.31)	8.3 (4.2)	1.0
LDT	0-3750	50,000	0.39 (0.25)	9.0 (3.4)	0.4
LDT[7]	0-3750	50,000	0.39 (0.25)	9.0 (3.4)	0.7
LDT	0-3750	100,000	(0.31)	(4.2)	n/a
Diesel LDT (Option 2)	0-3750	100,000	0.46 (0.31)	10.6 (4.2)	1.0
LDT	3751-5750	50,000	0.50 (0.32)	9.0 (4.4)	1.0
LDT	3751-5750	100,000	(0.40)	(5.5)	n/a
Diesel LDT (Option 1)	3751-5750	100,000	0.50 (0.40)	9.0 (5.5)	1.5

(1) "PC" means passenger cars.
"LDT" means light-duty trucks.
"n/a" means not applicable.

(2) In order to demonstrate compliance with a non-methane hydrocarbon emission standard, hydrocarbon emissions shall be measured in accordance with the "California Non-Methane Hydrocarbon Test Procedures." For methanol-fueled vehicles certifying to these standards, including fuel-flexible vehicles when certifying on methanol, "Non-Methane Hydrocarbons" shall mean "Organic Material Hydrocarbon Equivalent" (or "OMHCE"). For alcohol vehicles certifying to the phase-in standards in parenthesis, including fuel-flexible vehicles when certifying on methanol or ethanol, "Non-Methane Hydrocarbons" shall mean "Organic Material Non-Methane Hydrocarbon Equivalent" (or "OMNMHCE").

(3) The maximum projected emissions of oxides of nitrogen measured on the federal Highway Fuel Economy Test (HWFET; 40 CFR Part 600 Subpart B) shall be not greater than 1.33 times the applicable passenger car standards and 2.00 times the applicable light-duty truck and medium-duty vehicle standards shown in the table. Both the projected emissions and the HWFET standard shall be rounded in accordance with ASTM E29-67 to the nearest 0.1 g/mi before being compared.

(4) The standard for in-use compliance for passenger cars and light-duty trucks certifying to the 0.4 g/mi NOx standard shall be 0.55 g/mi NOx for 50,000 miles. If the in-use compliance level is above 0.4 g/mi NOx but does not exceed 0.55 g/mi NOx, and based on a review of information derived from a statistically valid and representative sample of

vehicles, the Executive Officer determines that a substantial percentage of any class or category of such vehicles exhibits, prior to 50,000 miles or 5 years, whichever occurs first, an identifiable, systematic defect in a component listed in Section 1960.1.5(c)(2), Title 13 California Code of Regulations, which causes a significant increase in emissions above those exhibited by vehicles free of such defects and of the same class or category and having the same period of use and mileage, then the Executive Officer may invoke the enforcement authority under subchapter 2.5, Title 13, California Code of Regulations, commencing with Section 2111, to require remedial action by the vehicle manufacturer. Such remedial action shall be limited to owner notification and repair or replacement of the defective component. As used in this section, the term "defect" shall not include failures which are the result of abuse, neglect, or improper maintenance. This provision is applicable for the 1993 model year only.

(5) Diesel passenger cars and light-duty trucks certifying to these standards are subject to a particulate exhaust emission standard of 0.08 g/mi, determined on a 50,000 mile durability vehicle basis.

(6) For gaseous-fueled vehicles certifying to these standards, the calculation procedures provided in Appendix V shall be used for determining emissions and fuel economy.

(7) This set of standards is optional. A manufacturer may choose to certify to these standards pursuant to the conditions set forth in Section 1960.1.5 of Title 13, California Code of Regulations.

(8) The emission standards in parenthesis are phase-in standards. For the 1993 model year, each manufacturer must certify a minimum of 40% of their vehicles to the phase-in standards or to the more stringent standards in Section 3.g of these test procedures. The percentage shall be applied to the manufacturers' total projected sales of California-certified passenger cars and light-duty trucks for the 1993 model year. For 1994 and subsequent model years, manufacturers shall comply with the fleet average requirements specified in Section 3.h. of these test procedures.

(9) The following conditions shall apply to the in-use compliance standards of 1993 and 1994 model-year passenger cars and light-duty trucks only.

(a) The in-use compliance standards for those passenger cars and light-duty trucks certifying to the 0.25 g/mi non-methane hydrocarbon and 3.4 g/mi carbon monoxide standards shall be 0.32 g/mi non-methane hydrocarbon and 5.2 g/mi carbon monoxide for 50,000 miles.

(b) The in-use compliance standards for those light-duty trucks certifying to the 0.32 g/mi non-methane hydrocarbon and 4.4 g/mi carbon monoxide standards shall be 0.41 g/mi non-methane hydrocarbon and 6.7 g/mi carbon monoxide for 50,000 miles.

(c) In-use compliance standards shall be waived beyond 50,000 miles.

(10) All passenger cars and light-duty trucks, except those diesel vehicles certifying to optional 100,000 mile standards, are subject to non-methane hydrocarbon, carbon monoxide, and oxides of nitrogen standards determined on a 50,000 mile durability basis and non-methane hydrocarbon and carbon monoxide standards determined on a 100,000 mile basis.

f. The exhaust emissions from new 1995 and subsequent model passenger cars and light-duty trucks shall not exceed:

1995 AND SUBSEQUENT MODEL-YEAR PASSENGER CAR AND LIGHT-DUTY TRUCK EXHAUST EMISSIONS STANDARDS[5,6,8,9,11]

(grams per mile)

Vehicle Type[1]	Loaded Vehicle Weight (lbs)	Durability Vehicle Basis (mi)	Non-Methane Hydrocarbons[2,7]	Carbon Monoxide[7]	Oxides of Nitrogen[1,3]
PC	All	50,000	0.25	3.4	0.4[4]
PC	All	100,000	0.31	4.2	0.6[10]
Diesel PC (Option 2)	All	100,000	0.31	4.2	1.0
LDT	0-3750	50,000	0.25	3.4	0.4[4]
LDT	0-3750	100,000	0.31	4.2	0.6[10]
Diesel LDT (Option 2)	0-3750	100,000	0.31	4.2	1.0
LDT	3751-5750	50,000	0.32	4.4	0.7
LDT	3751-5750	100,000	0.40	5.5	0.97[10]
Diesel LDT (Option 1)	3751-5750	100,000	0.40	5.5	1.5

(1) "PC" means passenger cars.
"LDT" means light-duty trucks.

(2) In order to demonstrate compliance with a non-methane hydrocarbon emission standard, hydrocarbon emissions shall be measured in accordance with the "California Non-Methane Hydrocarbon Test Procedures." For alcohol-fueled vehicles certifying to these standards, including fuel-flexible vehicles when certifying on methanol or ethanol, "Non-Methane Hydrocarbons" shall mean "Organic Material Non-Methane Hydrocarbon Equivalent" (or "OMNMHCE").

(3) The maximum projected emissions of oxides of nitrogen measured on the federal Highway Fuel Economy Test (HWFET; 40 CFR Part 600 Subpart B) shall be not greater than 1.33 times the applicable passenger car standards and 2.00 times the applicable light-duty truck standards shown in the table. Both the projected emissions and the HWFET standard shall be rounded in accordance with ASTM E29-67 to the nearest 0.1 g/mi before being compared.

(4) Small volume manufacturers may choose to certify to an optional 0.7 g/mi NOx standard for the 1995 model year only, pursuant to the conditions set forth in Title 13, California Code of Regulations, Sections 1960.1(f)(1) and 1960.1.5.

(5) Diesel passenger cars and light-duty trucks certifying to these standards are subject to a particulate exhaust emission standard of 0.08 g/mi, determined on a 50,000 mile durability vehicle basis.

(6) For gaseous-fueled vehicles certifying to these standards, the calculation procedures provided in Appendix V shall be used for determining fuel economy.

(7) For all vehicles, except those certifying to optional diesel standards, in-use compliance with the exhaust emission standards shall be limited to vehicles with less than 75,000 miles.

(8) For the 1995 and 1996 model years, all manufacturers, except those certifying to optional diesel standards, are permitted alternative in-use compliance. Alternative in-use compliance is permitted for 60% of a manufacturer's vehicles in the 1995 model year and 20% of a manufacturer's vehicles in the 1996 model year. For the 1995 and 1996 model years, small volume manufacturers only are permitted alternative in-use compliance for 100% of the fleet. The percentages shall be applied to the manufacturers' total projected sales of California-certified passenger cars and light-duty trucks for the model year. "Alternative in-use compliance" shall consist of the following:

a. For all passenger cars and those light-duty trucks from 0-3750 lbs., loaded vehicle weight, except those diesel vehicles certifying to optional 100,000 mile standards, in-use compliance standards shall be 0.32 g/mi non-methane hydrocarbon and 5.2 g/mi carbon monoxide for 50,000 miles.

b. For light-duty trucks from 3751-5750 lbs., loaded vehicle weight, except those diesel light-duty trucks certifying to optional 100,000 mile standards, in-use compliance standards shall be 0.41 g/mi non-methane hydrocarbon and 6.7 g/mi carbon monoxide for 50,000 miles.

c. In-use compliance standards shall be waived beyond 50,000 miles.

(9) All passenger cars and light-duty trucks, except those diesel vehicles certifying to optional standards, are subject to non-methane hydrocarbon, carbon monoxide, and oxides of nitrogen standards determined on a 50,000 mile durability basis and non-methane hydrocarbon and carbon monoxide standards determined on a 100,000 mile durability basis.

(10) All 1996 and subsequent model-year PCS and LDTs shall comply with the applicable 100,000 mile standards for NOx.

(11) Each manufacturer shall certify PCS or LDTs to the exhaust emission standards of Sections 3.f. and 3.g. of these test procedures such that the manufacturer's fleet average NMOG values for California-certified PCS and LDTs from 0-3750 lbs. Loaded Vehicle Weight (or "LVW"), and LDTs from 3751-5750 lbs. LVW produced and delivered for sale in California are less than or equal to the requirement for the corresponding Model Year, Vehicle Type, and LVW Class in Section 3.h. of these test procedures.

g. The exhaust emissions from new 1992 and subsequent model-year transitional low-emission vehicles, low-emission vehicles and ultra-low-emission vehicles, and new 2003 and subsequent model-year zero-emission vehicles shall not exceed:

EXHAUST MASS EMISSION STANDARDS FOR TRANSITIONAL LOW-EMISSION VEHICLES, LOW-EMISSION VEHICLES, ULTRA-LOW-EMISSION VEHICLES AND ZERO-EMISSION VEHICLES IN PASSENGER CAR AND LIGHT-DUTY TRUCK VEHICLE CLASSES [6,7,8,9,10]

["grams per mile" (or "g/mi")]

Vehicle Type[1]	Loaded Vehicle Weight (lbs)	Durability Vehicle Basis (mi)	Vehicle Emission Category[2]	Non-Methane Organic Gases[3,4]	Carbon Monoxide	Oxides of Nitrogen[5]
PC and LDT	All 0-3750	50,000	TLEV	0.125	3.4	0.4
			LEV	0.075	3.4	0.2
			ULEV	0.040	1.7	0.2
			ZEV[2.1]	--	--	--
		100,000	TLEV	0.156	4.2	0.6
			LEV	0.090	4.2	0.3
			ULEV	0.055	2.1	0.3
			ZEV[2.1]	--	--	--
LDT	3751-5750	50,000	TLEV	0.160	4.4	0.7
			LEV	0.100	4.4	0.4
			ULEV	0.050	2.2	0.4
			ZEV[2.1]	--	--	--
		100,000	TLEV	0.200	5.5	0.9
			LEV	0.130	5.5	0.5
			ULEV	0.070	2.8	0.5
			ZEV[2.1]	--	--	--

(1) "PC" means passenger cars.
"LDT" means light-duty trucks.
"LVW" means loaded vehicle weight.
"Non-Methane Organic Gases" or "NMOG" means the total mass of oxygenated and non-oxygenated hydrocarbon emissions.

(2) "TLEV" means transitional low-emission vehicle.
"LEV" means low-emission vehicle.
"ULEV" means ultra-low-emission vehicle.
"ZEV" means zero-emission vehicle.

(2.1) a. The Executive Officer shall certify as ZEVs vehicles that produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40°F and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions.

b. Prior to the 2003 model year a manufacturer that voluntarily produces vehicles that meet the ZEV emission standards applicable to 2003 and subsequent model

year vehicles may certify those vehicles as ZEVs for the purposes of calculating fleet average NMOG exhaust emission values under section (g)(2), note (4) or (5); NMOG credits under section (g)(2), note (7); and ZEV credits under section (g)(2), note (9)a.

(3) **Compliance with NMOG Standard.** To demonstrate compliance with an NMOG standard, NMOG emissions shall be measured in accordance with the "California Non-Methane Organic Gas Test Procedures" adopted July 12, 1991 and as last amended June 24, 1996.

a. **Reactivity Adjustment.** For TLEVs, LEVs, and ULEVs certified to operate on a fuel other than conventional gasoline, including fuel-flexible and dual-fuel vehicles when certifying on a fuel other than gasoline, manufacturers shall multiply the exhaust NMOG certification levels by the applicable reactivity adjustment factor set forth in Section 13 of these test procedures, or established by the Executive Officer pursuant to Appendix VIII of these test procedures. In addition, natural gas vehicles certifying to TLEV, LEV or ULEV standards shall calculate a reactivity-adjusted methane exhaust emission value by multiplying the methane exhaust certification level by the applicable methane reactivity adjustment factor set forth in section 13 of these test procedures. The product of the exhaust NMOG certification levels and the reactivity adjustment factor shall be compared with the exhaust NMOG mass emission standards established for the particular vehicle emission category and fuel to determine compliance. For natural gas vehicles, the reactivity-adjusted NMOG value shall be added to the reactivity-adjusted methane value and then compared to the exhaust NMOG mass emission standards established for the particular vehicle emission category to determine compliance.

b. **Fleet Average Requirement.** Each manufacturer shall certify PCS or LDTs to meet the exhaust mass emission standards for TLEVs, LEVs, ULEVs, or to the exhaust emission standards of Sections 3.b., 3.e., or 3.f. of these test procedures, or as Zero-Emission Vehicles, such that the manufacturer's fleet average NMOG values for California-certified PCS and LDTs from 0-3750 lbs. LVW, and LDTs from 3751-5750 lbs. LVW, produced and delivered for sale in California are less than or equal to the requirement for the corresponding Model Year, Vehicle Type, and LVW Class in Section 3.h. of these test procedures.

(4) **NMOG Standards for Fuel-Flexible and Dual-Fuel Vehicles.** Fuel-flexible and dual-fuel PCS and LDTs from 0-5750 lbs. LVW shall be certified to exhaust mass emission standards for NMOG established for the operation of the vehicle on an available fuel other than gasoline, and gasoline as specified in Section 9.a.1. of these test procedures.

a. **Reactivity Adjustment.** For TLEVs, LEVs, and ULEVs, when certifying for operation on a fuel other than gasoline, manufacturers shall multiply the exhaust NMOG certification levels by the applicable reactivity adjustment factor. In addition to multiplying the exhaust NMOG certification levels by the applicable reactivity adjustment factor, the exhaust methane certification level for natural gas vehicles shall be multiplied by the applicable methane reactivity adjustment factor and the resulting value shall be added to the reactivity-adjusted NMOG value. The exhaust NMOG certification levels for fuel-flexible or dual-fuel vehicles when certifying on gasoline shall not be multiplied by a reactivity adjustment factor.

b. **Standards for Fuel-Flexible and Dual Fuel Vehicles Operating on Gasoline.** For PCS and LDTs from 0-5750 lbs. LVW, the applicable exhaust mass

emission standard for NMOG when certifying the vehicle for operation on gasoline shall be:

Vehicle Type	Weight (LVW)	Emission Category	Durability Vehicle Basis (g/mi)	
			50,000 Mile	100,000 Mile
PCS, LDT	All, 0-3750	TLEV	0.25	0.31
		LEV	0.125	0.156
		ULEV	0.075	0.090
LDT	3751-5750	TLEV	0.32	0.40
		LEV	0.160	0.200
		ULEV	0.100	0.130

(5) **Highway NOx Standard.** The maximum projected emissions of Oxides of Nitrogen (or "NOx") measured on the federal Highway Fuel Economy Test (HWFET; 40 CFR 600 Subpart B) shall not be greater than 1.33 times the applicable light-duty vehicle standards shown in the table. Both the projected emissions and the HWFET standard shall be rounded in accordance with ASTM E29-67 to the nearest 0.1 g/mi before being compared.

(6) **Intermediate In-Use Compliance Standards.** The following standards are intermediate in-use compliance standards for 50,000 and 100,000 miles for PCS and LDTs from 0-5750 lbs. LVW, including fuel-flexible and dual-fuel vehicles when operating on an available fuel other than gasoline. Intermediate in-use compliance standards shall apply to TLEVs through the 1995 model year as follows:

	NMOG (g/mi)
PCS and LDTs 0-3750 lbs. LVW	0.188
LDTs 3751 - 5750 lbs. LVW	0.238

In-use compliance with standards beyond 50,000 miles shall be waived through the 1995 model year for TLEVs, and through the 1998 model year for LEVs and ULEVs. For LEVs and ULEVs, the following intermediate in-use standards shall apply:

Vehicle Type	Durability Vehicle Basis	LEV (g/mi)			ULEV (g/mi)			
		Model Year	NMOG	NOx	Model Year	NMOG	CO	NOx
PCS, 0-3750 lb. LVW LDTs	50,000	through 1998	0.100	0.3	through 1998	0.058	2.6	0.3
	50,000	1999	0.100	0.3	1999-2002	0.055	2.1	0.3
	100,000	1999	0.125	0.4	1999-2002	0.075	3.4	0.4
3751-5750 lb. LVW LDTs	50,000	through 1998	0.128	0.5	through 1998	0.075	3.3	0.5
	50,000	1999	0.130	0.5	1999-2002	0.070	2.8	0.5
	100,000	1999	0.160	0.7	1999-2002	0.100	4.4	0.7

a. **Reactivity Adjustment.** For TLEVs, LEVs, and ULEVs designed to operate on a fuel other than conventional gasoline, including fuel-flexible and dual-fuel vehicles when operating on a fuel other than gasoline, exhaust NMOG emission results shall be multiplied by the applicable reactivity adjustment factor to determine compliance with intermediate in-use compliance standards for NMOG. In addition to multiplying the exhaust NMOG emission results by the applicable reactivity adjustment factor, the exhaust methane emission results for natural gas vehicles shall be multiplied by the applicable methane reactivity adjustment factor and the resulting value shall be added to the reactivity-adjusted NMOG value. Exhaust NMOG mass emissions from fuel-flexible or dual-fuel vehicles when operating on gasoline shall not be multiplied by a reactivity adjustment factor.

b. **Intermediate In-Use Standards for Fuel-Flexible and Dual-Fuel Vehicles Operating on Gasoline.** For fuel-flexible and dual-fuel PCS and LDTs from 0-5750 lbs. LVW, intermediate in-use compliance standards for NMOG emissions at 50,000 miles when the vehicle is operated on gasoline shall be:

Vehicle Type	Loaded Vehicle Weight (LVW)	Emission Category	Durability Vehicle Basis (g/mi) 50,000 mi
PCS, LDT	All, 0-3750	TLEV	0.32
		LEV	0.188
		ULEV	0.100
LDT	3751-5750	TLEV	0.41
		LEV	0.238
		ULEV	0.128

Intermediate in-use compliance standards shall apply to TLEVs through the 1995 model year, and to LEVs and ULEVs through the 1998 model year. In-use compliance with standards beyond 50,000 miles shall be waived through the 1995 model year for TLEVs, and through the 1998 model year for LEVs and ULEVs.

(7) **Diesel Standards.** Manufacturers of diesel vehicles shall also certify to particulate standards at 100,000 miles. For all PCS and LDTs from 0-3750 lbs. LVW, the particulate standard is 0.08 g/mi, 0.08 g/mi, and 0.04 g/mi for TLEVs, LEVs, and ULEVs, respectively. For LDTs from 3751-5750 lbs. LVW, the particulate standard is 0.10 g/mi, 0.10 g/mi, and 0.05 g/mi for TLEVs, LEVs, and ULEVs, respectively. For diesel vehicles certifying to the standards set forth in section 3.g. of these test procedures, "NMOG" shall mean non-methane hydrocarbons.

(8) **50°F Requirement.** Manufacturers shall demonstrate compliance with the above standards for NMOG, carbon monoxide and NOx at 50° F, according to the procedure specified in Section 11k of these test procedures. Hybrid electric, natural gas, and diesel-fueled vehicles shall be exempt from 50° F test requirements.

(9) **Limit on In-Use Testing.** In-use compliance testing shall be limited to vehicles with fewer than 75,000 miles.

(10) **HEV Requirements.** Deterioration factors for hybrid electric vehicles shall be based on the emissions and mileage accumulation of the auxiliary power unit. For certification purposes only, Type A hybrid electric vehicles shall demonstrate compliance with 50,000 mile emission standards (using 50,000 mile deterioration factors), and demonstrating compliance with 100,000 mile emission standards shall not be required. For certification purposes only, Type B hybrid electric vehicles shall demonstrate compliance with 50,000 mile emission standards (using 50,000 mile deterioration factors) and 100,000 mile emission standards (using 75,000 mile deterioration factors). For certification purposes only, Type C hybrid electric vehicles shall demonstrate compliance with 50,000 mile emission standards (using 50,000 mile deterioration factors) and 100,000 mile emission standards (using 100,000 mile deterioration factors).

h. The fleet average non-methane organic gas exhaust mass emission values from the passenger cars and light-duty trucks produced and delivered for sale in California by a manufacturer each model year shall not exceed:

FLEET AVERAGE NON-METHANE ORGANIC GAS EXHAUST MASS EMISSION REQUIREMENTS FOR LIGHT-DUTY VEHICLE WEIGHT CLASSES [7,8,9]

[grams per mile" (or "g/mi")]

Vehicle Type[1]	Loaded Vehicle Weight (lbs.)	Durability Vehicle Basis (mi)[7]	Model Year	Fleet Average Non-Methane Organic Gases[2,3,4,5,6]
PC and LDT	All 0-3750	50,000	1994	0.250
			1995	0.231
			1996	0.225
			1997	0.202
			1998	0.157
			1999	0.113
			2000	0.073
			2001	0.070
			2002	0.068
			2003 and subsequent	0.062
LDT	3751-5750	50,000	1994	0.320
			1995	0.295
			1996	0.287
			1997	0.260
			1998	0.205
			1999	0.150
			2000	0.099
			2001	0.098
			2002	0.095
			2003 and subsequent	0.093

(1) "PC" means passenger cars.
"LDT" means light-duty trucks.
"MDV" means medium-duty vehicles.
"LVW" means loaded vehicle weight.

(2) "Non-Methane Organic Gases" (or "NMOG") shall mean the total mass of oxygenated and non-oxygenated hydrocarbon emissions.

(3) For the purpose of calculating fleet average NMOG values, vehicles which have no tailpipe emissions but use fuel fired heaters and which are not certified as ZEVs shall be treated as Type A Hybrid Electric Vehicles Ultra-Low-Emission Vehicles (or "Type A HEV ULEVs").

(4) **Calculation of Fleet Average NMOG Value (PCS and LDTs from 0-3750 lbs. LVW).** Each manufacturer's fleet average NMOG value for the total number of PCS and LDTs from 0-3750 lbs. LVW produced and delivered for sale in California shall be calculated in

units of g/mi NMOG according to the following equation, where the term "Produced" means produced and delivered for sale in California:

{[(No. of vehicles certified to the exhaust emission standards in Section 3.b. of these test procedures and produced) x (0.39)] +
[(No. of vehicles certified to the phase-in exhaust emission standards in Section 3.e. of these test procedures and produced) x (0.25)] +
[(No. of vehicles certified to the phase-out exhaust emission standards in 3.e. of these test procedures and produced) x (0.39)] +
[(No. of vehicles certified to the exhaust emission standards in Section 3.f. of these test procedures and produced) x (0.25)] +
[(No. of TLEVs produced excluding HEVs) x (0.125)] +
[(No. of LEVs produced excluding HEVs) x (0.075)] +
[(No. of ULEVs produced excluding HEVs) x (0.040)] +
(HEV contribution factor)} ÷
[Total No. of vehicles produced, including ZEVs and HEVs].

a. "HEV contribution factor" shall mean the NMOG emission contribution of HEVs to a manufacturer's fleet average NMOG value. The HEV contribution factor shall be calculated in units of g/mi as follows, where the term "Produced" means produced and delivered for sale in California:

HEV contribution factor =

{[No. of "Type A HEV" TLEVs produced] x (0.100) +
[No. of "Type B HEV" TLEVs produced] x (0.113) +
[No. of "Type C HEV" TLEVs produced] x (0.125)} +
{[No. of "Type A HEV" LEVs produced] x (0.057) +
[No. of "Type B HEV" LEVs produced] x (0.066) +
[No. of "Type C HEV" LEVs produced] x (0.075)} +
{[No. of "Type A HEV" ULEVs produced] x (0.020) +
[No. of "Type B HEV" ULEVs produced] x (0.030) +
[No. of "Type C HEV" ULEVs produced] x (0.040)}

b. ZEVs classified as LDTs 3751-5750 lbs. LVW which have been counted toward the ZEV requirement for PCS and LDTs 0-3750 lbs. LVW as specified in note (9) shall be included in the above equation of note (4).

c. Beginning with the 1996 model year, manufacturers that produce and deliver for sale in California PCS and LDTs 0-3750 lbs. LVW that are certified to the Tier I exhaust emission standards in 40 CFR 86.094-8 and 86.094-9 shall add the following term to the numerator of the fleet average NMOG equation in note (4) and calculate their fleet average values accordingly: [(No. of Vehicles Certified to federal Tier I exhaust emission standards and Produced) x (0.25)].

(5) **Calculation of Fleet Average NMOG Value (LDTs 3751-5750 lbs. LVW.)** Manufacturers that certify LDTs from 3751-5750 lbs. LVW, shall calculate a fleet average NMOG value in units of g/mi NMOG according to the following equation, where the term "Produced" means produced and delivered for sale in California:

{[(No. of vehicles certified to the exhaust emission standards in Section 3.b. of these test procedures and produced x (0.50)] +
[(No. of vehicles certified to the phase-in exhaust emission standards in Section 3.e. of these test procedures and produced) x (0.32)] +
[(No. of vehicles certified to the phase-out exhaust emission standards in Section 3.e. of these test procedures and produced) x (0.50)] +
[(No. of vehicles certified to the exhaust emission standards in Section 3.f. of these test procedures and produced) x (0.32)] +
[(No. of TLEVs produced excluding HEVs) x (0.160)] +
[(No. of LEVs produced excluding HEVs) x (0.100)] +
[(No. of ULEVs produced excluding HEVs) x (0.050)] +
(HEV contribution factor)} ÷
(Total No. of vehicles produced, including ZEVs and HEVs).

a. "HEV contribution factor" shall mean the NMOG emission contribution of HEVs to a manufacturer's fleet average NMOG value. The HEV contribution factor shall be calculated in units of g/mi as follows, where the term "Produced" means produced and delivered for sale in California:

HEV contribution factor =

{[No. of "Type A HEV" TLEVs Produced] x (0.130) +
[No. of "Type B HEV" TLEVs Produced] x (0.145) +
[No. of "Type C HEV" TLEVs Produced] x (0.160)} +
{[No. of "Type A HEV" LEVs Produced] x (0.075) +
[No. of "Type B HEV" LEVs Produced] x (0.087) +
[No. of "Type C HEV" LEVs Produced] x (0.100)} +
{[No. of "Type A HEV" ULEVs Produced] x (0.025) +
[No. of "Type B HEV" ULEVs Produced] x (0.037) +
[No. of "Type C HEV" ULEVs Produced] x (0.050)}

b. Only ZEVs which have been certified as LDTs 3751-5750 lbs. LVW and which have not been counted toward the ZEV requirements for PCS and LDTs 0-3750 lbs. LVW as specified in note (9) shall be included in the equation of note (5).

c. Beginning with the 1996 model year, manufacturers that produce and deliver for sale in California LDTs 3751-5750 lbs. LVW that are certified to the Tier I exhaust emission standards in 40 CFR 86.094-9 shall add the following term to the numerator of the fleet average NMOG equation in note (5) and calculate their fleet average NMOG values accordingly: [(No. of Vehicles Certified to federal Tier I exhaust emission standards and Produced and Delivered for Sale in California) x (0.32)]

(6) **Requirements for Small Volume Manufacturers.** As used in this section 3.h. of these test procedures, the term "small volume manufacturer" shall mean any vehicle manufacturer with California sales less than or equal to 3000 new PCS, LDTs, and MDVs per model year based on the average number of vehicles sold by the manufacturer each model year from 1989 to 1991, except as otherwise noted below. For manufacturers certifying for the first time in California, model-year sales shall be based on projected California sales. In 2000 and subsequent model years, small volume manufacturers shall comply with the fleet average NMOG requirements set forth below.

a. Prior to the model year 2000, compliance with the specified fleet average NMOG requirements shall be waived.

b. In 2000 and subsequent model years, small volume manufacturers shall not exceed a fleet average NMOG value of 0.075 g/mi for PCS and LDTs from 0-3750 lbs. LVW calculated in accordance with note (4).

c. In 2000 and subsequent model years, small volume manufacturers shall not exceed a fleet average NMOG value of 0.100 g/mi for LDTs from 3751-5750 lbs. LVW calculated in accordance with note (5).

d. If a manufacturer's average California sales exceeds 3000 units of new PCS, LDTs, and MDVs based on the average number of vehicles sold for any three consecutive model years, the manufacturer shall no longer be treated as a small volume manufacturer and shall comply with the fleet average requirements applicable for larger manufacturers as specified in Section 3.h. of these test procedures beginning with the fourth model year after the last of the three consecutive model years.

e. If a manufacturer's average California sales falls below 3000 units of new PCS, LDTs, and MDVs based on the average number of vehicles sold for any three consecutive model years, the manufacturer shall be treated as a small volume manufacturer and shall be subject to requirements for small volume manufacturers as specified in Section 3.h. of these test procedures beginning with the next model year.

(7) **Calculation of NMOG Credits/Debits and Procedure for Offsetting Debits.**

a. In 1992 and subsequent model years, manufacturers that achieve fleet average NMOG values lower than the fleet average NMOG requirement for the corresponding model year shall receive credits in units of g/mi NMOG determined as:

[(Fleet Average NMOG Requirement) - (Manufacturer's Fleet Average NMOG Value)] x (Total No. of Vehicles Produced and Delivered for Sale in California, Including ZEVs and HEVs).

Manufacturers with 1994 and subsequent model year fleet average NMOG values greater than the fleet average requirement for the corresponding model year shall receive debits in units of g/mi NMOG equal to the amount of negative credits determined by the aforementioned equation. For any given model year, the total g/mi NMOG credits or debits earned for PCS and LDTs 0-3750 lbs. LVW and for LDTs 3751-5750 lbs. LVW shall be summed together. The resulting amount shall constitute the g/mi NMOG credits or debits accrued by the manufacturer for the model year.

b. For the 1994 through 1997 model years, manufacturers shall equalize emission debits within three model years and prior to the end of the 1998 model year by earning g/mi NMOG emission credits in an amount equal to their g/mi NMOG debits, or by submitting a commensurate amount of g/mi NMOG credits to the Executive Officer that were earned previously or acquired from another manufacturer. For 1998 and subsequent model years, manufacturers shall equalize emission debits by the end of the following model year. If emission debits are not equalized within the specified time period, the manufacturer shall be subject to the Health and Safety Code section 43211 civil penalty applicable to a manufacturer which sells a new motor vehicle that does not meet the applicable emission standards adopted by the state board. The cause of action shall be deemed to accrue when the emission debits are not equalized by the end of the specified time period. For the purposes of Health and Safety Code section 43211, the number of vehicles not meeting the state board's emission standards shall be determined by dividing the total amount of g/mi NMOG emission debits for the model year by the g/mi

NMOG fleet average requirement for PCS and LDTs 0-3750 lbs. LVW applicable for the model year in which the debits were first incurred.

c. The g/mi NMOG emission credits earned in any given model year shall retain full value through the subsequent model year. The g/mi NMOG value of any credits not used to equalize the previous model-year's debit, shall be discounted by 50% at the beginning of second model year after being earned, discounted to 25% of its original value if not used by the beginning of the third model year after being earned, and will have no value if not used by the beginning of the fourth model year after being earned.

d. In order to verify the status of a manufacturer's compliance with the fleet average requirements for a given model year, and in order to confirm the accrual of NMOG credits or debits, each manufacturer shall submit an annual report to the Executive Officer which sets forth the production data used to establish compliance by no later than March 1 of the calendar year following the close of the model year.

(8) **Credits for Pre-1994 Model Year Vehicles.** Manufacturers that produce and deliver for sale in California vehicles certified to the phase-in exhaust emission standards in Section 3.e. of these test procedures or vehicles certified to the exhaust emission standards in Sections 3.f. or 3.g. of these test procedures and/or ZEVs in the 1992 and 1993 model years, shall receive emission credits as determined by the equations in notes (4), (5), and (7).

a. For PCS and LDTs from 0-3750 lbs. LVW, the fleet average NMOG requirement for calculating a manufacturer's emission credits shall be 0.390 and 0.334 g/mi NMOG for vehicles certified in the 1992 and 1993 model years, respectively.

b. For LDTs from 3751-5750 lbs. LVW, the fleet average NMOG requirement for calculating a manufacturer's emission credits shall be 0.500 and 0.428 g/mi NMOG for vehicles certified in the 1992 and 1993 model years, respectively.

c. Emission credits earned prior to the 1994 model year shall be considered as earned in the 1994 model year and discounted in accordance with the schedule specified in note (7).

(9) **ZEV Requirements.** While meeting the fleet average requirements, each manufacturer shall certify, produce, and deliver for sale in California at least 10% ZEVs in 2003 and subsequent model years. These percentages shall be applied to the manufacturer's total production of PCS and LDTs 0-3750 lbs. LVW delivered for sale in California.

a. **Calculation of ZEV Credits.** Manufacturers that produce for sale in California more ZEVs than required in a given model year shall earn ZEV credits, which shall be expressed in units of g/mi NMOG. The amount of ZEV credits earned shall be equal to the number of ZEVs required to be produced and delivered for sale in California for the model year subtracted from the number of ZEVs produced and delivered for sale in the model year and then multiplied by the NMOG fleet average requirement for PCS and LDTs 0-3750 lbs. LVW for that model year.

In calculating the number of ZEV credits under this note (9)a, each ZEV produced and delivered for sale prior to the 2003 model year may be counted as follows:

1. ZEV Credits based on vehicle range:

Number of ZEVs	Vehicle Range (miles)

	Model Years 1996 and 1997	Model Years 1998 and 1999	Model Years 2000, 2001 and 2002
2	any	≥ 100	≥ 140
3	≥70	≥ 130	≥ 175

Range shall be determined in accordance with section 9.f.(2)(a) of these test procedures.

2. ZEV Credits based on the specific energy of the battery:

Number of ZEVs	Specific Energy of Battery (w-hr/kg)		
	Model Years 1996, 1997 and 1998	Model Years 1999 and 2000	Model Years 2001 and 2002
2	any	≥ 50	≥ 60
3	≥40	≥ 60	≥ 90

For model years 1999 through 2002, additional ZEV credits will be determined by linear interpolation between the values shown in the above schedule. Battery specific energy shall be determined in accordance with section 9.g. of these test procedures.

3. For purposes of calculating ZEV credits, a ZEV may be counted according to note (9)a.1. or (9)a.2. above, but not both.

4. For purposes of calculating manufacturer's fleet average NMOG value under note (4) or (5), each ZEV shall be counted as one vehicle.

All ZEV credits earned prior to the 2003 model year shall be treated as if earned in the 2003 model year and shall be discounted in accordance with note (7)c.

b. **Submittal of ZEV Credits.** A manufacturer may meet the ZEV requirements in any given model year by submitting to the Executive Officer a commensurate amount of ZEV credits. These credits may be earned previously by the manufacturer or acquired from another manufacturer. The amount of ZEV credits required to be submitted shall be calculated by subtracting the number of ZEVs produced and delivered for sale in California by the manufacturer for the model year from the number of ZEVs required to be produced by the manufacturer for the model year and then multiplying by the fleet average requirement for PCS and LDTs 0-3750 lbs. LVW for that model year.

c. **Requirement to Make Up a ZEV Deficit.** Manufacturers that certify, produce, and deliver for sale in California fewer ZEVs than required in a given model year shall make up the deficit by the end of the next model year by submitting to the Executive Officer a commensurate amount of ZEV credits. The amount of ZEV credits required to be submitted shall be calculated by subtracting the number of ZEVs produced and delivered for sale in California by the manufacturer for the model year from the number of

ZEVs required to be produced by the manufacturer for the model year and then multiplying by the fleet average requirements for PCS and LDTs 0-3750 lbs. LVW for the model year in which the deficit is incurred.

d. **Penalty for Failure to Meet ZEV Requirements.** Any manufacturer that fails to produce and deliver for sale in California the required number of ZEVs or submit an appropriate amount of ZEV credits and does not make up ZEV deficits within the specified time period shall be subject to the Health and Safety Code § 43211 civil penalty applicable to a manufacturer which sells a new motor vehicle that does not meet the applicable emission standards adopted by the state board. The cause of action shall be deemed to accrue when the ZEV deficits are not balanced by the end of the specified time period. For the purposes of Health and Safety Code §43211, the number of vehicles not meeting the state board's standards shall be calculated according to the following equation:

(No. of ZEVs required to be produced and delivered for sale in California for the model year) - (No of ZEVs actually produced and delivered for sale in California for the model year) - [(Amount of ZEV credits submitted for the model year) / (the fleet average requirement for PCS and LDTs 0-3750 lbs. LVW for the model year)].

e. **ZEV Credits for MDVs and LDTs 3751-5750 lbs. LVW.** ZEVs classified as MDVs or as LDTs 3751-5750 lbs. LVW may be counted toward the ZEV requirement for PCS and LDTs 0-3750 lbs. LVW and included in the calculation of ZEV credits as specified in note (9)a., if the manufacturer so designates.

f. Small volume manufacturers as defined in note (6) shall not be required to meet the percentage ZEV requirements. However, small volume manufacturers may earn and market credits for ZEVs they produce and deliver for sale in California.

i. The exhaust emissions from new 1995 and subsequent model medium-duty vehicles shall not exceed:

1995 AND SUBSEQUENT MODEL-YEAR MEDIUM-DUTY VEHICLE EXHAUST EMISSIONS STANDARDS [1,2,3,7,8]

(grams per mile)

Test Weight(lbs.)	Durability Vehicle Basis(mi)	Non-Methane Hydrocarbons[4]	Carbon Monoxide	Oxides of Nitrogen[5]	Particulates[6]
0-3,750	50,000	0.25	3.4	0.4	n/a
0-3,750	120,000	0.36	5.0	0.55	0.08
3,751-5,750	50,000	0.32	4.4	0.7	n/a
3,751-5,750	120,000	0.46	6.4	0.98	0.10
5,751-8,500	50,000	0.39	5.0	1.1	n/a
5,751-8,500	120,000	0.56	7.3	1.53	0.12
8,501-10,000	50,000	0.46	5.5	1.3	n/a
8,501-10,000	120,000	0.66	8.1	1.81	0.12
10,001-14,000	50,000	0.60	7.0	2.0	n/a
10,001-14,000	120,000	0.86	10.3	2.77	0.12

(1) "n/a" means not applicable.
"Test Weight" (or "TW") shall mean the average of the vehicle's curb weight and gross vehicle weight.

(2) Manufacturers have the option of certifying engines used in incomplete and diesel medium-duty vehicles from 8501-14,000 pounds gross vehicle weight to the heavy-duty engine standards and test procedures set forth in Section 1956.8(g), Title 13, California Code of Regulations. Manufacturers certifying incomplete or diesel medium-duty vehicles to the heavy-duty engine standards and test procedures shall specify, in the application for certification, an in-use compliance test procedure, as provided in Sections 2139(c), Title 13, California Code of Regulations.

(3) For the 1995 model year only, manufacturers of medium-duty vehicles may certify a maximum of 50 percent of their vehicles to the applicable 1994 model year standards and test procedures. The percentage shall be based upon each manufacturer's projected sales of California-certified medium-duty vehicles. For the 1995 model year only, small volume manufacturers may certify 100 percent of their vehicles to the applicable 1994 model-year standards and test procedures.

(4) For alcohol-fueled vehicles certifying to these standards, including fuel-flexible vehicles when certifying on methanol or ethanol, "Non-Methane Hydrocarbons" shall mean "Organic Material Non-Methane Hydrocarbon Equivalent" (or "OMNMHCE").

(5) The maximum projected emissions of oxides of nitrogen measured on the federal Highway Fuel Economy Test (HWFET; 40 CFR Part 600 Subpart B) shall be not greater than 2.00 times the applicable medium-duty vehicle standards shown in the table. Both the projected emissions and the HWFET standard shall be rounded in accordance with ASTM E29-67 to the nearest 0.1 g/mi before being compared.

(6) Particulate standards are only applicable for diesel vehicles and shall be determined on a 120,000 mile basis.

(7) In-use compliance testing shall be limited to vehicles with less than 90,000 miles. For the 1995 through 1997 model years, alternative in-use compliance is available for medium-duty vehicle manufacturers. A manufacturer may use alternative in-use compliance for up to 100 percent of its fleet in the 1995 and 1996 model years and up to 50 percent of its fleet in the 1997 model year. Small volume manufacturers only may use alternative in-use compliance for up to 100 percent of their fleet in the 1995 through 1997 model years. The percentages shall be determined only from the manufacturer's projected California sales of medium-duty vehicles. For vehicles certified to the standards and test procedures of this subsection, "alternative in-use compliance" shall consist of an in-use allowance of 25 percent over the applicable 1995 model-year hydrocarbon, carbon monoxide, and oxides of nitrogen 50,000 mile emission standards and a waiver of the emission standards beyond 50,000 miles.

(8) All medium-duty vehicles, except diesel-fueled vehicles and those incomplete and diesel vehicles certifying to heavy-duty engine test procedures, are subject to 50,000 mile and 120,000 mile non-methane hydrocarbon, carbon monoxide, and oxides of nitrogen standards. Diesel-fueled vehicles shall be subject to 120,000 mile non-methane hydrocarbon, carbon monoxide, oxides of nitrogen, and particulate standards only.

j. The exhaust emission levels from new 1992 and subsequent model-year medium-duty low-emission vehicles, ultra-low-emission vehicles and super-ultra-low-emission vehicles, and new 2003 and subsequent model-year medium-duty zero-emission vehicles shall not exceed:

EXHAUST EMISSION STANDARDS FOR LOW-EMISSION VEHICLES, ULTRA-LOW-EMISSION VEHICLES, SUPER-ULTRA-LOW-EMISSION VEHICLES AND ZERO-EMISSION VEHICLES IN THE MEDIUM-DUTY VEHICLE WEIGHT CLASS [8,9,10, 11, 12, 13,14, 15, 16]

[grams per mile (or "g/mi")]

Test Weight (lbs)[1]	Durability Vehicle Basis (mi)	Vehicle Emission Category[2]	Non-Methane Organic Gases[1,3,4]	Carbon Monoxide	Oxides of Nitrogen[3,5]	Particulates[6,7]
0-3750	50,000	LEV	0.125	3.4	0.4	n/a
		ULEV	0.075	1.7	0.2	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.180	5.0	0.6	0.08
		ULEV	0.107	2.5	0.3	0.04
		ZEV[2.1]	--	--	--	--
3751-5750	50,000	LEV	0.160	4.4	0.4	n/a
		ULEV	0.100	4.4	0.4	n/a
		SULEV	0.050	2.2	0.2	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.230	6.4	0.6	0.10
		ULEV	0.143	6.4	0.6	0.05
		SULEV	0.072	3.2	0.3	0.05
		ZEV[2.1]	--	--	--	--
5751-8500	50,000	LEV	0.195	5.0	0.6	n/a
		ULEV	0.117	5.0	0.6	n/a
		SULEV	0.059	2.5	0.3	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.280	7.3	0.9	0.12
		ULEV	0.167	7.3	0.9	0.06
		SULEV	0.084	3.7	0.45	0.06
		ZEV[2.1]	--	--	--	--
8501-10,000	50,000	LEV	0.230	5.5	0.7	n/a
		ULEV	0.138	5.5	0.7	n/a
		SULEV	0.069	2.8	0.35	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.330	8.1	1.0	0.12
		ULEV	0.197	8.1	1.0	0.06

		SULEV	0.100	4.1	0.5	0.06
		ZEV[2.1]	--	--	--	--
10,001-	50,000	LEV	0.300	7.0	1.0	n/a
14,000		ULEV	0.180	7.0	1.0	n/a
		SULEV	0.09	3.5	0.5	n/a
		ZEV[2.1]	--	--	--	--
	120,000	LEV	0.430	10.3	1.5	0.12
		ULEV	0.257	10.3	1.5	0.06
		SULEV	0.130	5.2	0.7	0.06
		ZEV[2.1]	--	--	--	--

(1) "Test Weight" (or "TW") shall mean the average of the vehicle's curb weight and gross vehicle weight.
"Non-Methane Organic Gases" (or "NMOG") means the total mass of oxygenated and non-oxygenated hydrocarbon emissions.

(2) "LEV" means low-emission vehicle.
"ULEV" means ultra-low-emission vehicle.
"SULEV" means super ultra-low-emission vehicle.
"ZEV" means zero-emission vehicle.

(2.1) a. The Executive Officer shall certify as ZEVs vehicles that produce zero exhaust emissions of any criteria pollutant (or precursor pollutant) under any and all possible operational modes and conditions. Incorporation of a fuel fired heater shall not preclude a vehicle from being certified as a ZEV provided the fuel fired heater cannot be operated at ambient temperatures above 40°F and the heater is demonstrated to have zero evaporative emissions under any and all possible operational modes and conditions.

b. Prior to the 2003 model year a manufacturer that voluntarily produces vehicles that meet the ZEV emission standards applicable to 2003 and subsequent model year vehicles may certify those vehicles as ZEVs for the purposes of calculating ZEV credits under section (g)(2), note (9)a. and (9)e.

(3) **Compliance with NMOG Standards.** To determine compliance with an NMOG standard, NMOG emissions shall be measured in accordance with "California Non-Methane Organic Gas Test Procedures" adopted July 12, 1991 and last amended June 24, 1996.

a. **Reactivity Adjustment.** For LEVs and ULEVs certified to operate on an available fuel other than conventional gasoline, including fuel-flexible or dual-fuel vehicles when certifying on a fuel other than gasoline, manufacturers shall multiply the NMOG exhaust certification levels by the applicable reactivity adjustment factor set forth in Section 13 of these test procedures or established by the Executive Officer pursuant to Appendix VIII of these test procedures. In addition, natural gas vehicles certifying to LEV or ULEV standards shall calculate a reactivity-adjusted methane exhaust emission value by multiplying the methane exhaust certification level by the applicable methane reactivity adjustment factor set forth in section 13 of these test procedures. The product of the exhaust NMOG certification levels and the reactivity adjustment factor shall be compared

to the exhaust NMOG mass emission standard established for the particular vehicle emission category to determine compliance. For natural gas vehicles, the reactivity-adjusted NMOG value shall be added to the reactivity-adjusted methane value and then compared to the exhaust NMOG mass emission standards established for the particular vehicle emission category to determine compliance.

b. **Pre-1998 NOx standards.** Prior to the 1998 model year, the 50,000 mile and 120,000 mile LEV exhaust mass emission standards for NOx shall be: 0.7 and 1.0 g/mi for MDVs from 3751-5750 lbs. TW, 1.1 and 1.5 g/mi for MDVs from 5751-8500 lbs. TW, 1.3 and 1.8 g/mi for MDVs from 8501-10,000 lbs. TW, and 2.0 and 2.8 g/mi for MDVs from 10,001-14,000 lbs. TW, respectively.

(4) **NMOG Standards for Fuel-Flexible and Dual-Fuel Vehicles.** Fuel-flexible and dual-fuel "Medium-Duty Vehicles" (or "MDVs") from 0-14,000 lbs. TW shall be certified to exhaust mass emission standards for NMOG established for the operation of the vehicle on a fuel other than gasoline, and gasoline.

a. **Reactivity Adjustment.** For LEVs and ULEVs when certifying on the fuel other than gasoline, manufacturers shall multiply the exhaust NMOG certification levels by the applicable reactivity adjustment factor. In addition to multiplying the exhaust NMOG certification levels by the applicable reactivity adjustment factor, the exhaust methane certification level for natural gas vehicles shall be multiplied by the applicable methane reactivity adjustment factor and the resulting value shall be added to the reactivity-adjusted NMOG value. When certifying on gasoline, the exhaust NMOG certification levels of fuel-flexible and dual-fuel vehicles shall not be multiplied by a reactivity adjustment factor.

b. **Standards for Fuel-Flexible and Dual-Fuel Vehicles Operating on Gasoline.** For MDVs from 0-14,000 lbs. TW, the applicable exhaust mass emission standard for NMOG when certifying the vehicle for operation on gasoline shall be:

Test Weight (lbs.)	Vehicle Emission Category	Durability Vehicle Basis	
		50,000 (g/mi)	120,000 (g/mi)
0-3750	LEV	0.25	0.36
	ULEV	0.125	0.180
3751-5750	LEV	0.32	0.46
	ULEV	0.160	0.230
	SULEV	0.100	0.143
5751-8500	LEV	0.39	0.56
	ULEV	0.195	0.280
	SULEV	0.117	0.167
8501-10,000	LEV	0.46	0.66
	ULEV	0.230	0.330
	SULEV	0.138	0.197
10,001-14,000	LEV	0.60	0.86
	ULEV	0.300	0.430
	SULEV	0.180	0.257

(5) **Highway NOx.** The maximum projected emissions of Oxides of Nitrogen (or "NOx") measured on the federal Highway Fuel Economy Test (HWFET; 40 CFR Part 600 Subpart B) shall not be greater than 2.00 times the applicable MDV standards shown in the table. Both the projected emissions and the HWFET standard shall be rounded in accordance with ASTM E29-67 to the nearest 0.1 g/mi before being compared.

(6) Particulate standards are only applicable for diesel vehicles and shall be determined on a 120,000 mile basis.

(7) "n/a" means not applicable.

(8) **Certification of Incomplete and Diesel Vehicles.** Manufacturers have the option of certifying engines used in incomplete and diesel MDVs to the heavy-duty engine standards and test procedures set forth in Section 1956.8(g) or (h) Title 13, California Code of Regulations. Manufacturers certifying incomplete or diesel MDVs to the heavy-duty

engine standards and test procedures shall specify in the application for certification an in-use compliance procedure as provided in Section 2139(c), Title 13, California Code of Regulations. For diesel vehicles certifying to NMOG standards set forth in section 3.j of these test procedures, "NMOG" shall mean non-methane hydrocarbons.

(9) **Intermediate In-Use Compliance Standards.** The following intermediate in-use compliance standards for 50,000 miles and 120,000 miles for MDVs from 3751-14,000 lbs. TW, including fuel-flexible and dual-fuel vehicles when operating on an available fuel other than gasoline, shall apply for the specified model years only.

Intermediate In-Use Compliance Standards*
(in grams per mile)

Emission Category	Model Year	Durability Vehicle Basis (mi)	3751-5750 lbs.		5751 - 8500 lbs.		8501-10,000 lbs.		10,001-14,000 lbs.	
			NMOG	NOx	NMOG	NOx	NMOG	NOx	NMOG	NOx
LEV	through 1997	50,000	0.238	0.7	0.293	1.1	0.345	1.3	0.450	2.0
	1998-1999	50,000	0.238	0.6	0.293	0.9	0.345	1.0	0.450	1.5
	2000	50,000	--	0.6	--	0.9	--	1.0	--	1.5
	2000	120,000	--	0.8	--	1.2	--	1.3	--	2.0
ULEV	through 1999	50,000	0.128	0.6	0.156	0.9	0.184	1.0	0.240	1.5
	2000	50,000	0.128	0.6	0.156	0.9	0.184	1.0	0.240	1.5
	2000	120,000	0.160	0.8	0.195	1.2	0.230	1.3	0.300	2.0
	2001-2002	50,000	0.128	--	0.156	--	0.184	--	0.240	--
	2001-2002	120,000	0.160	--	0.195	--	0.230	--	0.300	--
SULEV	through 2002	50,000	0.072	0.3	0.084	0.45	0.100	0.5	0.130	0.7
	2002	120,000	0.100	0.4	0.117	0.6	0.138	0.65	0.180	1.0

In-use compliance with standards beyond 50,000 miles shall be waived through the 1999 model year for LEVs and ULEVs and through the 2001 model year for SULEVs.

* Dashes mean that the standard in the section 3.j. table applies.

a. **Reactivity Adjustment.** For LEVs and ULEVs designed to operate on an available fuel other than conventional gasoline, including fuel-flexible and dual-fuel vehicles when operating on an available fuel other than gasoline, NMOG exhaust mass

emission results shall be multiplied by the applicable reactivity adjustment factor to determine compliance with intermediate in-use compliance standards for NMOG. In addition to multiplying the exhaust NMOG mass emission levels by the applicable reactivity adjustment factor, natural gas vehicles shall multiply the exhaust methane mass emission results by the applicable methane reactivity adjustment factor and add that value to the reactivity-adjusted NMOG value. For fuel-flexible and dual-fuel vehicles when operating on gasoline, NMOG emission results shall not be multiplied by a reactivity adjustment factor.

b. **Gasoline Standards for Fuel-Flexible and Dual-Fuel Vehicles.** For fuel-flexible and dual-fuel MDVs from 0-14,000 lbs. TW, intermediate in-use compliance standards for NMOG emissions at 50,000 miles, when the vehicle is operated on gasoline, shall be:

Fuel-Flexible and Dual-Fuel MDVs
Intermediate In-Use Compliance Standards

Test Weight (lbs.)	Vehicle Emission Category	50,000 (g/mi)
0-3750	LEV	0.32
	ULEV	0.188
3751-5750	LEV	0.41
	ULEV	0.238
	SULEV	0.128
5751-8500	LEV	0.49
	ULEV	0.293
	SULEV	0.156
8501-10,000	LEV	0.58
	ULEV	0.345
	SULEV	0.184
10,001-14,000	LEV	0.75
	ULEV	0.450
	SULEV	0.240

Intermediate in-use compliance standards shall to apply to LEVs and ULEVs through the 1999 model year and to SULEVs through the 2001 model year. Compliance with the standards beyond 50,000 miles shall be waived through the 1999 model year for LEVs and ULEVs and through the 2001 model year for SULEVs.

(10) **Medium-Duty Vehicle Phase-In Requirements.** Each manufacturer's MDV fleet shall be defined as the total number of California certified MDVs from 0-14,000 lbs. TW produced and delivered for sale in California.

a. Manufacturers of MDVs shall certify an equivalent percentage of their MDV fleet according to the following phase-in schedule:

Model Year	Vehicles Certified to Title 13 CCR Section 1960.1(h)(1) and(2) (%)			Vehicles Certified to Title 13 CCR Section 1956.8(g) or (h) (%)		
	Tier 1	LEV	ULEV	Tier 1	LEV	ULEV
1998	73	25	2	100	0	0
1999	48	50	2	100	0	0
2000	23	75	2	100	0	0
2001	0	80	20	100	0	0
2002	0	70	30	0	100	0
2003	0	60	40	0	100	0
2004 +	0	60	40	0	0	100

c. The percentages shall be applied to the manufacturers' total production of California-certified medium-duty vehicles delivered for sale in California.

d. These requirements shall not apply to small volume manufacturers. Small volume manufacturers shall comply with the requirements of note (16) below.

(11) For the purpose of calculating "Vehicle Equivalent Credits" (or "VECs"), vehicles which have no tailpipe emissions but use fuel fired heaters and which are not certified as ZEVs shall be treated as Type A Hybrid Electric Vehicle Ultra-Low-Emission Vehicles (or "Type A HEV ULEVs").

(12) **Calculation of Vehicle Equivalent Credits.** In 1992 and subsequent model years, manufacturers that produce and deliver for sale in California MDVs in excess of the equivalent requirements for LEVs and/or ULEVs certified to the exhaust emission standards set forth in Title 13, CCR, Sections 1960.1(h)(2) or 1956.8(h), shall receive "Vehicle-Equivalent Credits" (or "VECs") calculated in accordance with the following equation, where the term "Produced" means produced and delivered for sale in California:

{[(No. of LEVs Produced excluding HEVs) + (No. of "Type C HEV" LEVs Produced)] +
[(No. of "Type A HEV" LEVs Produced) x (1.2)] +
[(No of "Type B HEV" LEVs Produced) x (1.1)] -
(Equivalent No. of LEVs Required to be Produced)} +

{(1.4) x [(No. of ULEVs Produced excluding HEVs) + (No. of "Type C HEV" ULEVs Produced)] +
[(1.7) x (No. of "Type A HEV" ULEVs Produced)] +
[(1.5) x (No. of "Type B HEV" ULEVs Produced)] -
[(1.4) x (Equivalent No. of ULEVs Required to be Produced)]} +
{[(1.7) x [(No. of SULEVs Produced excluding HEVs) + (No. of "Type C HEV" SULEVs Produced)] +
[(No. of "Type A HEV" SULEVs Produced) x (1.7)] +
[(No. of "Type B HEV" SULEVs) x (1.5)] -
[(1.7) x [(Equivalent No. of SULEVs Required to be Produced)]} +
[(2.0) x (No. of ZEVs Certified and Produced as MDVs)].

a. Manufacturers that fail to produce and deliver for sale in California the equivalent quantity of MDVs certified to LEV and/or ULEV exhaust emission standards, shall receive "Vehicle-Equivalent Debits" (or "VEDs") equal to the amount of negative VECs determined by the aforementioned equation.

b. Manufacturers shall equalize emission debits within one model year by earning VECs in an amount equal to their previous model-year's total of VEDs, or by submitting a commensurate amount of VECs to the Executive Officer that were earned previously or acquired from another manufacturer. Any manufacturer which fails to equalize emission debits within the specified time period shall be subject to the Health and Safety Code civil penalty applicable to a manufacturer which sells a new motor vehicle that does not meet the applicable emission standards adopted by the state board. The cause of action shall be deemed to accrue when the emission debits are not equalized by the end of the specified time period. For the purposes of Health and Safety Code section 43211, the number of vehicles not meeting the state board's emission standards shall be equal to the amount of VEDs incurred.

c. The VECs earned in any given model year shall retain full value through the subsequent model year.

d. The value of any VECs not used to equalize the previous model-year's debit, shall be discounted by 50% at the beginning of second model year after being earned, discounted to 25% of its original value if not used by the beginning of the third model year after being earned, and will have no value if not used by the beginning of the fourth model year after being earned.

e. Any VECs earned prior to the 1998 model year shall be treated as earned in the 1998 model year and discounted in accordance with the schedule specified in note (12)(d).

f. Only ZEVs certified as MDVs shall be included in the calculation of VECs.

g. In order to verify the status of a manufacturer's compliance with the phase-in requirements of this section and in order to confirm the accrual of VECs or VEDs, each manufacturer shall submit an annual report to the Executive Officer which sets forth the production data used to establish compliance by no later than March 1 of the calendar year following the close of the model year.

(13) **50° F Requirement.** Manufacturers shall demonstrate compliance with the above standards for NMOG, carbon monoxide, and oxides of nitrogen at 50°F, according to the procedure specified in Section 11k of these test procedures. Hybrid electric, natural gas and diesel-fueled vehicles are exempt from 50°F test requirements.

(14) In-use compliance testing shall be limited to vehicles with fewer than 90,000 miles.

(15) **HEV Requirements.** Deterioration factors for hybrid electric vehicles shall be based on the emissions and mileage accumulation of the auxiliary power unit. For certification purposes only, Type A hybrid electric vehicles shall demonstrate compliance with 50,000 mile emission standards (using 50,000 mile deterioration factors), and demonstrating compliance with 120,000 mile emission standards shall not be required. For certification purposes only, Type B hybrid electric vehicles shall demonstrate compliance with 50,000 mile emission standards (using 50,000 mile deterioration factors) and 120,000 mile emission standards (using 90,000 mile deterioration factors). For certification purposes only, Type C hybrid electric vehicles shall demonstrate compliance with 50,000 mile emission standards (using 50,000 mile deterioration factors) and 120,000 mile emission standards (using 120,000 mile deterioration factors).

(16) **Requirements for Small Volume Manufacturers.** As used in this subsection, the term "small volume manufacturer" shall mean any vehicle manufacturer with California sales less than or equal to 3000 new PCS, LDTs, and MDVs per model year based on the average number of vehicles sold by the manufacturer each model year from 1992 to 1994, except as otherwise noted below. For manufacturers certifying for the first time in California, model-year sales shall be based on projected California sales. In 2001 and subsequent model years, small volume manufacturers shall comply with the requirements set forth below.

a. Prior to the model year 2001, small volume manufacturers shall not be required to certify, produce, or deliver LEVs and ULEVs for sale in California.

b. In 2001 and subsequent model years, small volume manufacturers shall certify, produce, and deliver for sale in California LEVs in a quantity equivalent to 100% of their MDV fleet.

c. If a manufacturer's average California sales exceeds 3000 units of new PCs, LDTs, and MDVs based on the average number of vehicles sold for any three consecutive model years, the manufacturer shall no longer be treated as a small volume manufacturer and shall comply with the LEV and ULEV requirements applicable for larger manufacturers as specified in this subsection beginning with the fourth model year after the last of the three consecutive model years.

d. If a manufacturer's average California sales falls below 3000 units of new PCs, LDTs, and MDVs based on the average number of vehicles sold for any three consecutive model years, the manufacturer shall be treated as a small volume manufacturer and shall be subject to requirements for small volume manufacturers as specified in this subsection beginning with the next model year.

k. The cold temperature exhaust carbon monoxide emission levels from new 1996 and subsequent model-year passenger cars, light-duty trucks, and medium-duty vehicles shall not exceed:

1996 AND SUBSEQUENT MODEL-YEAR COLD TEMPERATURE CARBON MONOXIDE EXHAUST EMISSIONS STANDARDS FOR PASSENGER CARS, LIGHT-DUTY TRUCKS, AND MEDIUM-DUTY VEHICLES[1,2]
(grams per mile)

Vehicle Type	Loaded Vehicle Weight (lbs.)	Durability Vehicle Basis (mi)	Carbon Monoxide
Passenger Car	All	50,000	10.0
Light-Duty Truck	0-3750	50,000	10.0
Light-Duty Truck	3751-5750	50,000	12.5
Medium-Duty Vehicle	0-3750	50,000	10.0
Medium-Duty Vehicle	3751-8500[3]	50,000	12.5

(1) These standards are applicable to vehicles tested in accordance with 40 CFR Part 86 Subpart C, at a nominal temperature of 20°F (-7°C).

(2) Natural gas vehicles, diesel-fueled vehicles, hybrid electric vehicles, and zero-emission vehicles are exempt from these standards.

(3) Medium-duty vehicles with a gross vehicle weight rating greater than 8,500 lbs. are exempt from this standard.

4. Initial Requirements

a. Application for Certification

In paragraph 86.088-21, 86.090-21, 86.091-21, and 86.094-21:

1. Amend subparagraph (b)(1)(i) to read:

(i) Identification and description of the vehicles (or engines) covered by the application and a description (including a list and part numbers of all major emission control system parts and fuel system components) of their engine (vehicles only) emission control system and fuel system components, including if applicable, the turbocharger and intercooler. This shall include a detailed description of each auxiliary emission control device (AECD) to be installed in or on any certification test vehicle (or certification test engine).

2. Amend subparagraph (b)(2) to read:

(2) For 1992 and subsequent model-year TLEVs, LEVs, and ULEVs not certified exclusively on gasoline, projected California sales data and fuel economy data 19 months prior to January 1 of the calendar year with the same numerical designation as the model year for which the vehicles are certified, and projected California sales data for all vehicles, regardless of operating fuel or vehicle emission category, sufficient to enable the Executive Officer to select a test fleet representative of the vehicles (or engines) for which certification is requested at the time of certification.

3. Add subparagraph (g) which reads:

(1) For ZEVs and hybrid electric vehicles, the certification application shall include the following:

(i) Identification and description of the vehicle(s) covered by the application.

(ii) Identification of the vehicle weight category to which the vehicle is certifying: PC, LDT 0-3750 lbs. LVW, LDT 3751-5750 lbs. LVW, or MDV (state test weight range), and the curb weight and gross vehicle weight rating of the vehicle.

(iii) Identification and description of the propulsion system for the vehicle.

(iv) Identification and description of the climate control system used on the vehicle.

(v) Projected number of vehicles produced and delivered for sale in California, and projected California sales.

(vi) For electric and hybrid electric vehicles, identification of the energy usage in kilowatt-hours per mile from the point when electricity is introduced from the electrical outlet and the operating range in miles of the vehicle when tested in accordance with the All-Electric Range Test (see section 9.f. of these test procedures).

(vii) If the vehicle is equipped with a fuel fired heater, a description of the control system logic of the fuel fired heater, including an evaluation of the conditions under which the fuel fired heater can be operated and an evaluation of the possible operational modes and conditions under which evaporative emissions can exist. Vehicles which utilize fuel fired heaters which can be operated at ambient temperatures above 40° F or which cannot be demonstrated to have zero evaporative emissions under any and all possible operation modes and conditions shall not be certified as ZEVs.

For ZEVs and HEVs which use fuel fired heaters, the manufacturer shall provide the exhaust emissions value per mile produced by the auxiliary fuel fired heater. This shall be accomplished by determining heater emissions in grams per minute when operating at a maximum heating capacity for a period of 20 minutes, and multiplying that number by 3.6 minutes per mile. At the time of certification, manufacturers shall submit their test plan which describes the procedure used to determine the mass emissions of the fuel fired heater.

(viii) All information necessary for proper and safe operation of the vehicle, including information on the safe handling of the battery system, emergency procedures to follow in the event of battery leakage or other malfunctions that may affect the safety of the vehicle operator or laboratory personnel, method for determining battery state-of-charge, battery charging capacity and recharging procedures, and any other relevant information as determined by the Executive Officer.

In paragraph 86.088-21 and 86.090-21:

4. Amend subparagraph (b)(4)(iii)(C)(1) and (C)(2) to read:

(1) A statement of maintenance and procedures consistent with the restrictions imposed under subparagraph 86.085-25(a)(1), necessary to assure that the vehicles (or engines) covered by a certificate of conformity in operation in normal use to conform to the regulations, and a description of the program for training of personnel for such maintenance, and the equipment required.

(2) A statement that the vehicles sold comply with the California high-altitude emission requirements as specified in Section 11.b. (High Altitude Requirements) in these procedures.

b. Required Data

In paragraph 86.085-23, 86.087-23, 86.088-23, 86.091-23, and 86.094-23:

1. Amend (c)(1) by adding the following paragraph which reads:

For all TLEVs, LEVs, and ULEVs certifying on a fuel other than conventional gasoline, manufacturers shall multiply the NMOG exhaust certification level for each emission-data vehicle by the appropriate reactivity adjustment factor listed in Section 13.a. of these test procedures or established by the Executive Officer pursuant to Appendix VIII of these test procedures to demonstrate compliance with the applicable NMOG emission standard. For all TLEVs, LEVs, and ULEVs certifying on natural gas, manufacturers shall multiply the NMOG exhaust certification level for each emission-data vehicle by the appropriate reactivity adjustment factor listed in Section 13.a. of these test procedures or established by the Executive Officer pursuant to Appendix VIII of these test procedures and add that value to the product of the methane exhaust certification level for each emission-data vehicle and the appropriate methane reactivity adjustment factor listed in Section 13.a. of these test procedures or established by the Executive Officer pursuant to Appendix VIII of these test procedures to demonstrate compliance with the applicable NMOG emission standard. Manufacturers requesting to certify to existing standards utilizing an adjustment factor unique to its vehicle/fuel system must follow the data requirements described in Appendix VIII of these test procedures. A separate formaldehyde exhaust certification level shall also be provided for demonstrating compliance with emission standards for formaldehyde.

c. Test Vehicles and Test Engines; Assigned Deterioration Factors (DFs)

In paragraphs 86.085-24, 86.090-24, 86.092-24, 86.094.24 and 86.095-24:

1. Amend subparagraph (a)(1) by adding the following additional statement:

(a)(1) The vehicles or engines covered by an application for certification will be divided into groupings of engines which are expected to have similar emission characteristics throughout their useful life. Each group of engines with similar emission characteristics shall be defined as a separate engine family. For 1995 and subsequent model-year vehicles or engines, all engines classified in the same engine family shall be certified to identical exhaust emission standards.

2. Delete subparagraph (b) (Emission-data vehicle selection provisions)

REPLACE WITH:

(b) Emission-data vehicles shall be selected according to the provisions of Appendix II. Selection shall be based on highest sales volume and will require only two emission-data vehicles for certification testing per engine family. (For fifty-state families, the reference in the federal procedures to configuration or sales shall mean California configurations and sales rather than total family configurations and sales.) The Executive Officer will accept data from California (or fifty-state) configuration vehicles or from federal vehicles which meet the requirements of subparagraph 4.c.5. Federal vehicles may be reconfigured to California versions and tested to show compliance with California emission standards. The Executive Officer will also allow the manufacturer to reconfigure California vehicles.

3. Delete subparagraph (e)(1) (Reduced number of test vehicles)

REPLACE WITH:

(1) Any manufacturer whose projected California annual sales for the model year in which certification is sought is less than a combined total of 3,000 passenger cars, light-duty trucks, medium-duty vehicles, and heavy-duty engines may request a reduction in the number of test vehicles determined in accordance with the foregoing provisions of this paragraph. The Executive Officer may agree to such lesser numbers as he or she determines would meet the objectives of this procedure.

4. Delete subparagraph (e)(2) (Assigned deterioration factors)

REPLACE WITH:

(2)(i) Any manufacturer may request to certify engine families using assigned DFs for a combined total of 3,000 projected annual California sales of passenger cars, light-duty trucks, medium-duty vehicles, and heavy-duty engines per manufacturer regardless of total sales.

(2)(ii) Assigned DFs shall be used only where specific mileage accumulation data do not exist (i.e., if a vehicle manufacturer uses an engine/system combination where DFs derived from exhaust emission testing exist, then the assigned factors cannot be used).

Assigned DFs shall be used in lieu of data from durability vehicle(s) only when a manufacturer demonstrates that it has control over design specifications, can provide development data, has in-house testing capabilities including accelerated aging of components/systems, and has evaluation criteria to ensure emission control system (ECS) durability for the vehicle's useful life. The applying manufacturer must demonstrate engine durability and that the emission control system(s) developed or adapted for the particular engine will be durable and comply with the applicable emission standards for the engine's or vehicle's useful life. In evaluating any information provided, all relevant test data and design factors shall be considered, including but not limited to: vehicle application, engine design, catalyst loading and volume, space velocity in the catalyst, engine exhaust gas concentrations and catalyst temperatures for various operating modes, and the durability of any emission control system components which may have been used in other vehicle applications. The assigned DFs shall be applied only to entire families.

If emission control parts from other certified vehicles are utilized, then parameter comparisons of the above data must also be provided including part numbers where applicable. Emission control durability may include special in-house specifications.

(2)(iii) The criteria for evaluating assigned DFs for evaporative families are the same as those for exhaust families. However, in determining evaporative family DFs the "California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles" require that an evaporative family DF be determined by averaging DFs obtained from durability vehicle testing and from bench testing. Therefore, if a manufacturer meets the criteria as specified above in (e)(2)(i) and (e)(2)(ii), the Executive Officer may grant assigned DFs for either (or both) the durability vehicle DF or the bench DF.

Assigned DFs for bench test requirements do not depend upon the 3,000 maximum sales limit. The assigned bench DF is applicable only to evaporative emission control systems which are similar to those used by the manufacturer for 1980 or later model-year vehicles and where an evaporative vehicle DF was determined. In evaluating a request for an assigned bench DF, all relevant information shall be considered, including but not limited to: fuel tank capacity, fuel tank temperatures, carburetor bowl "capacity", underhood temperatures, canister capacity and location, and any other comparisons to the certified application.

5. Amend subparagraph (f) and (h)(1)(v) by adding the following additional requirement which reads:

The durability or emission data submitted may be from vehicles previously certified by ARB. For 1993 through 1996 model-year passenger cars and light-duty trucks and 1995 through 1997 model-year medium-duty vehicles, the manufacturer shall submit durability data from only California (or fifty-state) configuration vehicles unless the durability data was generated from a vehicle certified by EPA or ARB prior to the 1993 model year (1995 for medium-duty vehicles). For 1997 (2001 for medium-duty vehicles) and subsequent model-year vehicles, durability data shall be submitted from only California (or fifty-state) configuration vehicles. For 1993 and (1995 for medium-duty vehicles) subsequent model-year vehicles, the Executive Officer shall permit the use of federal durability data vehicles if he or she determines that the federal data will adequately represent the durability characteristics of the California configuration. This determination shall be based upon similarity of catalyst location and configuration; similarity of fuel metering system; similarity of major features of emission control system logic and design; and similarity of any other features determined by the Executive Officer to be likely to affect durability. If data from a federal durability data vehicle is used, the requirements of subparagraph 6.b.5. (durability vehicles must meet emission standards) will refer to the federal emissions standards in effect for the model year for which the durability data was generated.

For the 1998 through 2000 model years, the Executive Officer shall allow the use of durability data for medium-duty vehicles certifying to the LEV standards as set forth in section 3.j. of these test procedures submitted from California only, federal, or fifty-state durability vehicles which line cross applicable NOx standards. This provision shall also be applicable to durability data generated using a federal or California alternate durability program. Medium-duty vehicles certifying to the optional heavy-duty engine standards as set forth in Title 13, CCR Section 1956.8(h) shall not be eligible for this NOx line-crossing exemption.

d. Compliance with the Inspection and Maintenance Program

All 1993 and subsequent model-year emission-data vehicles shall be required to be tail-pipe tested at 4,000 miles and demonstrate compliance with the California Inspection and Maintenance emission standards in place at the time of certification as specified in the "Mandatory Exhaust Emissions Inspection Standards and Test Procedures", Title 16, California Code of Regulations, Section 3340.42. Test vehicles shall undergo preconditioning procedures prior to the tail-pipe test which consist of idle conditions for a minimum period of ten minutes after the thermostat is open. Preconditioning and test procedures shall be conducted at an ambient temperature from 68° to 86° F. The manufacturer shall, in accordance with good engineering practice, attest that such test vehicles will meet the requirements of this section when preconditioned and tested at ambient temperatures from 35° to 68° F.

5. Maintenance Requirements

a. Maintenance[1]

Delete paragraph 86.090-25.
Delete paragraph 86.088-25.
Delete paragraph 86.087-25.

In paragraph 86.085-25:

1. Amend the title and first sentence of subparagraph (a) to read:

(a) Light-duty vehicles. Paragraph (a) of this section applies to passenger cars, light-duty trucks, and medium-duty vehicles.

2. Amend subparagraph (a)(1) to read:

(1) Scheduled maintenance on the engine, emission control system, and fuel system of durability vehicles shall, unless otherwise provided pursuant to paragraph (a)(5)(iii), be restricted as set forth in the following provisions. If a manufacturer must revise the maintenance schedule, prior approval by the Executive Officer is required. Unscheduled maintenance must not render a durability vehicle nonrepresentative of the production vehicles. The unscheduled maintenance must not be likely to be required in the normal use of the vehicle. Unauthorized or unjustifiable unscheduled maintenance may be cause for disqualification of a durability vehicle.

Manufacturers must submit durability maintenance logs to the Executive Officer. The maintenance logs shall include the mileage where maintenance occurred, the nature of the maintenance, and the name and part numbers of all fuel system and emission control parts involved with the maintenance. Manufacturers of series hybrid electric vehicles and parallel hybrid electric vehicles shall be required to incorporate into the vehicles a separate odometer or other device subject to the approval of the Executive Officer which can accurately gauge the mileage accumulation on the engines which are used in these vehicles.

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[1] These requirements are for vehicles certified to the primary 50,000 mile and 100,000 or 120,000 mile standards. Requirements for the vehicles certified to the optional 100,000 mile standards are found in section 10 (Optional 100,000 Mile Certification Procedure) of these procedures.

(i)(A) For Otto-cycle vehicles and hybrid electric vehicles which use Otto-cycle engines, maintenance shall be restricted to the inspection, replacement, cleaning, adjustment, and/or service of the following items at intervals no more frequent than indicated:

(1) Drive belts on engine accessories (tension adjustment only); (30,000 miles of engine operation).

(2) Valve lash (15,000 miles of engine operation).

(3) Spark plugs (30,000 miles of engine operation).

(4) Air filter (30,000 miles of engine operation).

(5) Exhaust gas sensor (30,000 miles of engine operation). Provided that:

(a) the manufacturer shall equip the vehicle with a maintenance indicator consisting of a light or flag, which shall be preset to activate automatically by illuminating in the case of a light or by covering the odometer in the case of a flag the first time the minimum maintenance interval established during certification testing is reached and which shall remain activated until reset. After resetting, the maintenance indicator shall activate automatically when the minimum maintenance interval, when added to the vehicle mileage at the time of resetting, is again reached and shall again remain activated until reset. When the maintenance indicator consists of a light, it shall also activate automatically in the engine-run key position before engine cranking to indicate that it is functioning. The maintenance indicator shall be located in the instrument panel and shall, when activated, display the words "oxygen sensor" or may display such other words determined by the Executive Officer to be likely to cause the vehicle owner to seek oxygen sensor replacement. The maintenance indicator shall be separate from the malfunction indicator light required by Section 1968, Title 13, California Code of Regulations;

(b) the manufacturer shall provide free replacement of the oxygen sensor, including both parts and labor, and shall reset the maintenance indicator without any charge, the first time the maintenance interval established during certification testing is reached for vehicles certified with scheduled sensor maintenance before 50,000 miles. If the oxygen sensor is replaced pursuant to the warranty provisions of Section 2037, Title 13, California Code of Regulations, before the first maintenance interval is reached, the manufacturer shall also replace the oxygen sensor and reset the maintenance indicator at the mileage point determined by adding the maintenance interval to the vehicle's mileage at the time of the warranty replacement. If the calculated mileage point for a second oxygen sensor replacement would exceed 50,000 miles, no free second replacement shall be required;

(c) The maintenance indicator shall be resettable. The maintenance instructions required by section 5.b. of these procedures shall provide instructions for the resetting of the maintenance indicator, and shall specify that the maintenance indicator shall be reset each time the oxygen sensor is replaced; and

(d) Notwithstanding the provisions of Section 2037(c), Title 13, California Code of Regulations; the oxygen sensor, including any replacement required pursuant to this section, shall be warranted for the applicable warranty period of the vehicle or engine in accordance with Section 2037(a), Title 13, California Code of Regulations. If such oxygen sensor fails during this period, it shall be replaced by the manufacturer in accordance with Section 2037(d), Title 13, California Code of Regulations.

(6) Choke (cleaning or lubrication only); (30,000 miles of engine operation).

(7) Positive crankcase ventilation valve (50,000 miles of engine operation).

(8) Ignition wires (50,000 miles of engine operation).

(9) In addition, adjustment of the engine idle speed (curb idle and fast idle), valve lash, and engine bolt torque may be performed once during the first 5,000 miles of scheduled driving, provided the manufacturer makes a satisfactory showing that the maintenance will be performed on vehicles in use. For hybrid electric vehicles, these adjustments may only be performed once during the first 5,000 miles of engine operation.

(10) Hybrid electric vehicle battery system (manufacturer's established performance limits). Provided that:

(a) The manufacturer shall equip the vehicle with a maintenance indicator consisting of a light which shall activate automatically by illuminating the first time the minimum performance level is observed for all battery system components. Possible battery system components requiring monitoring are:

i. battery water level
ii. temperature control
iii. pressure control
iv. other parameters critical for determining battery condition

(b) The manufacturer shall equip the vehicle with a useful life indicator for the battery system consisting of a light which shall illuminate the first time the battery system is unable to achieve an all-electric operating range (starting from a full state-of-charge) which is at least 75% of the range determined for the vehicle in the All-Electric Range-Urban (see section 9.f.(2)(a) of these test procedures) and submitted in the certification application.

(i)(B) For diesel vehicles and hybrid electric vehicles which use diesel engines, maintenance shall be restricted to the following items at intervals no more frequently than every 12,500 miles of engine operation, provided that no maintenance may be performed within 5,000 miles of the final test point:

(1) Adjust low idle speed.
(2) Adjust valve lash if required.
(3) Adjust injector timing.

(4) Adjust governor.
(5) Clean and service injector tips.
(6) Adjust drive belt tension on engine accessories.
(7) Check engine bolt torque and tighten as required.
(8) Hybrid electric vehicle battery system. Manufacturers shall maintain the battery system according to the requirements in section 5.a.(2)(i)(A)(10) of these test procedures.

(ii) Change of engine and transmission oil, change or service of oil filter and, for diesel vehicles only, change or service of fuel filter and air filter, will be allowed at the mileage intervals specified in the manufacturer's maintenance instructions.

(iii) Maintenance shall be conducted in a manner consistent with service instructions and specifications provided by the manufacturer for use by customer service personnel.

3. Delete subparagraph (a)(3) (Service of exhaust gas recirculation system).

4. Delete subparagraph (a)(4) (Service of catalytic converter).

5. Amend subparagraph (a)(5), by adding a new subparagraph (iv) to read:

(iv) When a part has to be replaced while conducting unscheduled maintenance, a similarly aged part shall be used for those parts that affect emissions, unless it is impractical and unnecessary to age a part and prior approval has been obtained from the Executive Officer for use of the part without aging. In either case, an engineering report on the nature of the problem with the probable cause and corrective action shall be supplied to the Executive Officer.

6. Delete subparagraph (b) (Maintenance of light-duty trucks and heavy-duty engines).

b. Maintenance Instructions

Delete paragraph 86.087-38.
In paragraph 86.085-38:

1. Amend subparagraph (a) to read:

(a) The manufacturer shall furnish or cause to be furnished to the purchaser of each new motor vehicle subject to the standards prescribed in Section 3 of these procedures, written instructions for the maintenance and use of the vehicle by the

purchaser as may be reasonable and necessary to assure the proper functioning of emission control systems in normal use. Such instructions shall be consistent with and not require maintenance in excess of the restrictions imposed under subparagraph 86.085-25(a)(1) as amended above, except that the instructions may, subject to approval by the Executive Officer, require additional maintenance for vehicles operated under extreme conditions. In addition, subject to approval by the Executive Officer, the instructions may require inspections necessary to insure safe operation of the vehicle in use.

In addition to any maintenance which may be required pursuant to the preceding paragraph, the instructions may also recommend such inspections, maintenance, and repair as may be reasonable and necessary for the proper functioning of the vehicle and its emission control systems. If the instructions recommend maintenance in addition to that which may be required pursuant to the preceding paragraph, they shall distinguish clearly between required and recommended maintenance.

2. Amend both subparagraphs (c)(1) and (d)(1) to read:

(1) Such instructions shall specify the performance of all scheduled maintenance performed by the manufacturer under subparagraph 86.085-25(a)(1).

c. Submission of Maintenance Instructions

Amend subparagraph 86.079-39(a) to read:

(a) The manufacturer shall provide to the Executive Officer, no later than the time of the submission required by paragraph 86.088-23, 86.091-23, or 86.094-23, a copy of the maintenance instructions which the manufacturer proposes to supply to the ultimate purchaser in accordance with subparagraph 86.085-38(a). The Executive Officer will review such instructions to determine whether they are consistent with California requirements, and to determine whether the instructions for required maintenance are consistent with the restrictions imposed under subparagraph 86.085-25(a)(1). The Executive Officer will notify the manufacturer of his or her determinations.

6. Demonstrating Compliance

a. Mileage and Service Accumulation; Emission Measurements

In paragraphs 86.084-26 and 86.090-26:

1. Amend subparagraph (a)(1) to read:

   (a)(1) Paragraph (a) of this section applies to light-duty vehicles, except ZEVs which shall be exempt from all mileage and service accumulation, durability-data vehicle, and emission-data vehicle testing requirements.

2. Amend (a)(2) to read:

   The procedure for mileage accumulation shall be the Durability Driving Schedule as specified in Appendix IV to Part 86 of the Code of Federal Regulations. A modified procedure may also be used if approved in advance by the Executive Officer. All passenger cars, light-duty trucks, pre-1995 model year medium-duty vehicles, and 1995 model- year vehicles certified to 1994 model-year emission standards shall accumulate mileage at a measured curb weight which is within 100 pounds of the estimated curb weight. All 1995 and subsequent model-year medium-duty vehicles (except those certified to 1994 model-year emission standards) and all 1992 and subsequent medium-duty LEVs, ULEVs, and SULEVs shall accumulate mileage at a loaded weight that is within 100 pounds of the average of the vehicle's curb weight and gross vehicle weight. If the vehicle weight is within 100 pounds of being included in the next higher inertia weight class, the manufacturer may elect to conduct the respective emission tests at the higher weight. All mileage accumulation of hybrid electric vehicles shall be conducted with the battery pack at the manufacturer's indicated lowest state-of-charge at the beginning of the test cycle. At no time throughout mileage accumulation shall the battery pack be charged using any off-board charging source.

3. Amend (a)(3)(i) and (a)(3)(ii) (Emission-data vehicle mileage accumulation) by adding the following additional requirement which reads:

   The Executive Officer will accept the manufacturer's determination of the mileage at which the engine-system combination is stabilized for emission data testing if (prior to testing) a manufacturer determines that the interval chosen yields emissions performance which is stable and representative of design intent. Sufficient mileage should be accumulated to reduce the possible effects of any emissions variability that is the result of insufficient vehicle operation. Of primary

importance in making this determination is the behavior of the catalyst, EGR valve, trap oxidizer or any other part of the ECS which may have non-linear aging characteristics. In the alternative, the manufacturer may elect to accumulate 4,000 mile ± 250 mile on each test vehicle within an engine family without making a determination.

4. Amend (a)(4)(i) and (a)(4)(ii) (Durability-data vehicle mileage accumulation) by adding the following new subparagraphs (A), (B), (C), and (D) to read:

(A) For Otto-cycle and diesel vehicles and battery assisted combustion engine vehicles which use Otto-cycle or diesel engines:

(1) Passenger cars, light-duty trucks and medium-duty vehicles certifying to exhaust emissions standards only on a 50,000 mile durability basis and selected by the Executive Officer or elected by the manufacturer under 86.085-24(c)(1), 86.090-24(c)(1), 86.092-24(c)(1), 86.094-24(c)(1), or 86.095-24(c)(1) shall be driven, with all emission control systems installed and operating, for 50,000 miles or such lesser distance as the Executive Officer may agree to as meeting the objective of this procedure.

(2) Prior to initiation of mileage accumulation in a durability-data vehicle, manufacturers must establish the mileage test interval for durability-data vehicle testing of the engine family. Once testing has begun on a durability-data vehicle, the durability test interval for that family may not be changed. At a minimum, multiple tests must be performed at 5,000 miles, 50,000 miles, and the final mileage point as long as they meet the requirements of Appendix III. The Executive Officer will accept durability test interval schedules determined by the manufacturer. The testing must provide a DF confidence level equal to or better than the confidence level using the former fixed mileage test and scheduled maintenance intervals. The procedure for making this determination is also given in Appendix III. The mileage intervals between test points must be approximately of equal length. The ± 250 mile test point tolerance and the requirement that tests be conducted before and after scheduled maintenance is still mandatory. Emission control systems for Otto-cycle engines which have step function changes designed into the control system must use the 5,000 mile test interval schedule.

(3) Testing before and after scheduled (or unscheduled) maintenance points must be conducted, and these data are to be included in the deterioration factor calculation.[2]

The number of tests before and after scheduled maintenance and the mileage intervals between test points should be approximately equal. Durability test interval schedules with multiple testing at test points within 10,000 miles of or at the 50,000 mile and the final mileage test point must be submitted for approval. Multiple testing at maintenance mileage tests points within 10,000 miles of the 50,000 mile and the final mileage test points may be approved if it can be demonstrated by previously generated data that the emission effects of the maintenance are insignificant.

(4) For engine families which are to be certified to the full useful life emission standards, each exhaust emission durability-data vehicle shall be driven with all emission control systems installed and operating, for the full useful life or such lesser distance as the Executive Officer may agree to as meeting the objective of this procedure. Durability tests shall be at every 5,000 miles, from 5,000 miles to the full useful life, however, the above procedures may be used to determine alternate test intervals subject to the following.

For engine families which are to be certified to the full useful life emission standards, durability vehicles may accumulate less than the full useful life if the manufacturer submits other data or information sufficient to demonstrate that the vehicle is capable of meeting the applicable emission standards for the full useful life. At a minimum, 75% of the full useful life shall be accumulated. For the purpose of conducting mileage accumulation on light-duty hybrid electric vehicles, the full useful life of the auxiliary power unit shall be defined as 50,000 miles for a Type A hybrid electric vehicle, 75,000 miles for a Type B hybrid electric vehicle, and 100,000 miles for a Type C hybrid electric vehicle. For medium-duty hybrid electric vehicles, the full useful life of the auxiliary power unit shall be defined as 60,000 miles for a Type A hybrid electric vehicle, 90,000 miles for a Type B hybrid electric vehicle, and 120,000 miles for a Type C hybrid electric vehicle. Alternative durability plans may also be used if the manufacturer provides a demonstration that the alternative plan provides equal or greater confidence that the vehicles will comply in-use with the emission standards. The demonstration shall include, but not be limited to, bench test data and

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[2] Testing before unscheduled maintenance may be omitted with the prior consent of the Executive Officer when testing would be dangerous to a vehicle or an operator.

engineering data. A manufacturer's in-use emission data may also be used. All alternative durability plans, including the use of durability vehicles which accumulate less than the full useful life are subject to approval in advance by the Executive Officer.

(B) For diesel vehicles equipped with periodically regenerating trap oxidizer systems, at least four regeneration emission tests (see 86.106 through 86.145) shall be made.[3] With the advance approval of the Executive Officer, the manufacturer may install (1) a manual override switch capable of preventing (i.e., delaying until the switch is turned off) the start of the regeneration process and (2) a light which indicates when the system would initiate regeneration if it had no override switch. Upon activation of the override switch the vehicle will be operated on a dynamometer to precondition it for the regeneration emission test in accordance with section 86.132-82 or 86.132-90 and section 9.b. of these procedures. The Urban Dynamometer Driving Schedule (UDDS) which is in progress at the time when the light comes on shall be completed and the vehicle shall proceed to the prescribed soak period followed by testing. With the advance approval of the Executive Officer, the manual override switch will be turned off at some predetermined point in the testing sequence permitting the regeneration process to proceed without further manual interaction. The mileage intervals between test points shall be approximately equal. The first regeneration emission test shall be made at the 5,000 mile point. The regeneration emission tests must provide a deterioration factor confidence level equal to or better than the confidence level achieved by performing regeneration emission tests at the following mileage point: 5,000; 20,000; 35,000; and 50,000. The procedure for making this determination is shown in Appendix IV.

(C) For gasoline-, gaseous-, and alcohol-fueled vehicles, the "California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles," as incorporated in Title 13, California Code of Regulations, Section 1976, specify evaporative durability testing at 5,000, 10,000, 20,000, 30,000, 40,000 and 50,000 mile test points. These requirements are also applicable to hybrid electric vehicles. With the exception of fuel-flexible vehicles, a manufacturer may conduct evaporative testing at test points used for exhaust emission durability testing provided that the same deterioration confidence level for the evaporative emission DF determination is retained (see Appendix III).

(D) For 1993 and 1994 fuel-flexible vehicles which are not certified to TLEV, LEV, or ULEV standards, the test schedule must include exhaust emission tests at 5,000, 10,000, and every 10,000 miles thereafter to the final mileage point using

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3 Included in Appendix V are the pollutant mass emission calculation procedures for vehicles equipped with periodically regenerating trap oxidizer systems.

M85 or E85 for methanol and ethanol fuel-flexible vehicles, respectively. Exhaust emission tests shall also be conducted at 5,000 miles, 50,000 miles, and the final mileage point with certification gasoline. For all 1995 and subsequent fuel-flexible vehicles and all 1992 and subsequent fuel-flexible vehicles certifying to TLEV, LEV, ULEV, or SULEV standards, the test schedule shall include exhaust emission tests at 5,000 miles, 10,000 miles, and every 10,000 miles thereafter to the final mileage point using M85 or E85 and certification gasoline. For all fuel-flexible vehicles, if evaporative emission testing is conducted, exhaust and evaporative emission tests shall also be conducted using M35 or E10, or another approved fuel, at the mileage points where M85 or E85 testing is conducted. The results of these exhaust and evaporative emission tests will be used by the Executive Officer to evaluate the vehicle's emission control deterioration with various fuels (M85, M35, and unleaded gasoline; See Fuel Specifications, Section 9.a. of these procedures). Only the M85 or E85 and certification gasoline exhaust emission results and the M35 or E10 evaporative emission results will be used to determine applicable exhaust and evaporative emission deterioration factors, respectively, as required in Section 6.b. (Compliance with Emission Standards) of these procedures.

(E) The Executive Officer may determine under 86.085-24(f), 86.090-24(f), 86.092-24(f), 86.094-24(f), or 86.095-24(f) that no testing is required.

5. Amend subparagraph (a)(5)(i) by adding the following requirement which reads:

In addition, the emission tests performed on emission-data vehicles and durability-data vehicles shall be non-regeneration emission tests for diesel passenger cars, light-duty trucks, and medium-duty vehicles equipped with periodically regenerating trap oxidizer systems. For any of these vehicles equipped with continually regenerating trap oxidizer systems, manufacturers may use the provisions applicable to periodically regenerating trap oxidizer systems as an option.

If such an option is elected, all references in these procedures to vehicles equipped with periodically regenerating trap oxidizer systems shall be applicable to the vehicles equipped with continually regenerating trap oxidizer systems.

6. Amend subparagraph (a)(8) to read:

(8) Once a manufacturer submits the information required in paragraphs (a)(7) of this section for a durability-data vehicle, the manufacturer shall continue to run the vehicle to 50,000 miles if the family is certified to 50,000 mile emission standards or to the full useful life if it is certified to emission standards beyond 50,000 miles (or to a lesser distance which the Executive Officer may have previously agreed

to), and the data from the vehicle will be used in the calculations under 86.088-28, 86.090-28, and 86.091-28. Discontinuation of a durability-data vehicle shall be allowed only with the consent of the Executive Officer.

7. Delete subparagraph (b) (Emission-data and durability-data mileage accumulation for light duty trucks).

b. Compliance with Emission Standards

In paragraph 86.088-28, 86.090-28, and 86.091-28:

1. Amend subparagraph (a)(1) to read:

(1) Paragraph (a) of this section applies to passenger cars, light-duty trucks and medium-duty vehicles, except ZEVs.

2. Amend Subparagraph (a)(3) to read:

(3) Since it is expected that emission control efficiency will change with mileage accumulation on a vehicle, the emission level of a vehicle which has accumulated 50,000 miles will be used as the basis for determining compliance with the 50,000 mile emission standards.

3. Amend subparagraph (a)(4)(i) to read:

(i) Separate emission deterioration factors shall be determined from the exhaust emission results of the durability-data vehicle(s) for each engine-system combination. A separate factor shall be established for exhaust HC (non-alcohol vehicles, non-TLEVs, non-LEVs, and non-ULEVs), exhaust OMHCE or OMNMHCE (alcohol vehicles that are not TLEVs, LEVs, or ULEVs), exhaust NMOG (all TLEVs, LEVs, ULEVs, and SULEVs), exhaust formaldehyde (alcohol vehicles, TLEVs, LEVs, ULEVs, and SULEVs), exhaust CO, exhaust NOx, and exhaust particulate (diesel vehicles only) for each engine- system combination. A separate evaporative emission deterioration factor shall be determined for each evaporative emission family-evaporative emission control system combination from the testing conducted by the manufacturer (gasoline- and alcohol-fueled vehicles only).

Separate emission correction factors (diesel passenger cars, light-duty trucks, and medium-duty vehicles equipped with periodically regenerating trap oxidizer systems only) shall be determined from the exhaust emission results of the durability-data vehicle(s) for each engine-system combination. A separate factor shall be established for exhaust HC (non-alcohol vehicles, non-TLEVs, non-LEVs,

and non-ULEVs), exhaust OMHCE or OMNMHCE (alcohol vehicles that are not TLEVs, LEVs, or ULEVs), exhaust NMOG (TLEVs, LEVs, ULEVs, and SULEVs), exhaust CO, exhaust NOx, and exhaust particulate for each engine-system combination.

4. Delete subparagraph (a)(4)(i)(A)(4) (Outlier test point procedure).

REPLACE WITH:

(4) The manufacturer must use the California outlier identification procedure entitled "Calculation of t- Statistic for Deterioration Data Outlier Test", dated December 17, 1976 and set forth in Appendix VII, to test for irregular data from a durability-data set. If any data point is identified as a statistical outlier, the Executive Officer shall determine, on the basis of an engineering analysis of the causes of the outlier submitted by the manufacturer, whether the outlier is to be rejected. The outlier shall be rejected only if the Executive Officer determines that the outlier does not reflect representative characteristics of the emission control system i.e., the outlier is a result of an emission control system anomaly, test procedure error, or an extraordinary circumstance not expected to recur. Only the identified outlier shall be eliminated; other data at that test point (i.e., data for other pollutants) shall not be eliminated unless the Executive Officer determines, based on the engineering analysis, that they also do not reflect representative characteristics of the emission control system. Where the manufacturer chooses to apply both the outlier procedure and averaging (as allowed under 86.084-26(b)(6)(i) and 86.090- 26(a)(6)(1) to the same data set, the outlier procedure shall be completed prior to applying the averaging procedure. All durability test data, including any outliers and the manufacturer's engineering analysis, shall be submitted with the final application.

5. Amend subparagraph (a)(4)(i)(B) (durability vehicles must meet emissions standards) to read:

(B) All applicable exhaust emission results shall be plotted as a function of the mileage on the system, rounded to the nearest mile, and the best fit straight lines, fitted by the method of least squares, shall be drawn through all these data points. The emission data will be acceptable for use in the calculation of the deterioration factor only if the interpolated 4,000-mile, 50,000-mile, and full useful life points on this line are within the emission standards given in subparagraph 3. or within the federal emission standards if a federal durability data vehicle is approved in accordance with subparagraph 4.c.5., as applicable. For hybrid electric vehicles, the emission data will be acceptable for use in the calculation of the deterioration factor only if the engine mileage points corresponding to the interpolated 4,000 mile, 50,000 mile, and full useful life points of the vehicle on this line are within the

emission standards given in subparagraph 3. or within the federal emission standards if a federal durability data vehicle is approved in accordance with subparagraph 4.c.5., as applicable. The engine mileage points shall be determined based on the test schedule submitted to the Executive Officer as required in paragraphs 86.084-26 and 86.090-26. As an exception, the Executive Officer will review the data on a case-by-case basis and may approve its use in those instances where the best fit straight line crosses an applicable standard but no data point exceeds the standard or when the best fit straight line crosses the applicable standard at the 4,000-mile point but the 5,000- mile actual test point and the 50,000 mile and full useful life interpolated points are both below the standards. For the 1998 through 2000 model years, the Executive Officer shall allow the use of durability data for medium-duty vehicles certifying to the LEV standards as set forth in section 3.j. of these test procedures submitted from California only, federal or fifty-state durability vehicles which line cross applicable NOx standards. Medium-duty vehicles certifying to the optional heavy-duty engine standards as set forth in Title 13, CCR Section 1956.8(h) shall not be eligible for this NOx line-crossing exemption. A multiplicative exhaust emission deterioration factor shall be calculated for each engine system combination as follows:

(1) For engine families certified to 50,000 mile emissions standards:

Factor = Exhaust emissions interpolated to 50,000 miles divided by exhaust emissions interpolated to 4,000 miles.

(2) For engine families certified to full useful life emissions standards beyond 50,000 miles:

Factor = Exhaust emissions interpolated to the full useful life divided by exhaust emissions interpolated to 4,000 miles.

6. Add subparagraph (a)(4)(i)(D) to read:

(D) The regeneration exhaust emission data (diesel passenger cars, light-duty trucks, and medium-duty vehicles equipped with periodically regenerating trap oxidizer systems only) from the tests required under 86.084-26(a)(4) or 86.090-26(a)(4) shall be used to determine the regeneration exhaust emissions interpolated to the 50,000-mile point. The regeneration exhaust emission results shall be plotted as a function of the mileage on the system, rounded to the nearest mile, and the best fit straight lines, fitted by the method of least squares, shall be drawn through all these data points. The interpolated 50,000-mile point of this line shall be used to calculate the multiplicative exhaust emission correction factor for each engine-system combination as follows:

$$\text{Factor} = 1 + \frac{R-1}{4505} n$$

where, R = the ratio of the regeneration exhaust emissions interpolated to 50,000 miles to the non-regeneration exhaust emissions interpolated to 50,000 miles.

n = the number of complete regenerations which occur during the durability test.

These interpolated values shall be carried out to a minimum of four places to the right of the decimal point before dividing one by the other to determine the correction factor. The results shall be rounded to three places to the right of the decimal point in accordance with ASTM E 29-67. For applicability to gaseous emission standards under the 100,000 mile option, R will be determined based upon projected 100,000 mile emissions.

7. Amend subparagraph (a)(4)(ii)(A) to read:

(A) The official exhaust emission test results for each emission-data vehicle at the 4,000 mile test point shall be multiplied by the appropriate deterioration factor, and correction factor (diesel passenger cars, light-duty trucks, and medium-duty vehicles equipped with periodically regenerating trap oxidizer systems only): Provided: that if a deterioration factor as computed in paragraph (a)(4)(i)(B) of this section or a correction factor as computed in paragraph (a)(4)(i)(D) of this section is less than one, that deterioration factor or correction factor shall be one for the purposes of this paragraph.

8. Amend subparagraph (a)(4)(iii) to read:

(iii) The emissions to compare with the standard (or the family particulate emission limit, as appropriate) shall be the adjusted emissions of paragraphs (a)(4)(ii)(A) and (B) of this section for each emission-data vehicle. Before any emission value is compared with the standard (or the family particulate limit, as appropriate), it shall be rounded, in accordance with ASTM E29-67 to one significant figure beyond the number of significant figures contained in the standard (or the family particulate emission limit, as appropriate). The rounded emission values may not exceed the standard (or the family particulate emission limit, as appropriate). Fleet average NMOG value calculations shall be rounded, in accordance with ASTM E29-67, to four significant figures before comparing with fleet average NMOG requirements.

9. Delete subparagraph (b) (Compliance provisions for light-duty trucks).

c. Prohibition of Defeat Devices

In paragraph 86.094-16:

1. Amend subparagraph (a) to read:

   No new passenger car, light-duty truck, or medium-duty vehicle shall be equipped with a defeat device.

7. Small-Volume Manufacturer's Certification Procedures

a. In paragraphs 86.084-14, 86.090-14, 86.092-14, and 86.095-14:

1. Amend subparagraph (b)(1) to read:

(1) The optional small-volume manufacturers certification procedures apply to light-duty vehicles (passenger cars, light-duty trucks, and medium-duty vehicles), produced by manufacturers with California sales (for the model year in which certification is sought) of fewer than 3,000 units (PC, LDT and MDV combined). The optional small-volume manufacturers certification procedures shall not apply to hybrid electric vehicles. All hybrid electric vehicle manufacturers shall be subject to the certification requirements established for hybrid electric vehicles.

2. Delete subparagraphs (b)(2) through (b)(5) (Determining aggregated sales; aggregated sales provisions for small volume manufacturers).

3. Amend subparagraph (c)(4) to read:

(4) A small-volume manufacturer shall include in its records all of the information that ARB requires in 86.088- 21, 86.090-21, 86.091-21, or 86.094-21, including the modifications noted in Section 4.a. of these test procedures. This information will be considered part of the manufacturer's application for certification and must be submitted to the Executive Officer.

4. Delete subparagraph (c)(7)(i)(A) (Worst-case selection of emission-data vehicles).

5. Amend subparagraph (c)(11)(ii)(D)(1) to show the 3,000 total vehicle sales limit applicable to California for determining a small-volume manufacturer.

8. Alternative Procedures for Notification of Additions and Changes

a. Amend subparagraph 86.082-34(a) by adding the following additional requirements which read:

> A manufacturer must notify the Executive Officer within 10 working days of making an addition of a vehicle to a certified engine family or a change in a vehicle previously covered by certification.

The manufacturer shall also submit, upon request of the Executive Officer, the following items:

(1) service bulletin.
(2) driveability statement.
(3) test log.
(4) maintenance log.

All running changes and field fixes which do not adversely affect the system durability are deemed approved unless disapproved by the Executive Officer within 30 days of the receipt of the running change or field fix request. A change not specifically identified in the manufacturer's application must also be reported to the Executive Officer if the change may adversely affect engine or emission control system durability. Examples of such changes include any change that could affect durability, thermal characteristics , deposit formation, or exhaust product composition, i.e., combustion chamber design, cylinder head material, camshaft profile, computer modifications, turbocharger, intercooler wastegate characteristics, and transmission or torque converter specifications. Running changes and field fixes meeting the definitions contained in Appendix VI shall be automatically deemed approved by the Executive Officer, as long as the conditions set forth in Appendix VI are satisfied.

The manufacturer is required to update and submit to the Executive Officer the "supplemental data sheet" for all running changes and field fixes implemented with the change notification. The manufacturer shall submit, on a monthly basis, by engine family, a list of running changes/field fixes giving the document number date submitted and a brief description of the change.

9. Test Requirements

a. Fuel Specifications

In paragraph 86.113-90, 86.113-91, and 86.113-94:

1. Add subparagraphs (a)(1)(i) and (ii) which read:

(i) For 1992-1994 model-year Otto-cycle vehicles, gasoline having the specifications listed below may be used in exhaust and evaporative emission testing as an option to the specifications referred to in subparagraph (a)(1). If a manufacturer elects to utilize this option, both exhaust and evaporative emission testing shall be conducted by the manufacturer with gasoline having the specifications listed below, and the Executive Officer shall conduct exhaust and evaporative emission testing with gasoline having the specifications listed below.

Research Octane, minimum	93
Sensitivity, minimum	7.5
Lead (organic), maximum, g/US gal	0.050
Distillation Range	
IBP, degrees F	75-100
10 pct. point, degrees F	120-140
50 pct. point, degrees F	200-230
90 pct. point, degrees F	300-325
EP, maximum, degrees F	415
Sulfur, maximum weight pct.	0.03
Phosphorous, maximum, g/US gal	0.005
RVP, psi	7.5-8.0
Hydrocarbon composition	
Olefins, maximum pct.	10
Aromatics, maximum pct.	35
Saturates	remainder

(ii) For 1993-1994 model-year Otto-cycle TLEVs, LEVs, and ULEVs and for all 1995 and subsequent model-year Otto-cycle vehicles, gasoline having the specifications listed below may be used in exhaust and evaporative emission testing as an option to the specifications referred to in subparagraph (a)(1). If a manufacturer elects to utilize this option, both exhaust and evaporative emission testing shall be conducted by the manufacturer with gasoline having the specifications listed below, and the Executive Officer shall conduct exhaust and evaporative emission testing with gasoline having the specifications listed below.

Fuel Property a/	Limit	Test Method b/
Octane, (R+M)/2 (min)	91	D2699-88, D 2700-88
Sensitivity (min)	7.5	D 2699-88, D 2700-88
Lead, g/gal (max) (No lead added)	0-0.01	Title 13 CCR §2253.4(c)
Distillation Range, °F		Title 13 CCR §2263 c/
10 pct. point,	130-150	
50 pct. point,	200-210 d/	
90 pct. point,	290-300 e/	
EP, maximum	390	
Residue, vol% (max)	2.0	
Sulfur, ppm by wt.	30-40	Title 13 CCR §2263
Phosphorous, g/gal (max)	0.005	Title 13 CCR §2253.4(c)
RVP, psi	6.7-7.0	Title 13 CCR §2263
Olefins, vol %	4.0-6.0	Title 13 CCR §2263
Total Aromatic Hydrocarbons (vol%)	22-25	Title 13 CCR §2263
Benzene, vol %	0.8-1.0 f/	Title 13 CCR §2263
Multi-Substituted Alkyl Aromatic Hydrocarbons, vol %	12-14 g/	
MTBE, vol %	10.8-11.2	Title 13 CCR §2263
Additives: Sufficient to meet requirements of Title 13, CCR §2257		
Copper Corrosion	No. 1	D 130-88
Gum, Washed, mg/100 ml (max)	3.0	D 381-86
Oxidation Stability, minutes (min)	1000	D 525-88
Specific Gravity	Report h/	
Heat of Combustion	Report h/	
Carbon, wt%	Report h/	
Hydrogen, wt%	Report h/	

a/ The gasoline must be blended from typical refinery feedstocks.

b/ ASTM specification unless otherwise noted. A test method other than that specified may be used following a determination by the Executive Officer that the other method produces results equivalent to the results with the specified method.

c/ Although Title 13 CCR § 2263 refers to the temperatures of the 50 and 90 percent points, this procedure can be extended to the 10 percent and end point temperatures, and to the determination of the residue content.

d/ The range for interlaboratory testing is 195-215° F.

e/ The range for interlaboratory testing is 285-305° F.

f/ The range for interlaboratory testing is 0.7-1.1 percent by volume.

g/ "Detailed Hydrocarbon Analysis of Petroleum Hydrocarbon Distillates, Reformates, and Gasoline by Single Column High Efficiency (Capillary) Column Gas Chromatography," by Neil Johansen, 1992, Boulder, CO.

h/ The fuel producer should report this fuel property to the fuel purchaser. Any generally accepted test method may be used and shall be identified in the report.

2. Delete subparagraph (a)(3) (Methanol test fuel for Otto-cycle vehicles).

3. Delete subparagraph (a)(4) (Alternative methanol test fuels for Otto-cycle vehicles).

4. Amend subparagraph (a)(5) to read:

(5) The specification range of the fuels to be used under paragraph (a)(2) of this section shall be reported in accordance with 86.090-21(b)(3) or 86.091-21(b)(3).

5. Amend subparagraph (b)(2) to read:

(2) Except as noted below, petroleum fuel for diesel vehicles meeting the specifications referenced in 86.113-90(b)(2), or substantially equivalent specifications approved by the Executive Officer, shall be used in exhaust emission testing. The grade of petroleum fuel recommended by the engine manufacturer, commercially designated as "Type 2-D" grade diesel, shall be used. For 1993 and subsequent model-year diesel vehicles, petroleum fuel meeting the specifications of 86.113-94(b)(2) may be used in exhaust emission testing as an option to the specifications in 86.113-90(b)(2). For 1995 and subsequent model-year diesel-fueled vehicles, the petroleum fuel used in exhaust emission testing may meet the specifications listed below, or substantially equivalent specifications approved by the Executive Officer, as an option to the specifications in 86.113-90(b)(2) or 86.113-94(b)(2). Where a manufacturer elects pursuant to this subparagraph to conduct exhaust emission testing using the specifications of 86.113-94(b)(2), or the specifications listed below, the Executive Officer shall conduct exhaust emission testing with the diesel fuel meeting the specifications elected by the manufacturer.

Fuel Property	Limit	Test Method a/
Natural Cetane Number	47-55	D 613-86
Distillation Range, °F		D 86-82
IBP	340-420	
10% point	400-490	
50% point	470-560	
90% point	550-610	
EP	580-660	
API Gravity, degrees	33-39	D 287-82
Total Sulfur, wt. %	0.01-0.05	D 2622-82
Nitrogen Content, ppmw	100-500	D 4629-86
Total Aromatic Hydrocarbons, vol. %	8-12	D 1313-83, D 5186-91
Polycyclic Aromatic Hydrocarbons, wt. % (max)	1.4	D 2425-88
Flashpoint, °F (max)	130	D 93-80
Viscosity @ 40°F, centistokes	2.0-4.1	D 445-83

a/ ASTM specifications

6. Amend subparagraph (b)(3) to read:

(3) Except as noted below, petroleum fuel for diesel vehicles meeting the following specifications, or substantially equivalent specifications approved by the Executive Officer shall be used in service accumulation. The grade of diesel fuel recommended by the engine manufacturer, commercially designated as "Type 2-D" grade diesel fuel, shall be used. For 1993 and subsequent model-year diesel-fueled vehicles, petroleum fuel meeting the specifications of 86.113-94(b)(3) may be used in service accumulation. For 1995 and subsequent model-year diesel- fueled vehicles, diesel fuel representative of commercial diesel fuel which will be generally available through retail outlets shall be used in service accumulation.

7. Delete subparagraph (b)(4) (Methanol test fuel for diesel vehicles).

8. Delete subparagraph (b)(5) (Alternative methanol test fuels for diesel vehicles)

9. Amend subparagraph (b)(6) to read:

(6) The specification range of the fuels to be used under paragraphs (b)(2) and (b)(3) of this section shall be reported in accordance with 86.090-21(b)(3) or 86.091-21(b)(3).

10. Replace subparagraph (d) with:

(d) Methanol-Gasoline Fuel Specifications for 1993 Model-Year Vehicles.

Various methanol-gasoline fuel blends will be used according to the type of methanol-fueled vehicle being certified and the particular aspect of the certification procedure being conducted, as specified below. Gasoline used for blending fuel for use in mileage accumulation shall be representative of commercial regular unleaded gasoline which will be generally available through retail outlets. Gasoline used for blending fuel for use in emission testing shall conform with the unleaded gasoline specification noted in paragraph (a) above.

Fuel additives and ignition improvers intended for use in methanol test fuels shall be subject to the approval of the Executive Officer. In order for such approval to be granted, a manufacturer must demonstrate that emissions will not be adversely affected by the use of the fuel additive or ignition improver.

(1) Otto-cycle methanol vehicles and hybrid electric vehicles which use Otto-cycle methanol engines

Mileage-accumulation fuel: For methanol vehicles and hybrid electric vehicles which use Otto-cycle methanol engines a methanol-gasoline blend composed of 85-percent methanol which is representative of commercially available methanol and 15-percent unleaded gasoline as noted above.

Emission-testing fuel: For vehicles certifying on methanol, a methanol-gasoline blend composed of 85 percent chemical grade methanol and 15-percent unleaded gasoline as noted above.

(2) Methanol-fueled diesel vehicles and hybrid electric vehicles which use methanol-fueled diesel engines.

Mileage-accumulation fuel: For methanol vehicles and hybrid electric vehicles which use methanol-fueled diesel engines, commercially available methanol fuel.

Emission-testing fuel: chemical grade methanol.

(3) Fuel-flexible vehicles

Mileage-accumulation fuel: For both durability-data vehicles and emission-data vehicles, mileage accumulation shall be conducted with one fuel. For vehicles designed to operate on methanol, a methanol-gasoline blend composed of 85-percent methanol and 15-percent unleaded gasoline both of which are representative of commercially available fuels shall be used. Alternative mileage accumulation fuels and procedures may be used if demonstrated to result in equivalent or more severe deterioration of the vehicle's emission control system, subject to the prior approval of the Executive Officer.

Emission-testing fuel: Case (1) For exhaust only emission testing of emission-data vehicles, a methanol-gasoline blend composed of 85-percent chemical grade methanol and 15-percent unleaded gasoline (M85), and unleaded gasoline shall be used. For evaporative emission testing, a blend of 35-percent chemical grade methanol and 65-percent unleaded gasoline (M35) shall be used.

Case (2) For the testing required under 6.a.4.(D) of these procedures (of durability-data vehicles), exhaust (exhaust OMHCE or OMNMHCE for non-TLEVs, non-LEVs, and non-ULEVs, exhaust NMOG for TLEVs, LEVs, and ULEVs, exhaust formaldehyde, exhaust CO, and exhaust NOx) and evaporative emission tests (evaporative OMHCE) shall be conducted at the specified mileage intervals and with the specified fuels using 85-percent chemical grade methanol and 15-percent unleaded gasoline (M85), unleaded gasoline, and/or 35-percent chemical grade methanol and 65-percent unleaded gasoline (M35), as applicable.

For both Case (1) and (2), alternative methanol-gasoline blends may be used in place of M35 if demonstrated to result in equivalent or higher evaporative emissions, subject to the prior approval of the Executive Officer.

(4) Other methanol fuels may be used for testing and service accumulation provided: (i) they are commercially available; (ii) information, acceptable to the Executive Officer, is provided to show that only the designated fuel would be used in customer service; (iii) use of a fuel listed

in this section would not have a detrimental effect on emissions or durability; (iv) written approval from the Executive Officer of the fuel specifications must be provided prior to the start of testing.

(5) The specification of the fuels to be used under paragraphs (d)(1), (d)(2), and (d)(3) of this section shall be reported in accordance with 86.090- 21(b)(3), 86.091-21(b)(3), or 86.094-21(b)(3).

(6) The specifications set forth in subparagraph (e) may be used as an option for 1993 model-year vehicles.

11. Add new subparagraph (e) to read:

(e) Alcohol-Gasoline Fuel Specifications for 1994 and Subsequent Model-Year Vehicles.

Various alcohol-gasoline fuel blends will be used according to the type of alcohol-fueled vehicle being certified and the particular aspect of the certification procedure being conducted, as specified below.

Fuel additives and ignition improvers intended for use in alcohol test fuels shall be subject to the approval of the Executive Officer. In order for such approval to be granted, a manufacturer must demonstrate that emissions will not be adversely affected by the use of the fuel additive or ignition improver.

(1) Otto-cycle alcohol vehicles and hybrid electric vehicles which use Otto-cycle alcohol engines

Mileage-accumulation fuel: For methanol, ethanol and hybrid electric vehicles which use Otto-cycle methanol or ethanol engines, fuel which meets the specifications listed in Title 13, CCR, Section 2292.1, 2292.2, 2292.3 or 2292.4, as applicable.

Emission-testing fuel: For methanol, ethanol and hybrid electric vehicles which use Otto-cycle methanol or ethanol engines, fuel which meets the specifications listed in Title 13, CCR, Section 2292.1, 2292.2, 2292.3 or 2292.4, as modified by the following:

The fuel specification for Title 13, CCR, Section 2292.1 shall be modified to: a) require methanol content at 98.0 ± 0.5 volume percent; b) require ethanol content at 1.0 ± 0.1 volume percent; c) require certification gasoline conforming with specifications noted

in section 9.a.1. of these test procedures at 1.0 ± 0.1 volume percent.

The fuel specification for Title 13, CCR, Section 2292.3 shall be modified to: a) require ethanol content at 98.0 ± 0.5 volume percent; b) require methanol content at 1.0 ± 0.1 volume percent; c) require certification gasoline conforming with specifications noted in section 9.a.1. of these test procedures at 1.0 ± 0.1 volume percent.

The fuel specification for Title 13, CCR, Section 2292.2 and 2292.4 shall be modified to require certification gasoline conforming with specifications noted in section 9.a.1. of these test procedures as the hydrocarbon fraction. The vapor pressure specification for the emission-testing fuel shall be adjusted to 8.0 - 8.5 psi., using common blending components from the gasoline stream.

(2) Alcohol-fueled diesel vehicles and hybrid electric vehicles which use alcohol-fueled diesel engines

Mileage-accumulation fuel: For methanol, ethanol and hybrid electric vehicles which use alcohol-fueled diesel engines, fuel which meets the specifications listed in Title 13, CCR, Section 2292.1, 2292.2, 2292.3 or 2292.4, as applicable.

Emission-testing fuel: For methanol, ethanol and hybrid electric vehicles which use Otto-cycle alcohol engines, fuel which meets the specifications listed in Title 13, CCR, Section 2292.1, 2292.2, 2292.3 or 2292.4, as modified by the following:

The fuel specification for Title 13, CCR, Section 2292.1 shall be modified to: a) require methanol content at 98.0 ± 0.5 volume percent; b) require ethanol content at 1.0 ± 0.1 volume percent; c) require certification gasoline as noted in section 9.a.1. of these test procedures at 1.0 ± 0.1 volume percent.

The fuel specification for Title 13, CCR, Section 2292.3 shall be modified to require ethanol content at 98.0 ± 0.5 volume percent and require certification gasoline conforming with specifications noted in section 9.a.1. of these test procedures at 1.0 ± 0.1 volume percent.

The fuel specification for Title 13, CCR, Section 2292.2 and 2292.4 shall be modified to require certification gasoline conforming with specifications noted in section 9.a.1. of these test procedures as the hydrocarbon fraction. The vapor pressure specification for the emission-testing fuel shall be adjusted to 8.0 - 8.5 psi., using common blending components from the gasoline stream.

(3) Fuel-flexible vehicles

Mileage-accumulation fuel: For both durability-data vehicles and emission-data vehicles, mileage accumulation shall be conducted with one fuel. For vehicles designed to operate on methanol, a fuel that meets the specifications listed in Title 13, CCR, Section 2292.2 shall be used. For vehicles designed to operate on ethanol, a fuel that meets the specifications listed in Title 13, CCR, Section 2292.4 shall be used. Alternative mileage accumulation fuels and procedures may be used if demonstrated to result in equivalent or more severe deterioration of the vehicle's emission control system, subject to the prior approval of the Executive Officer.

Emission-testing fuel: Case (1) For exhaust only emission testing of emission-data vehicles, fuel that meets the specifications listed in Title 13, CCR, Section 2292.2 or 2292.4. For evaporative emission testing, a blend of fuel that meets the specifications listed in Title 13, CCR, Section 2292.2 or 2292.4 and gasoline meeting the specifications of section 9.a.1. of these test procedures such that the final blend is composed of either 35 volume percent methanol (plus or minus 1 volume percent of total blend) for methanol-fueled vehicles or 10 volume percent ethanol (plus or minus 1 volume percent of total blend) for ethanol-fueled vehicles shall be used.

Case (2) For the testing required under 6.a.4.(D) of these procedures (of durability-data vehicles), exhaust emission tests (exhaust OMHCE or OMNMHCE for non-TLEVs, non-LEVs, and non-ULEVs, exhaust NMOG for TLEVs, LEVs, and ULEVs, exhaust formaldehyde, exhaust CO, and exhaust NOx) and evaporative emission tests (evaporative OMHCE) shall be conducted at the specified mileage intervals using: (i) emission testing fuel that meets the specifications listed in subparagraph (e)(1) of section 9.a.11. of these test procedures and (ii) a blend of fuel produced by combining emission- testing fuel that meets the specifications in subparagraph (e)(1) of section 9.a.11. of these test procedures and certification gasoline described in section 9.a.1. of

these test procedures such that the final fuel is either 35 volume percent methanol (plus or minus 1 volume percent of total blend) and 65 volume percent certification gasoline for methanol-fueled vehicles or 10 volume percent ethanol (plus or minus 1 volume percent of total blend) and 90 volume percent certification gasoline for ethanol-fueled vehicles.

For both Case (1) and (2), alternative alcohol-gasoline blends may be used in place of M35 or E10 if demonstrated to result in equivalent or higher evaporative emissions, subject to the prior approval of the Executive Officer.

(4) The specification of the fuels to be used under paragraphs (e)(1), (e)(2), (e)(3) and (e)(4) of this section shall be reported in accordance with 86.090-21(b)(3) or 86.091-21(b)(3).

12. Add new subparagraph (f) to read:

(f) Gaseous Fuel Specifications for 1988 Through 1993 Model Year Vehicles.

(1) Gaseous fuels representative of commercial gaseous fuels which will be generally available through retail outlets in California or liquid petroleum gas having the ASTM D1835 or NGPA HD-5 specification shall be used in service accumulation.

(2) Liquid petroleum gas having the ASTM D1835 or NGPA HD-5 specification shall be used for exhaust and evaporative emission testing.

(3) Natural gas representative of commercial natural gas which will be generally available through retail outlets in California shall be used for exhaust emission testing.

(4) Written approval from the Administrator of the fuel specifications must be provided prior to the start of testing.

(5) For dedicated gaseous- and dual-fueled vehicles and for hybrid electric vehicles which use gaseous-fueled engines, the mileage accumulation fuel for both durability-data vehicles and emission-data vehicles shall be conducted with one fuel. For vehicles designed to operate on natural gas, natural gas which meets the requirements of (3) shall be

used. For vehicles designed to operate on liquefied petroleum gas, liquefied petroleum gas which meets the requirements of (2) shall be used.

(6) The specifications set forth in subparagraph (g) may be used as an option for 1993-model year vehicles.

(7) Alternative mileage-accumulation fuels and test procedures may be used if demonstrated to result in equivalent or more severe deterioration of the vehicle's emission control system, subject to the prior approval of the Executive Officer.

(8) Alternative emission-test fuels may be used if demonstrated to result in equivalent or higher exhaust emissions, subject to the prior approval of the Executive Officer.

13. Add new subparagraph (g) to read:

(g) Gaseous Fuel Specifications for 1994 and Subsequent Model Year Vehicles.

(1) Dedicated gaseous- and dual-fueled vehicles and hybrid electric vehicles which use liquefied petroleum gas

Mileage accumulation fuel: Liquefied petroleum gas meeting the specifications listed in Title 13, CCR, Section 2292.6 shall be used in service accumulation.

Emission-testing fuel: Liquefied petroleum gas meeting the specifications listed in Title 13, CCR, Section 2292.6 shall be used for exhaust and evaporative emission testing with the following exceptions: a) propane content limited to 93.5 ± 1.0 volume percent; b) propene content limited to 3.8 ± 0.5 volume percent; c) butane and heavier components limited to 1.9 ± 0.3 volume percent.

(2) Dedicated gaseous- and dual-fueled vehicles and hybrid electric vehicles which use natural gas

Mileage accumulation fuel: Natural gas meeting the specifications listed in Title 13, CCR, Section 2292.5 shall be used in service accumulation.

Emission-testing fuel: Natural gas meeting the specifications listed in Title 13, CCR, Section 2292.5 as modified by the following: a) methane content limited to 90.0 ± 1.0 mole percent; b) ethane content limited to 4.0

± 0.5 mole percent; c) C_3 and higher hydrocarbon content at 2.0 ± 0.3 mole percent; d) oxygen content at 0.5 mole percent maximum; e) inert gases (sum of CO_2 and N_2) content at 3.5 ± 0.5 mole percent.

b. Road Load Power Test Weight

In paragraph 86.129-80 and 86.129-94:

1. Amend subparagraph (a) to add:

ROAD LOAD POWER TEST WEIGHT AND INERTIA WEIGHT CLASS DETERMINATION

ROAD LOAD POWER @ 50 mph - Light-Duty Trucks

LOADED WEIGHT (POUNDS)[4]	EQUIVALENT TEST WEIGHT (POUNDS)	INERTIA WEIGHT CLASS (POUNDS)
10001 to 10250	10000	10000
10251 to 10750	10500	10500
10751 to 11250	11000	11000
11251 to 11750	11500	11500
11751 to 12250	12000	12000
12251 to 12750	12500	12500
12751 to 13250	13000	13000
13251 to 13750	13500	13500
13751 to 14000	14000	14000

2. Add subparagraph (d) to read:

(d) Power absorption unit adjustment- medium-duty vehicles.

(1) The power absorption unit shall be adjusted to reproduce road load power at 50 mph true speed. The dynamometer power absorption shall

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4 For 1995 and subsequent medium-duty vehicles, "Loaded Weight" shall be the average of the vehicle's curb weight and gross vehicle weight.

take into account the dynamometer friction, as discussed in paragraph 86.118-78.

(2) The dynamometer road load setting is determined from the loaded test weight, the reference frontal area, vehicle protuberances, and an aerodynamic drag coefficient as determined appropriate by the Executive Officer. The vehicle manufacturer shall submit the procedure by which the aerodynamic drag coefficient was determined in the test vehicle information section in the certification application. The dynamometer road load setting shall be determined by the following equation.

(i) For medium-duty vehicles to be tested on twin or single, large roll dynamometers.

$$Hp = (0.00182)V((0.015)(W)+(0.0375)(Cd)(A)(V^2)/(32.2ft/s^2))+P$$

where:

Hp = the dynamometer power absorber setting at 50 mph (horsepower).
0.00182 = conversion factor to horsepower.
V = velocity in feet/sec.
0.015 = coefficient of rolling resistance.
W = loaded vehicle weight in pounds.
0.0375 = air density in lbm/cubic ft.
Cd = aerodynamic drag coefficient.
A = reference frontal area in square ft.
32.2 ft/s^2 = gravitational acceleration
P = protuberance power (horsepower)

(ii) The protuberance power, P shall be determined per subparagraph 86.129-80(c)(2)(i).

(iii) The dynamometer power absorber setting for medium-duty vehicles shall be rounded to the nearest 0.1 horsepower.

(3) The road load power calculated above shall be used or the vehicle manufacturer may determine the road load power by an alternate procedure requested by the manufacturer and approved in advance by the Executive Officer.

(4) Where it is expected that more than 33 percent of a vehicle line within an engine-system combination will be equipped with air conditioning, per subparagraph 86.090-24(g)(2), 86.092-24(g)(2), 86.094-24(g)(2), or

86.095-24(g)(2), the road load power as determined in paragraph (d) (2) or (3) of this section shall be increased by 10 percent up to a maximum increment of 1.4 horsepower, for testing all test vehicles of that vehicle line within that engine-system combination if those vehicles are intended to be offered with air conditioning in production. This power increment shall be added to the indicated dynamometer power absorption setting prior to rounding off this value.

(5) For electric and hybrid electric vehicle lines where it is expected that more than 33 percent of a vehicle line will be equipped with air conditioning, per subparagraph 86.090-24(g)(2), 86.092-24(g)(2), 86.094-24(g)(2), or 86.095-24(g)(2), which derives power from the battery pack, the road load shall be increased by the incremental horsepower required to operate the air conditioning unit. The incremental increase shall be determined by recording the difference in energy required for a hybrid electric vehicle under all-electric power to complete the running loss test fuel tank temperature profile test sequence without air conditioning and the same vehicle tested over the running loss test fuel tank temperature profile test sequence with the air conditioning set to the "NORMAL" air conditioning mode and adjusted to the minimum discharge air temperature and high fan speed over the time period needed to perform the test sequence, and converting this value into units of horsepower. Vehicles equipped with automatic temperature controlled air conditioning systems shall be operated in "AUTOMATIC" temperature and fan modes with the system set at 72°F. The running loss test fuel tank temperature profile test sequence is found in the "California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles" as incorporated by reference in section 1976, Title 13, CCR.

c. **Test Sequence; General Requirements**

Amend paragraph 86.130-78 to read:

The test sequence shown in figure B78-10 shows the steps encountered as the test vehicle undergoes the procedures subsequently described to determine conformity with the standards set forth. Ambient temperature levels shall not be less than 68°F (20°C) nor more than 86° F (30°C). For purposes of determining conformity with 50°F test requirements, the procedures set forth in Section 11k of these test procedures shall apply. For all hybrid electric vehicles and all 1995 and subsequent model-year vehicles certifying to running loss and useful life evaporative emission standards, the test sequence specified in"California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent

Model Motor Vehicles" as incorporated by reference in section 1976, Title 13, CCR shall apply.

d. Vehicle Preconditioning

In paragraphs 86.132-82 and 86.132-90:

1. Amend subparagraph (a)(2) to read:

(2) Within one hour of being fueled the vehicle shall be placed, either by being driven or pushed, on a dynamometer and operated through one Urban Dynamometer Driving Schedule (UDDS) test procedure, see 86.115 and Appendix I of the federal procedures.

The UDDS performed prior to a non-regeneration emission test shall not contain a regeneration (diesel passenger cars, light-duty trucks, and medium-duty vehicles equipped with periodically regenerating trap oxidizer systems only). A gasoline fueled test vehicle may not be used to set dynamometer horsepower.

2. Amend subparagraph (a)(3) to read:

(3) For those unusual circumstances where additional preconditioning is desired by the manufacturer, such preconditioning may be allowed with the advance approval of the Executive Officer. The Executive Officer may also choose to conduct or require the conduct of additional preconditioning to insure that the evaporative emission control system is stabilized in the case of Otto-cycle engines, or to insure that the exhaust system is stabilized in the case of diesel engines. The additional preconditioning shall consist of an initial one hour minimum soak and, one, two, or three driving cycles of the UDDS (or more in the case of a diesel vehicle equipped with a periodically regenerating trap oxidizer system, which is being preconditioned for a regeneration emission test), as described in paragraph (a)(2) of this section, each followed by a soak of at least one hour with engine off, engine compartment cover closed and cooling fan off. The vehicle may be driven off the dynamometer following each UDDS for the soak period.

3. For all hybrid electric vehicles and all 1995 and subsequent model-year vehicles subject to running loss and useful life evaporative emission standards, the preconditioning sequence specified in "California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles" as incorporated by reference in section 1976, Title 13, CCR shall apply.

e. Regeneration Recording Requirements

Amend paragraph 86.142-82 by adding the following subparagraph (r)which reads:

(r) The manufacturer shall record in the durability-data vehicle logbook, the number of regenerations which occur during the 50,000 mile durability test of each diesel passenger car, light-duty truck and medium-duty vehicle equipped with a periodically regenerating trap oxidizer system. The manufacturer shall include, for each regeneration: the date and time of the start of regeneration, the duration of the regeneration, and the accumulated mileage at the start and the end of regeneration. The number of regenerations will be used in the calculation of the correction factor in 40 CFR Part 86, Section 28.

Amend paragraph 86.142-90 by adding the following subparagraph (s)which reads:

(s) The manufacturer shall record in the durability-data vehicle logbook, the number of regenerations which occur during the 50,000 mile durability test of each diesel passenger car, light-duty truck and medium-duty vehicle equipped with a periodically regenerating trap oxidizer system. The manufacturer shall include, for each regeneration: the date and time of the start of regeneration, the duration of the regeneration, and the accumulated mileage at the start and the end of regeneration. The number of regenerations will be used in the calculation of the correction factor in 40 CFR Part 86, Section 28.

f. All-Electric Range Test Requirements

All 1993 and subsequent ZEVs and Type A and Type B hybrid electric vehicles shall be subject to the All-Electric Range Test specified below for the purpose of determining the energy efficiency and operating range of a ZEV or of a hybrid electric vehicle operating without the use of its auxiliary power unit. For hybrid electric vehicles, the manufacturer may elect to conduct the All-Electric Range Test prior to vehicle preconditioning in the exhaust and evaporative emission test sequence specified in "California Evaporative Emission Standards and Test Procedures for 1978 and Subsequent Model Motor Vehicles" as incorporated by reference in section 1976, Title 13, CCR.

(1) Cold soak. The vehicle shall be stored at an ambient temperature not less than 68°F (20°C) and not more than 86°F (30°C) for 12 to 36 hours. During this time, the vehicle's battery shall be charged to a full state-of-charge.

(2) Driving schedule.

(a) Determination of All-Electric Range-Urban. At the end of the cold soak period, the vehicle shall be placed, either driven or pushed, onto a dynamometer and operated through an Urban Dynamometer Driving

Schedule, 40 CFR, Part 86, Appendix I, until the vehicle is no longer able to maintain within 5 miles per hour of the speed requirements or within 2 seconds of the time requirements of the driving schedule. For hybrid electric vehicles, this determination shall be performed without the use of the auxiliary power unit.

(b) Determination of All-Electric Range-Highway. At the end of the cold soak period, the vehicle shall be placed, either driven or pushed, onto a dynamometer and operated through a Highway Fuel Economy Driving Schedule, found in 40 CFR, Part 600, Appendix I, until the vehicle is no longer able to maintain within 5 miles per hour of the speed requirements or within 2 seconds of the time requirements of the driving schedule. For hybrid electric vehicles, this determination shall be performed without the use of the auxiliary power unit.

(3) Recording requirements. Once the vehicle is no longer able to maintain the speed and time requirements specified in (2) above, or once the auxiliary power unit turns on, in the case of a hybrid electric vehicle, the accumulated mileage and energy usage of the vehicle from the point where electricity is introduced from the electrical outlet shall be recorded, and the vehicle shall be brought to an immediate stop, thereby concluding the All-Electric Range Test.

(4) Regenerative braking. Regenerative braking systems may be utilized during the range test. The braking level, if adjustable, shall be set according to the manufacturer's specifications prior to the commencement of the test. The driving schedule speed and time tolerances specified in (2)shall not be exceeded due to the operation of the regenerative braking system.

g. **Determination of Battery Specific Energy for ZEVs.**

Determine the specific energy of batteries used to power a ZEV in accordance with the U.S. Advanced Battery Consortium's Electric Vehicle Battery Procedure Manual (January 1996), Procedure No. 2, "Constant Current Discharge Test Series," using the C/3 rate. The weight calculation must reflect a completely functional battery system as defined in Appendix of the Manual, including pack(s), required support ancillaries (e.g., thermal management), and electronic controller.

h. Calculations; exhaust emissions

Amend paragraph 86.144-94 by adding the following subparagraph(b)(10) which reads:

(10) Organic material non-methane hydrocarbon equivalent mass for ethanol vehicles:

$$OMNMHCE_{mass} = NMHC_{mass} + (13.8756/32.042) \times (CH_3OH)_{mass} + (13.8756/46.064) \times (CH_3CH_2OH)_{mass} + (13.8756/30.0262) \times (HCHO)_{mass} + (13.8756/44.048) \times (CH_3CHO)_{mass}$$

10. Optional 100,000 Mile Certification Procedure

The following provisions and alternate emission standards shown in section 3. of these procedures shall apply to any engine family certified to the optional 100,000 mile certification standards.[5]

a. General Guidelines for Implementation

1. Designation

The manufacturer shall designate in the preliminary application for certification those engine families that will be certified to the 100,000 mile procedures. In order to allow the manufacturer as much flexibility as possible, the manufacturer may at any time designate additional engine families or remove any designated engine family. Families originally intended for 50,000 mile certification may be designated as 100,000 mile families after the start of durability testing and vice versa. The Executive Officer must be notified within ten working days of any such changes. Manufacturers are cautioned that any engine family certified to the 100,000 mile certification procedure must comply with the allowable maintenance provisions of section 10.b in these procedures during the engine mileage accumulation.

2. Mileage Accumulation

All durability vehicles must be run to at least 50,000 miles for established emission control systems; early termination of mileage accumulation may be requested by the manufacturer if sufficient evidence as described below is provided to satisfy the Executive Officer that further testing is unnecessary.

Testing beyond 50,000 miles must be conducted in accordance with the certification test procedures applicable prior to 50,000 miles. Exhaust emissions tests shall be performed at every 5,000 mile interval starting with the 55,000 mile point and ending with the 100,000 mile point, and before and after all scheduled maintenance.

The Executive Officer may, upon request by the manufacturer waive any exhaust emission testing beyond 50,000 miles, if he or she finds that (1) the extrapolated 100,000 mile points and interpolated 4,000 mile points on the least squares lines comply with the line crossing provisions of section 10.b. of the procedures, and (2) the system and engine designs, on the basis of previous engineering experience, would not be expected to exceed the applicable standards after 100,000 miles. For example, a diesel vehicle that shows a

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5 The additional criteria outlined in Section 6.a. (Mileage and Service Accumulation: Emission Measurements) shall be used to determine the durability-data testing schedule and the emission-data 4,000 mile test point.

flat deterioration curve (D.F. = 1.0) for the first 50,000 miles and which is not equipped with any add-on emission control system (such as EGR) may be eligible for such a waiver. The Executive Officer will evaluate each request on a case-by-case basis. The manufacturer must submit its request to the Executive Officer to stop testing within ten working days after the last emission test.

If a durability vehicle accumulates less than 100,000 miles the manufacturer shall submit evidence that the engine is capable of meeting the applicable emission standards for 100,000 miles. Such evidence shall include engineering data on piston rings, piston, valves, cylinder head, fuel system ignition system, etc., as applicable.

Any decision to stop mileage accumulation before 100,000 miles does not relieve the manufacturer from its warranty and recall obligations.

For the last 50,000 miles, the Executive Officer may, upon the request of the manufacturer, allow driving schedules different from the standard AMA driving cycle for accelerated mileage accumulation and a reduced test frequency. The evaluation of alternate test programs will be based on the type of emission control system involved and the characteristic of the cumulative emission control system deterioration.

3. Scheduled Maintenance

A vehicle manufacturer who initially intends to certify a vehicle to the 50,000 mile procedure may not change to the 100,000 mile option after mileage accumulation unless the manufacturer starts initial mileage accumulation using, for each maintenance item, the most stringent maintenance schedule of either the 100,000 mile option or the 50,000 mile certification requirements.

4. Unscheduled Maintenance

The Executive Officer will follow the provisions of section 5.a of these procedures, in evaluating any manufacturer's request for unscheduled maintenance. Manufacturers shall obtain the Executive Officer's approval before performing any unscheduled emission control component/system maintenance. In all cases, the degree of system degradation must not be improved by any inspection or repairs. Emission tests must be performed before and after all unscheduled maintenance and be used in the DF calculation.

5. Evaporative Compliance Criteria

If a manufacturer conducts evaporative emission testing (gasoline- and alcohol-fueled vehicles only) in conjunction with exhaust durability testing, the vehicle manufacturer is required to show compliance with the evaporative emission standard for 50,000 miles. If the manufacturer wishes to conduct testing beyond 50,000 miles, all data

must be submitted to the Executive Officer. The Executive Officer will not use any evaporative emission standard. However, the manufacturer must warrant the evaporative emission control system for 10 years or 100,000 miles.

b. Specific Guidelines for Compliance

Each exhaust emission durability data vehicle shall be driven, with all emission control systems installed and operating, for 100,000 miles or such lesser distance as the Executive Officer may agree to as meeting the objectives of this procedure. Emission tests performed on emission-data vehicles and durability-data vehicles (for determination of the deterioration factors) shall be non-regeneration emission tests for diesel passenger cars, light-duty trucks and medium-duty vehicles equipped with periodically regenerating trap oxidizer systems. Compliance with the emission standards shall be established as follows:

1. The linear regression line for all pollutants shall be established by use of all required data from tests of the durability vehicle at every 5,000 mile interval from 5,000 to 100,000 miles. The requirements in subparagraph 86.088- 28(a)(4)(i)(B), 86.090-28(a)(4)(i)(B), and 86.091- 28(a)(4)(i)(B) (durability vehicles must meet emissions standards) refer, for each pollutant, to the California 100,000 mile emission standards.

2. Compliance with the hydrocarbon and carbon monoxide standards shall be determined as follows:

i. For Option 1:

A. The interpolated 4,000 and 50,000 mile points on the linear regression line in section b.1. shall not exceed the appropriate hydrocarbon and carbon monoxide standards, except as in B. below.

B. The linear regression line in section b.1. may exceed the standard provided that no data point exceeds the standard.

C. The hydrocarbon and carbon monoxide data from the 4,000 mile test point of the emission data vehicle shall be multiplied by the deterioration factor computed by dividing the interpolated 50,000 mile point by the interpolated 4,000 mile point, and the appropriate exhaust emission correction factor (diesel passenger cars, light-duty trucks, and medium-duty vehicles equipped with periodically regenerating trap oxidizer systems only). These values shall not exceed the appropriate hydrocarbon and carbon monoxide standards.

ii. For Option 2:

A. The interpolated 4,000 and 100,000 mile points on the linear regression line in section b.1. shall not exceed the appropriate hydrocarbon and carbon monoxide standards, except as in B. below.

B. The linear regression line in section b.1. may exceed the standard provided that no data point exceeds the standard.

C. The hydrocarbon and carbon monoxide data from the 4,000 mile test point of the emission data vehicle shall be multiplied by the deterioration factor computed by dividing the interpolated 100,000 mile point by the interpolated 4,000 mile point, and the appropriate exhaust emission correction factor (diesel passenger cars, light-duty trucks, and medium-duty vehicles equipped with periodically regenerating trap oxidizer systems only). These values shall not exceed the appropriate 100,000 mile hydrocarbon and carbon monoxide standards.

3. Compliance with the oxides of nitrogen standard for Options 1 and 2 shall be determined as follows:

i. the interpolated 4,000 and 100,000 mile points on the linear regression line in section b.1. shall not exceed the appropriate 100,000 mile oxides of nitrogen standard, except as in ii. below.

ii. the linear regression line in section b.1. may exceed the standard provided that no data point exceeds the standard.

iii. the oxides of nitrogen data from the 4,000 mile test point of the emission data vehicle shall be multiplied by the deterioration factor computed by dividing the interpolated 100,000 mile point by the interpolated 4,000 mile point, and the appropriate exhaust emission correction factor (diesel passenger cars, light-duty trucks, and medium-duty vehicles equipped with periodically regenerating trap oxidizer systems only). These values shall not exceed the appropriate 100,000 mile oxides of nitrogen standard.

4. Compliance with the particulate standard for options 1 and 2 shall be determined as follows:

i. the interpolated 4,000 and 50,000 mile points on the linear regression line in section b.1. shall not exceed the appropriate particulate, except as in ii. below.

ii. the linear regression line in section b.1. may exceed the standard provided that no data point exceeds the standard.

iii. the particulate data from the 4,000 mile test point of the emission data vehicle shall be multiplied by the deterioration factor computed by dividing the interpolated 50,000 mile point by the interpolated 4,000 mile point, and the appropriate exhaust emission correction factor (diesel passenger cars, light-duty trucks, and medium-duty vehicles equipped with periodically regenerating trap oxidizer systems only). These values shall not exceed the appropriate particulate standard.

5. All references in these test procedures to "useful life", 5 years, and 50,000 miles shall mean "total life", 10 years, and 100,000 miles, respectively, except in section 10.b.2.

c. Maintenance

Only the following scheduled maintenance shall be allowed under subparagraph 86.085-25 (a)(1)(i).

1. 25(a)(1)(i) Option 1. For 1988 model Otto-cycle or diesel vehicles, and 1989 and later model Otto-cycle or diesel light- duty trucks and medium-duty vehicles 3751 L.V.W. and greater, and 1993 and subsequent diesel light-duty trucks and medium-duty vehicles 3751 L.V.W. and greater, maintenance shall be restricted to the inspection, replacement, cleaning, adjustment, and/or service of the following items at intervals no more frequent than indicated.

(1) Drive belt tension on engine accessories (30,000 miles).
(2) Valve lash (15,000 miles).
(3) Spark plugs (30,000 miles).
(4) Air filter (30,000 miles).
(5) Exhaust gas sensor (30,000 miles): Provided that:

(a) the manufacturer shall equip the vehicle with a maintenance indicator consisting of a light or flag, which shall be preset to activate automatically by illuminating in the case of a light or by covering the odometer in the case of a flag the first time the minimum maintenance interval established during certification testing is reached and which shall remain activated until reset. After resetting, the maintenance indicator shall activate automatically when the minimum maintenance interval, when added to the vehicle mileage at the time of resetting, is again reached and shall again remain activated until reset. When the maintenance indicator consists of a light, it shall also activate automatically in the engine-run key position before engine cranking to indicate that it is functioning. The maintenance indicator shall be located on the instrument panel and shall, when activated, display the words "oxygen sensor" or may display such other words determined by the Executive Officer to be likely to cause the vehicle owner to seek

oxygen sensor replacement. The maintenance indicator shall be separate from the malfunction indicator light required by Section 1968, Title 13, California Code of Regulations;

(b) the manufacturer shall provide free replacement of the oxygen sensor, including both parts and labor, and shall reset the maintenance indicator without any charge, the first time the maintenance interval established during certification testing is reached for vehicles certified with scheduled sensor maintenance before 50,000 miles. If the oxygen sensor is replaced pursuant to the warranty provisions of Section 2037, Title 13, California Code of Regulations, before the first maintenance interval is reached, the manufacturer shall also replace the oxygen sensor and reset the maintenance indicator at the oxygen sensor and reset the maintenance indicator at the mileage point determined by adding the maintenance interval to the vehicle's mileage at the time of the warranty replacement. If the calculated mileage point for a second oxygen sensor replacement would exceed 50,000 miles, no free second replacement shall be required;

(c) the maintenance indicator shall be resettable. The maintenance instructions required by paragraph 5.b. of these procedures shall provide instructions for the resetting of the maintenance indicator, and shall specify that the maintenance indicator shall be reset each time the oxygen sensor is replaced; and

(d) notwithstanding the provisions of Section 2037(c), Title 13, California Code of Regulations, the oxygen sensor, including any replacement required pursuant to this section, shall be warranted for the applicable warranty period of the vehicle or engine in accordance with Section 2037(a), Title 13, California Code of Regulations. If such oxygen sensor fails during this period, it shall be replaced by the manufacturer in accordance with Section 2037(d), Title 13, California Code of Regulations.

(6) Choke, cleaning or lubrication only (30,000 miles).
(7) Idle speed (30,000 miles).
(8) Fuel Filter (30,000 miles).
(9) Injection timing (30,000 miles).

Option 2. For 1981-1988 and later model Otto-cycle vehicles or 1988 and later diesel vehicles, maintenance shall be restricted to the inspection, replacement, cleaning, adjustment, and/or service of the following items at intervals no more frequent than indicated:

(1) Drive belt tension on engine accessories (30,000 miles).
(2) Valve lash (15,000 miles).
(3) Spark plugs (30,000 miles).

(4) Air filter (30,000 miles).
(5) Fuel Filter (30,000 miles).
(6) Idle speed (30,000 miles).
(7) Injection timing (30,000 miles).

2. In addition, adjustment of the engine idle speed (curb idle and fast idle), valve lash, and engine bolt torque may be performed once during the first 5,000 miles of scheduled driving, provided the manufacturer makes a satisfactory showing that the maintenance will be performed on vehicles in use.

d. The manufacturer shall agree to apply to vehicles certified under this paragraph the provision of Section 43204 of the California Health and Safety Code for a period of ten years or 100,000 miles, whichever first occurs.

11. Additional Requirements

a. **Alternative Durability Procedures.** In order to qualify for the alternative durability program, in addition to the requirements of paragraph 86.085-13, the algorithm requirements of Appendix III shall be met and only the first 50,000 miles (or 100,000 miles, as applicable) of data or its equivalent shall be used.

b. **High Altitude Requirements.** For Otto-cycle vehicles or hybrid electric vehicles which use Otto-cycle engines, evidence shall be supplied showing that the air/fuel metering system or secondary air injection system is capable of providing sufficient oxygen to theoretically allow enough oxidation to attain the CO emission standards at barometric pressures equivalent to those expected at altitudes ranging from sea level to 6000 feet elevations.

A vehicle will be deemed in compliance with the above requirement if the manufacturer demonstrates that the tailpipe air/fuel ratio (TAFR) is, at elevations up to 6000 feet, stoichiometric or leaner in each of several driving modes. However, if a vehicle operates in a given driving mode at sea level with a TAFR richer than stoichiometric, then for that particular driving mode the manufacturer is only required to show that the TAFR is, at elevations up to 6000 feet, no richer than the TAFR at sea level. The driving modes selected for testing shall be representative of the full range of normal driving conditions, and shall include the following three steady-state modes: idle, 30 mph road load cruise, 50 mph road load cruise. Assuming the use of dry air and indolene fuel (hydrogen to carbon atom ratio of 1.85), a TAFR of 14.6 shall be considered a stoichiometric ratio. The vehicle manufacturer may correct this value for different fuels and/or humidity, subject to approval by the Executive Officer.

For fuel injected vehicles or hybrid electric vehicles which use fuel-injected engines, compliance may be demonstrated upon a showing by the manufacturer that the fuel injection system distributes fuel based on air mass flow, rather than volume flow, and is therefore self-compensating. All submitted test proposals will be evaluated on their acceptability by the Executive Officer.

As an alternative to the demonstration described above, a manufacturer may demonstrate compliance by testing California vehicle configurations as part of its federal high altitude certification requirements. Engine families which meet all the applicable California low altitude emission standards when tested at the EPA test elevation are deemed to be in compliance.

Exemptions to the high altitude provisions as allowed by the federal government in 86.087-8, 86.088-9, 86.090-8, 86.090-9, and 86.091-9 shall not be approved.

c. **Highway Fuel Economy Test.** The exhaust emissions shall be measured from all exhaust emission data vehicles tested in accordance with the federal Highway Fuel Economy Test (HWFET; 40 CFR Part 600, Subpart B). The oxides of nitrogen emissions measured during such tests shall be multiplied by the oxides of nitrogen deterioration factor computed in accordance with paragraph 86.088-28, 86.090-28, and 86.091-28, and then rounded and compared with the standard as set forth in section 3 preceding. All data obtained pursuant to this paragraph shall be reported in accordance with procedures applicable to other exhaust emissions data required pursuant to these procedures. Hybrid electric vehicles shall be tested with the battery state-of- charge set such that one of the following two conditions is satisfied: (1) the state-of-charge is at the lowest level allowed by the control unit of the auxiliary power unit; or (2) the state-of-charge is set such that auxiliary power unit operation will be at its maximum level at the beginning and throughout the emission test.

In the event that one or more of the manufacturer's emission data vehicles fail the HWFET standard listed in section 3, the manufacturer may submit to the Executive Officer engineering data or other evidence showing that the system is capable of complying with the standard. If the Executive Officer finds, on the basis of an engineering evaluation, that the system can comply with the HWFET standard, he or she may accept the information supplied by the manufacturer in lieu of vehicle test data.

d. **Labeling Requirements.** Labeling required pursuant to paragraph 86.088-35, 86.090-35, 86.091-35, 86.04-35, and 86.095-35, and Section 1965, Title 13 of the California Code of Regulations shall conform with the requirements specified in the "California Motor Vehicle Emission Control and Smog Index Label Specifications."

e. **Driveability and Performance Requirements.** The manufacturer shall submit to the Executive Officer a statement that those vehicles for which certification is requested have driveability and performance characteristics which satisfy that manufacturer's customary driveability and performance requirements for vehicles sold in the United States. This statement shall be based on driveability data and other evidence showing compliance with the manufacturer's performance criteria. This statement shall be supplied with the manufacturer's final application for certification, and with all running changes for which emission testing is required.

If the Executive Officer has evidence to show that in-use vehicles demonstrate poor performance that could result in wide-spread tampering with the emission control systems, he or she may request all driveability data and other evidence used by the manufacturer to justify the performance statement.

f. **Malfunction and Diagnostic System Requirements.** For all vehicles subject to the provisions of Section 1968, or 1968.1, Title 13, California Code of Regulations, the manufacturer shall submit with its application for certification a description of the

malfunction and diagnostic system to be installed on the vehicles. (The vehicles shall not be certified unless the Executive Officer finds that the malfunction and diagnostic system complies with the requirements of Section 1968 or 1968.1).

g. **Methanol and Formaldehyde Emission Testing.** The provisions of the incorporated federal test procedures which allow manufacturers to omit methanol and formaldehyde emission testing of 1990 through 1994 methanol-fueled vehicles shall not be applicable in California.

h. **FFV Emission Testing.** The following requirements shall apply to methanol and ethanol fuel-flexible vehicles which are not certified to TLEV, LEV, ULEV, or SULEV emission standards:

The emission testing required under 6.a.4.(D) (Fuel-flexible vehicle special emission testing) shall be made part of the regular certification program and submitted to the Executive Officer for review. Certification for methanol-fueled vehicles shall be denied unless the exhaust emission values resulting from testing with 35-percent methanol and 65-percent certification gasoline, or another approved methanol-gasoline blend, at the required mileage intervals, and with certification gasoline at 5,000 miles, 50,000 miles and the final mileage point, comply with the applicable standards. Certification for ethanol-fueled vehicles shall be denied unless the exhaust emission values resulting from testing with 10-percent ethanol and 90-percent certification gasoline, or another approved ethanol-gasoline blend, at the required mileage intervals, and with certification gasoline at 5,000 miles, 50,000 miles and the final mileage point, comply with the applicable standards.

i. **Scope of Certification.** Certification, if granted, is effective only for the vehicle/engine family described in the original manufacturer's certification application. Modifications by a secondary manufacturer to vehicles/engines shall be deemed not to increase emissions above the standards under which those vehicles/engines were certified and to be within the original certification if such modifications do not: (1) increase vehicle weight more than 10 percent above the curb weight, increase frontal area more than 10 percent, or result in a combination increase of weight plus frontal area of more than 14 percent; or (2) include changes in axle ratio, tire size, or tire type resulting in changes in the drive train ratio of more than 5 percent; or (3) include any modification to the emission control system. No originally certified vehicle/engine which is modified by a secondary manufacturer in a manner described in items (1) through (3) of the preceding sentence may be sold to an ultimate purchaser, offered or delivered for sale to an ultimate purchaser, or registered in California unless the modified vehicle/engine is certified by the state board in accordance with applicable test procedures to meet emission standards for the model year for which the vehicle/engine was originally certified.

For the purposes of this subsection, "secondary manufacturer" means any person, other than the original manufacturer, who modifies a new motor vehicle prior to sale to the ultimate purchaser.

j. **Statement on Production Vehicles.** A statement must be supplied that the production vehicles shall be in all material respects the same as those for which certification is granted.

k. **50°F Emission Test Requirement.** Following a 12 to 36 hour cold soak at a nominal temperature of 50°F, emissions of CO and NOx measured on the Federal Test Procedure (40 CFR Part 86), conducted at a nominal test temperature of 50°F, shall not exceed the standards for vehicles of the same emission category and vehicle type subject to a cold soak and emission test at 68 to 86°F. For all TLEVs, emissions of NMOG and formaldehyde at 50°F shall not exceed the 50,000 mile certification standard multiplied by a factor of 2.00. For all LEVs, emissions of NMOG and formaldehyde at 50°F shall not exceed the 50,000 mile certification standard multiplied by a factor of 2.00. For all ULEVs, emissions of NMOG and formaldehyde at 50°F shall not exceed the 50,000 mile certification standard multiplied by a factor of 2.00. Emissions of NMOG shall be multiplied by a reactivity adjustment factor, if any, prior to comparing with the 50,000 certification standard multiplied by the specified factor.

The test vehicles shall not be subject to a diurnal heat build prior to the cold start exhaust test or evaporative emission testing.

i. For the 50°F emission test, the nominal preconditioning, soak, and test temperatures shall be maintained within 3°F of the nominal temperature on an average basis and within 5°F of the nominal temperature on a continuous basis. The temperature shall be sampled at least once every 15 seconds during the preconditioning and test periods and at least once each 5 minutes during the soak period. A continuous strip chart recording of the temperature with these minimum time resolutions is an acceptable alternative to employing a data acquisition system.

ii. The test site temperature shall be measured at the inlet of the vehicle cooling fan used for testing.

iii. The test vehicle may be fueled before the preconditioning procedure in a fueling area maintained within a temperature range of 68 to 86°F. The preconditioning shall be conducted at a nominal temperature of 50°F. The requirement to saturate the evaporative control canister(s) shall not apply.

iv. If a soak area remote from the test site is used, the vehicle may pass through an area maintained within a temperature range of 68 to 86° F during a

time interval not to exceed 10 minutes. In such cases, the vehicle shall be restabilized to 50°F by soaking the vehicle in the nominal 50°F test area for six times as long as the exposure time to the higher temperature area, prior to starting the emission test.

v. The vehicle shall be approximately level during all phases of the test sequence to prevent abnormal fuel distribution.

Manufacturers shall demonstrate compliance with this requirement each year by testing at least three PC or LDT and three MDV emission data and/or engineering development vehicles (with at least 4000 miles) which are representative of the array of technologies available in that model year. Only TLEVs, LEVs, and ULEVs are to be considered for testing at 50°F. It is not necessary to apply deterioration factors (DFs) to the 50°F test results to comply with this requirement. Testing at 50°F shall not be required for fuel-flexible and dual-fuel vehicles when operating on gasoline. Natural gas, hybrid electric and diesel-fueled vehicles shall also be exempt from 50°F testing.

The following schedule outlines the parameters to be considered for vehicle selection:

1. Fuel control system (e.g., multiport fuel injection, throttle body electronic fuel injection, sequential multiport electronic fuel injection, etc.)
2. Catalyst system (e.g., electrically heated catalyst, close-coupled catalyst, underfloor catalyst, etc.)
3. Control system type (e.g., mass-air flow, speed density, etc.)
4. Vehicle category (e.g., TLEV, LEV, ULEV)
5. Fuel type (e.g., gasoline, methanol, etc.)

The same engine family shall not be selected in the succeeding two years unless the manufacturer produces fewer than three engine families. If the manufacturer produces more than three TLEV, LEV, or ULEV engine families per model year, the Executive Officer may request 50°F testing of specific engine families. If the manufacturer provides a list of the TLEV, LEV, and ULEV engine families that it will certify for a model year and provides a description of the technologies used on each engine family (including the information in items 1 through 5 of the vehicle selection parameters listed above), the Executive Officer shall select the engine families subject to 50°F testing within a 30 day period after receiving such a list and description. The Executive Officer may revise the engine families selected after the 30 day period if the information provided by the manufacturer does not accurately reflect the engine families actually certified by the manufacturer.

l. **Emission Control System Continuity at Low Temperature.** For each engine family certified to TLEV, LEV, ULEV, or SULEV standards, manufacturers shall submit

with the certification application, an engineering evaluation demonstrating that a discontinuity in emissions of non-methane organic gases, carbon monoxide, oxides of nitrogen and formaldehyde measured on the Federal Test Procedure (40 CFR Part 86) does not occur in the temperature range of 20 to 86°F. For diesel vehicles, the engineering evaluation shall also include particulate emissions.

12. Identification of New Clean Fuels to be Used in Certification Testing

Any person may petition the state board to establish by regulation certification testing specifications for a new clean fuel for which specifications for a new clean fuel are not specifically set forth in paragraph 86.113-90 as amended herein. Prior to adopting such specifications, the state board shall consider the relative cost-effectiveness of use of the fuel in reducing emissions compared to the use of other fuels. Whenever the state board adopts specifications for a new clean fuel for certification testing, it shall also establish by regulation specifications for the fuel as it is sold commercially to the public.

(a) If the proposed new clean fuel may be used to fuel existing motor vehicles, the state board shall not establish certification specifications for the fuel unless the petitioner has demonstrated that:

(1) Use of the new clean fuel in such existing motor vehicles would not increase emissions of NMOG (on a reactivity-adjusted basis), NOx, CO, and the potential risk associated with toxic air contaminants, as determined pursuant to the procedures set forth in "California Test Procedures for Evaluating Substitute Fuels and New Clean Fuels." In the case of fuel-flexible vehicles or dual-fuel vehicles which were not certified on the new clean fuel but are capable of being operated on it, emissions during operation with the new clean fuel shall not increase compared to emissions during vehicle operation on gasoline.

(2) Use of the new clean fuel in such existing motor vehicles would not result in increased deterioration of the vehicle and would not void the warranties of any such vehicles.

(b) Whenever the state board designates a new clean fuel pursuant to this section, the state board shall also establish by regulation required specifications for the new clean fuel.

13. Reactivity Adjustment Factors

For the purpose of complying with the NMOG exhaust emission standards in Section 1960.1, Title 13, California Code of Regulations, the mass of NMOG emissions from a vehicle certified to operate on a fuel other than conventional gasoline, including fuel-flexible and dual-fuel vehicles when operated on a fuel other than conventional gasoline, shall be multiplied by the reactivity adjustment factor applicable to the vehicle emission control technology category and fuel. The product of the NMOG mass emission value and the reactivity adjustment factor shall be compared to the NMOG exhaust emission standards to determine compliance with the standards. In addition to the above requirements, vehicles operating on natural gas shall add to the product of the NMOG mass emission value and the reactivity adjustment factor, the product of the methane mass emission value and the methane reactivity adjustment factor. This result shall be compared to the NMOG exhaust emission standards to determine compliance with the standards for natural gas-fueled vehicles.

a. The following reactivity adjustment factors have been established pursuant to the criteria in Appendix VIII of these test procedures:

1. **Passenger cars and light-duty trucks 0-5750 lbs. LVW and all medium-duty vehicles 0-14,000 TW**

Vehicle Emission Control Technology Category	Fuel	Reactivity Adjustment Factor
1993 and subsequent model-year TLEVs	85% methanol, 15% gasoline blends	0.41
1993 -2000 model-year LEVs and ULEVs	85% methanol, 15% gasoline blends	0.41
1993 through 2000 model-year TLEVs	gasoline meeting the specifications of section 9.a.1.(ii) of these test procedures	0.98
1993 through 2000 model-year LEVs and ULEVs	gasoline meeting the specifications of section 9.a.1.(ii) of these test procedures	0.94
1993 through 2000 model-year TLEVs	fuel meeting the specifications of section 9.a.13.(g)(1) of these test procedures (liquefied petroleum gas)	1.00

1993 through 2000 model-year LEVs and ULEVs	fuel meeting the specifications of section 9.a.13.(g)(1) of these test procedures (liquefied petroleum gas)	0.50
1993 through 2000 model-year TLEVs	fuel meeting the specifications of section 9.a.13.(g)(2) of these test procedures (natural gas)	1.00
1993 through 2000 model-year LEVs and ULEVs	fuel meeting the specifications of section 9.a.13.(g)(2) of these test procedures (natural gas)	0.43

2. **Natural gas passenger cars and light-duty trucks 0-5750 lbs. LVW**

Vehicle Emission Control Technology Category	**Methane Reactivity Adjustment Factor**
1993 and subsequent model-year TLEVs	0.0043
1993 and subsequent model-year LEVs and ULEVs	0.0047

3. **Natural gas medium-duty vehicles 0-8500 lbs. TW**

Vehicle Emission Control Technology Category	**Methane Reactivity Adjustment Factor**
1995 and subsequent model-year LEVs and ULEVs	0.0047

b. The Executive Officer may establish by executive order new reactivity adjustment factors pursuant to Appendix VIII of these test procedures in addition to those listed in Section 13.a. The Executive Officer shall notify manufacturers in writing of the new reactivity adjustment factors within 30 days of their establishment.

c. The Executive Officer may revise any reactivity adjustment factor listed in Section 13.a. or established by the Executive Officer pursuant to Appendix VIII of these test procedures if he or she determines that the revised reactivity adjustment factor is more representative of the ozone-forming potential of vehicle NMOG emissions based on the best available scientific knowledge and sound engineering judgment. The Executive Officer shall notify manufacturers in writing of any such reactivity adjustment factor at least 3 years prior to January 1 of the calendar year which has the same numerical designation as the model year for which the revised reactivity- adjustment factor first becomes effective. However, manufacturers may use the revised reactivity adjustment factor in certifying any new engine family whose certification application is submitted

following such notification, if they so choose. Manufacturers may also continue to use the original reactivity adjustment factor for any existing engine family previously certified with that reactivity adjustment factor until a new durability-data vehicle is tested for that engine family.

d. Manufacturers may request the use of a unique reactivity adjustment factor for a specific vehicle emission control technology category and fuel. The Executive Officer shall approve such requests in accordance with the conditions and procedures of Appendix VIII of these test procedures. For the purpose of calculating the reactivity adjustment factor as specified in Appendix VIII, the 'g ozone potential per g NMOG' value for the vehicle emission control technology category and fuel system for which the manufacturer is requesting the use of a unique reactivity adjustment factor shall be divided by the 'g ozone potential per g NMOG' value for a conventional gasoline-fueled vehicle established for the vehicle emission control technology category. The following 'g ozone potential per g NMOG' values for conventional gasoline-fueled vehicle emission control technology categories have been established:

1. **Passenger cars and light-duty trucks 0-5750 lbs. LVW**

Vehicle Emission Control Technology Category	'g ozone potential per g NMOG' for conventional gasoline
All TLEVs	3.42
All 1993 and subsequent model-year LEVs and ULEVs	3.13

2. **Medium-Duty Vehicles 0-8500 lbs. TW**

All 1993 and subsequent model year LEVs and ULEVs	3.13

14. Cold Temperature Test Procedure

a. General Applicability

In paragraph 86.201-94:

1. Amend subparagraph (a) to read:

(a) This subpart describes procedures for determining the cold temperature carbon monoxide (CO) emissions from 1996 and later model year new passenger cars, light-duty trucks, and medium-duty vehicles (excluding natural gas vehicles, diesel-fueled vehicles, hybrid electric vehicles, and zero-emission vehicles).

b. Equipment Required; Overview

In paragraph 86.206.94:

1. Amend subparagraph (a) to read:

(a) This subpart contains procedures for exhaust emission tests on passenger cars, light-duty trucks, and medium-duty vehicles (excluding natural gas vehicles, diesel-fueled vehicles, hybrid electric vehicles, and zero-emission vehicles.) Equipment required and specifications are as follows:

2. Amend subparagraph (a)(1) to read:

(a)(1) Exhaust emission tests. Exhaust from vehicles (excluding natural gas vehicles, diesel-fueled vehicles, hybrid electric vehicles, and zero-emission vehicles) is tested for gaseous emissions using the Constant Volume Sampler (CVS) concept (Section 86.209). Equipment necessary and specifications appear in 40 CFR Part 86, Section 86.208 through 86.214.

3. Amend subparagraph (a)(2) to read:

(a)(2) Fuel, analytical gas, and driving schedule specifications. Fuel specifications for exhaust emission testing for gasoline-fueled vehicles are specified in 40 CFR Part 86, Section 86.213. Fuel specifications for exhaust emission testing for alcohol-fueled vehicles and liquefied petroleum gas vehicles are specified in Section 9.a. of these Test Procedures. Analytical gases are specified in 40 CFR Part 86, Section 86.214. The EPA Urban Dynamometer Driving Schedule (UDDS) for use in emission tests is specified in 40 CFR Part 86, Section 86.215 and Appendix I.

APPENDIX I

List of Sections of Subparts A, B, and C, Part 86, Title 40, Code of Federal Regulations, Incorporated by Reference

This Appendix sets forth the sections of Subparts A, B, and C, Part 86, Title 40, Code of Federal Regulations, as adopted or amended by the U.S. Environmental Protection Agency (EPA) on the date listed for each section, which are incorporated by reference in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles."

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

86.085-1 General applicability. July 7, 1986.
86.090-1 General applicability. April 11, 1989.
86.082-2 Definitions. November 2, 1982.
86.084-2 Definitions. December 10, 1984.
86.085-2 Definitions. November 26, 1983.
86.088-2 Definitions. March 15, 1985.
86.090-2 Definitions. April 11, 1989.
86.078-3 Abbreviations. January 21, 1980.
86.090-3 Abbreviations. April 11, 1989.
86.084-4 Section numbering; construction. September 25, 1980.
86.084-5 General standards; increase in emissions; unsafe conditions. November 2, 1982.
86.090-5 General standards; increase in emissions; unsafe conditions. April 11, 1989.
86.078-7 Maintenance of records; submitted information; right of entry. November 1, 1982.
86.087-8 Emission standards for 1987 light-duty vehicles. January 24, 1984.
86.090-8 Emission standards for 1990 and later model year light-duty vehicles. April 11, 1989.
86.088-9 Emission standards for 1988 and later model year light-duty trucks. October 31, 1988.
86.080-12 Alternative certification procedures. April 17, 1980.
86.085-13 Alternative durability program. May 19, 1983.
86.084-14 Small-volume manufacturer certification procedures. January 31, 1985.
86.090-14 Small-volume manufacturer certification procedures. April 11, 1989.
86.092-14 Small-volume manufacturer certification procedures. February 28, 1990.
86.095-14 Small-volume manufacturer certification procedures. June 5, 1991.
86.094-16 Prohibition of defeat devices. July 17, 1992.
86.085-20 Incomplete vehicles. January 12, 1983.
86.088-21 Application for certification. March 15, 1985.
86.090-21 Application for certification. April 11, 1989.
86.091-21 Application for certification. April 11, 1989.

86.094-21 Application for certification. July 17, 1992.
86.085-22 Approval of application for certification; test fleet selection, etc. July 7, 1986.
86.090-22 Approval of application for certification; test fleet selection, etc. April 11, 1989.
86.094-22 Approval of application for certification; test fleet selection, etc. July 17, 1992.
86.088-23 Required data. July 19, 1985.
86.090-23 Required data. April 11, 1989.
86.091-23 Required data. July 26, 1990.
86.094-23 Required data. June 5, 1991.
86.085-24 Test vehicles and engines. January 31, 1985.
86.090-24 Test vehicles and engines. April 11, 1989.
86.092-24 Test vehicles and engines. July 26, 1990.
86.094-24 Test vehicles and engines. July 17, 1992.
86.095-24 Test vehicles and engines. July 17, 1992.
86.085-25 Maintenance. July 7, 1986.
86.087-25 Maintenance. July 7, 1986.
86.088-25 Maintenance. July 7, 1986.
86.090-25 Maintenance. April 11, 1989.
86.084-26 Mileage and service accumulation; emission measurements. July 7, 1986.
86.090-26 Mileage and service accumulation; emission requirements. April 11, 1989.
86.085-27 Special test procedures. January 12, 1983.
86.090-27 Special test procedures. April 11, 1989.
86.088-28 Compliance with emission standards. July 7, 1986.
86.090-28 Compliance with emission standards. April 11, 1989.
86.091-28 Compliance with emission standards. July 17, 1992.
86.088-29 Testing by the Administrator. March 15, 1985.
86.090-29 Testing by the Administrator. April 11, 1989.
86.091-29 Testing by the Administrator. April 11, 1989.
86.088-30 Certification. January 24, 1984.
86.090-30 Certification. July 26, 1990.
86.091-30 Certification. July 26, 1990.
86.094-30 Certification. June 5, 1991.
86.095-30 Certification. June 5, 1991.
86.079-31 Separate certification. September 8, 1977.
86.079-32 Addition of a vehicle or engine after certification. September 8, 1977.
86.079-33 Changes to a vehicles or engine covered by certification. September 8, 1977.
86.082-34 Alternative procedures for notification of addition and changes. November 2, 1982.
86.088-35 Labeling. March 15, 1985.
86.090-35 Labeling. April 11, 1989.
86.091-35 Labeling. April 11, 1989.
86.094-35 Labeling. July 17, 1992.
86.095-35 Labeling. July 17, 1992.
86.079-36 Submission of vehicle identification numbers. November 14, 1978.
86.085-37 Production vehicles and engines. January 12, 1983.

86.085-38 Maintenance instructions. November 16, 1983.
86.087-38 Maintenance instructions. July 7, 1986.
86.079-39 Submission of maintenance instructions. September 8, 1977.
86.084-40 Automatic expiration of reporting and record keeping requirements. September 25, 1980.

Subpart B-Emission Regulations for 1977 and Later Model Year New Light-Duty Vehicles and New Light-Duty Trucks; Test Procedures.

86.101 General applicability. June 28, 1977.
86.102 Definitions. March 5, 1980.
86.103 Abbreviations. March 5, 1980.
86.104 Section numbering, construction. April 11, 1989.
86.105 Introduction; structure of subpart. April 11, 1989.
86.106-82 Equipment required; overview. March 5, 1980.
86.106-90 Equipment required; overview. April 11, 1989.
86.106-94 Equipment required; overview. June 5, 1991.
86.107-78 Sampling and analytical system, evaporative emissions. June 28, 1977.
86.107-90 Sampling and analytical system, evaporative emissions. April 11, 1989.
86.108-79 Dynamometer. September 12, 1977.
86.109-82 Exhaust gas sampling system; gasoline-fueled vehicles. March 5, 1980.
86.109-90 Exhaust gas sampling system; Otto-cycle vehicles. April 11, 1989.
86.109-94 Exhaust gas sampling system; Otto-cycle vehicles not requiring particulate emission measurements. June 5, 1991.
86.110-82 Exhaust gas sampling system; diesel vehicles. October 13, 1981.
86.110-90 Exhaust gas sampling system; diesel vehicles. April 11, 1989.
86.110-94 Exhaust gas sampling system; diesel vehicles. June 5, 1991.
86.111-82 Exhaust gas analytical-system. March 5, 1980.
86.111-90 Exhaust gas analytical-system. April 11, 1989.
86.111-94 Exhaust gas analytical-system. June 5, 1991.
86.112-82 Weighing chamber (or room) and microgram balance specifications. March 5, 1980.
86.112-91 Weighing chamber (or room) and microgram balance specifications. June 5, 1991.
86.113-90 Fuel Specifications. April 11, 1989.
86.113-91 Fuel Specifications. August 21, 1990.
86.113-94 Fuel Specifications. August 21, 1990.
86.114-79 Analytical gases. November 14, 1978.
86.114-94 Analytical gases. June 5, 1991.
86.115-78 EPA urban dynamometer driving schedules. June 28, 1977.
86.116-82 Calibrations, frequency and overview. March 5, 1980.
86.116-90 Calibrations, frequency and overview. April 11, 1989.
86.117-78 Evaporative emission enclosure calibrations. June 28, 1977.
86.117-90 Evaporative emission enclosure calibrations. April 11, 1989.
86.118-78 Dynamometer calibration. June 28, 1977.

86.119-78 CVS calibration. June 28, 1977.
86.119-90 CVS calibration. April 11, 1989.
86.120-82 Gas meter or flow instrumentation calibration, particulate measurement. March 5, 1980.
86.121-82 Hydrocarbon analyzer calibration. March 5, 1980.
86.121-90 Hydrocarbon analyzer calibration. April 11, 1989.
86.122-78 Carbon monoxide analyzer calibration. June 28, 1977.
86.123-78 Oxides of nitrogen analyzer calibration. September 12, 1977.
86.124-78 Carbon dioxide analyzer calibration. June 28, 1977.
86.126-78 Calibration of other equipment. June 28, 1977.
86.126-90 Calibration of other equipment. April 11, 1989.
86.127-82 Test procedures; overview. March 5, 1980.
86.127-90 Test procedures; overview. April 11, 1989.
86.128-79 Transmission. November 14, 1978.
86.129-80 Road load power test weight and inertia weight class determination. November 14, 1978.
86.129-94 Road load power test weight and inertia weight class determination. June 5, 1991.
86.130-78 Test sequence; general requirements. June 28, 1977.
86.131-78 Vehicle preparation. June 28, 1977.
86.131-90 Vehicle preparation. April 11, 1989.
86.132-82 Vehicle preconditioning. March 5, 1980.
86.132-90 Vehicle preconditioning. April 11, 1989.
86.133-78 Diurnal breathing loss test. November 16, 1983.
86.133-90 Diurnal breathing loss test. April 11, 1989.
86.135-82 Dynamometer procedure. December 10, 1984.
86.135-90 Dynamometer procedure. April 11, 1989.
86.136-82 Engine starting and restarting. March 5, 1980.
86.136-90 Engine starting and restarting. April 11, 1989.
86.137-82 Dynamometer test run, gaseous and particulate emissions. March 5, 1980.
86.137-90 Dynamometer test run, gaseous and particulate emissions. April 11, 1989.
86.138-78 Hot soak test. June 28, 1977.
86.138-90 Hot soak test. April 11, 1989.
86.139-82 Diesel particulate filter handling and weighing. March 5, 1980.
86.139-90 Diesel particulate filter handling and weighing. April 11, 1989.
86.140-82 Exhaust sample analysis. March 5, 1980.
86.140-90 Exhaust sample analysis. April 11, 1989.
86.142-82 Records required. March 5, 1980.
86.142-90 Records required. April 11, 1989.
86.143-78 Calculations; evaporative emissions. June 28, 1977.
86.143-90 Calculations; evaporative emissions. April 11, 1989.
86.144-78 Calculations; exhaust emissions. December 10, 1984.
86.144-90 Calculations; exhaust emissions. April 11, 1989.
86.144-94 Calculations; exhaust emissions. July 5, 1991.
86.145-82 Calculations; particulate emissions. October 13, 1981.

Subpart C-Emission Regulations for 1994 and Later Model Year Gasoline-Fueled New Light-Duty Vehicles and New Light-Duty Trucks; Cold Temperature Test Procedures.

86.201-94 General applicability. July 17, 1992.
86.202-94 Definitions. July 17, 1992.
86.203-94 Abbreviations. July 17, 1992.
86.204-94 Section number construction. July 17, 1992.
86.205-94 Introduction; structure of subpart. July 17, 1992.
86.206-94 Equipment required; overview. July 17, 1992.
86.208-94 Dynamometer. July 17, 1992.
86.209-94 Exhaust gas sampling system; gasoline-fueled vehicles. July 17, 1992.
86.211-94 Exhaust gas analytical system. July 17, 1992.
86.213-94 Fuel specifications. July 17, 1992.
86.214-94 Analytical gases. July 17, 1992.
86.215-94 EPA urban dynamometer driving schedule. July 17, 1992.
86.216-94 Calibrations, frequency and overview. July 17, 1992.
86.218-94 Dynamometer calibration. July 17, 1992.
86.219-94 CVS calibration. July 17, 1992.
86.221-94 Hydrocarbon analyzer calibration. July 17, 1992.
86.222-94 Carbon monoxide analyzer calibration. July 17, 1992.
86.223-94 Oxides of nitrogen analyzer calibration. July 17, 1992.
86.224-94 Carbon dioxide analyzer calibration. July 17, 1992.
86.226-94 Calibration of other equipment. July 17, 1992.
86.227-94 Test procedures; overview. July 17, 1992.
86.228-94 Transmissions. July 17, 1992.
86.229-94 Road load force, test weight, and inertia weight class determination. July 17, 1992.
86.230-94 Test Sequence; general requirements. July 17, 1992.
86.231-94 Vehicle Preparation. July 17, 1992.
86.232-94 Vehicle Preconditioning. July 17, 1992.
86.235-94 Dynamometer procedure. July 17, 1992.
86.236-94 Engine starting and restarting. July 17, 1992.
86.237-94 Dynamometer test run, gaseous emissions. July 17, 1992.
86.240-94 Exhaust sample analysis. July 17, 1992.
86.242-94 Records required. July 17, 1992.
86.244-94 Calculations; exhaust emissions. July 17, 1992.
86.246-94 Intermediate temperature testing. July 17, 1992.

APPENDIX II

Exhaust Emission-Data Vehicle Selection Criteria For Passenger Cars, Light-Duty Trucks and Medium-Duty Vehicles

I. Selection of Exhaust Emission-Data Vehicles (see flow diagram on page II-4)

A. Item 1 of the attached emission-data vehicle selection worksheet (page II-5) shall be prepared with the highest projected sales engine displacement-system combination first and the remainder in order of decreasing projected sales volume.

B. For engine families with a single engine displacement-exhaust emission control system combination representing 70 percent or more of the projected sales.

1. The first vehicle selection will be determined as follows:

a. The engine displacement-exhaust emission control system combination shall be the one with the highest projected sales. (Item 1, on worksheet.)

b. Using the data entered in Item 2 of the worksheet and the formula shown below, the equivalent test weight of the vehicle is determined from the calculated sales weighted equivalent test weight for that engine displacement-exhaust emission control system combination.

Sales Weighted Test Weight (SWTW)

Determine the sales weighted test weight as follows:

T_i = Test weight of i'th class
S_i = Sales volume of i'th class
N = Number of test weight classes

$$SWTW = \frac{\sum_{i=1}^{N} S_i T_i}{\sum_{i=1}^{N} S_i}$$

Select the equivalent test weight that includes the calculated SWTW. If the SWTW is exactly between two equivalent test weights, select the higher equivalent test weight. Similarly, if there are no vehicles with the desired displacement-exhaust emission control system combination in the

same equivalent test weight that includes the calculated SWTW, the next higher equivalent test weight that contains such a vehicle will be specified.

c. The transmission will be the class with the highest sales for the engine displacement-exhaust emission control system combination (Item 3, worksheet). If the highest sales transmission class is not available in the equivalent test weight determined in (b), above, the next higher equivalent test weight with the highest sales transmission class will be selected. If manual transmissions are the highest selling class, the transmission configuration with the highest sales should generally be selected (Item 4, worksheet). If the manufacturer wishes to test a vehicle with an M-4 transmission both as an M-4 vehicle and an M-3 vehicle, use of the vehicle with an M-4 transmission will be allowed provided the first three gear ratios are identical in both transmissions. Similarly, use of an M-5 will be allowed to represent both an M-5 vehicle and an M-4 vehicle, providing the first four gear ratios are identical in both transmissions.

d. The highest selling engine code within the engine displacement-exhaust emission control system-equivalent test weight-transmission class combination will be specified (Item 5, worksheet).

e. The highest selling body style within the engine displacement-exhaust emission control system-equivalent test weight-transmission class-engine code combination will be specified (Item 6, worksheet.)

f. The N/V ratio will be the standard ratio (standard tire and axle ratio combination) for the vehicle selected (Item 7, worksheet).

g. Standard or optional equipment that can reasonably be expected to influence emissions (Item 8, worksheet) and is expected to be installed on more than 33 percent of the vehicles in the car line within the engine-system combination shall be specified (and the full estimated weight of those items should be included in the curb weight computation) unless an item is not available on the particular vehicle specified. Other standard or optional equipment expected to be installed on more than 33 percent of the vehicles in the car line within the engine-system combination shall have their full estimated weight included in the curb weight computation and be included in the specified vehicle's weight. Overdrive units are considered transmission configurations and not items of optional equipment. The weight of an overdrive unit should be included in the curb weight computation of vehicles with such units. (In other words, the weight of overdrive units should not be disregarded when car line sales of such items are 33 percent or less.)

2. The second vehicle will be determined as follows.

a. The transmission class, from Item 3 of worksheet, with the second highest sales will be specified if this transmission class has projected sales of more than 30

percent of the engine displacement-exhaust emission control system combination. The equivalent test weight, engine code body style, N/V ratio, and optional equipment specified for the second vehicle are determined by criteria in Section 1.

b. If the second transmission class does not meet the criteria of 2.a. above, the second vehicle will be the worst case vehicle selected from the family.

c. For engine families with multiple displacement-emission control system combinations, the first vehicle selection will be highest sales combination, and the second vehicle selection will be second highest sales combination. Other vehicle configuration details will be as in Section B.1.b. through B.1.g.

d. An exception to the two maximum emission-data vehicles may occur for engine families with vehicles in multiple standard classifications, i.e., loaded vehicle weight classifications for light-duty trucks and/or medium-duty vehicles. The first vehicle selection will be determined as above in B.1. in the highest sales loaded vehicle weight classification, and the subsequent vehicle selection(s) will be a worst case vehicle(s) in the other loaded vehicle weight classification(s).

C. For determining cold temperature CO exhaust emission compliance for each engine family, the Executive Officer shall select for testing the vehicle expected to emit the highest emissions from the vehicles selected in accordance with sections I.A. and I.B. of this Appendix. The selected vehicle shall be tested by the manufacturer in accordance with the test procedures in Subpart C, Part 86, Title 40, Code of Federal Regulations or with alternative procedures requested by the manufacturer and approved in advance by the Executive Officer.

Emission-Data Vehicle Selection Worksheet

Manufacturer _____ Date _____

Engine Family _____

1. **Vehicle Selection**

	Engine Displacement	Emission Control System	Unit	Percent	Cumulative%
a)	_____	_____	____	_____	_____
b)	_____	_____	____	_____	_____
c)	_____	_____	____	_____	_____
d)	_____	_____	____	_____	_____

2. **Sales Weighted Test Weight**

Total projected sales: _____

	Test Weight - lb.	Sales Volume
a)	_____	_____
b)	_____	_____
c)	_____	_____
d)	_____	_____

Calculated SWTW_____ lbs. Equivalent Test Weight _____ lbs.

3. **Transmission Selection**

	Class	Sales Volumes	Percentage Sales	High Sales
a)	_____	_____	_____	_____
b)	_____	_____	_____	_____

4. **Transmission Configuration**

	Configuration	Sales Volumes	High Sales
a)	_____	_____	_____
b)	_____	_____	_____
c)	_____	_____	_____

5.	**Engine Code** (within 1, 2, 3, and 4 above)	Sales Volumes	High Sales
a)	_____	_____	_____
b)	_____	_____	_____
c)	_____	_____	_____
d)	_____	_____	_____

6.	**Body Style** (within 1, 2, 3, 4, and 5 above)	Sales Volumes	High Sales
a)	_____	_____	_____
b)	_____	_____	_____
c)	_____	_____	_____
d)	_____	_____	_____
e)	_____	_____	_____
f)	_____	_____	_____

7. **STD Axle**_____ **STD N/V** _____.

8. **Options over 33 percent**

9. **Second and Subsequent Selections Vehicles**

   a) High Sales Engine Displacement-Exhaust Emission Control System_____

   b) Second-Highest Selling Transmission Class_____

Designated Second and Subsequent Selections Vehicles

Disp.	Eng. Code	Evap. Code	Model	Trans.	ETW	Axle	N/V

APPENDIX III

Determination of Acceptable Durability Test Schedule*

A manufacturer may determine mileage test intervals for durability-data vehicles subject to the conditions specified in 40 CFR 86.084-26 or 86.090-26. The following procedure shall be used to determine if the schedule is acceptable to the Executive Officer.

1. Select exhaust system mileage test points and maintenance mileage test points for proposed (prop) schedule.

2. Calculate the sums of the squares corrected to the mean of the system mileages at the proposed test points:

$$A_{prop} = [\Sigma(X_P)^2 - ((\Sigma X_P)^2 / N_P)]_{prop}$$

Where:

X_p = Individual mileages at which the vehicle will be tested.
N_p = Total number of tests (including before and after maintenance tests).
(Subscript "p" refers to proposed test schedule).

3. Determine exhaust system mileage test points and maintenance mileage test points based on testing at five thousand mile intervals from 5,000 miles through the final testing point and maintenance mileage test points selected for the proposed schedule in section 1. This schedule will be designated as the standard(std) test schedule.

4. Calculate the sums of squares corrected to the mean of the standard schedule.

$$B_{std} = [\Sigma(X_s)^2 - ((\Sigma X_s)^2 / N)]_{std}$$

Where:

X_s = Individual mileages at which the vehicle will be tested.
N_s = Total number of tests (including before and after maintenance).
(Subscript "s" refers to standard test schedule).

5. Refer to Table I and determine t_p at $(N_p - 2)_{prop}$ degrees of freedom and t_s at $(N_s - 2)_{std}$.

---

* For diesel vehicles equipped with periodically regenerating trap oxidizer systems (or those with continuously regenerating trap oxidizer systems elected to be certified to the provisions of diesel vehicles with periodically regenerating trap oxidizer systems), additional test schedule requirements for regeneration tests must be met as outlined in subparagraphs 6.a.4.(B) and 6.b.7.(D) in these procedures.

If $(A_{prop})^{½} \geq t_p / t_s \times (B_{std})^{½}$ the proposed plan is acceptable.

Table I

Degrees of freedom N-2	t
1	6.314
2	2.920
3	2.353
4	2.132
5	2.015
6	1.943
7	1.895
8	1.860
9	1.833
10	1.812
11	1.796
12	1.782
13	1.771
14	1.761
15	1.753
16	1.746
17	1.740
18	1.734
19	1.729
20	1.725
21	1.721
22	1.717
23	1.714
24	1.711
25	1.708

APPENDIX IV

Procedure for Determining An Acceptable Exhaust Regeneration Durability-Data Test Schedule for Diesel Cycle Vehicles, Equipped with Periodically Regenerating Traps Oxidizer Systems

1. Select exhaust system mileage test points for proposed (prop) schedule.

2. Calculate the sums of the squares corrected to the mean of the system mileages at the proposed test points:

$$A_{prop} = [\Sigma(X_p)^2 - ((\Sigma X_p)^2 / N_p)]_{prop}$$

Where:

X_p = Individual mileages at which the vehicle will be tested.
N_p = Total number of tests (including before and after maintenance tests).
(Subscript "p" refers to proposed test schedule).

3. The exhaust system mileage tests points at 5,000, 20,000, 35,000 and 50,000 miles will be designated as the standard (std) test schedule.

4. Calculate the sums of square corrected to the mean of the standard tests schedule.

$$B_{std} = [\Sigma(X_s)^2 - ((\Sigma X_s)^2 / N_s)]_{std}$$

Where:

X_s = Individual mileages at which the vehicle will be tested.
N_s = Total number of regeneration emission tests.
(Subscript "s" refers to standard test schedule)

5. Refer to Table I and determine t_p at $(N_p - 2)_{prop}$ degrees of freedom and t_s at $(N_s - 2)_{std}$ degrees of freedom.

If $(A_{prop})^{½} \geq t_p / t_s \times (B_{std})^{½}$ the proposed plan is acceptable.

Table I

Degrees of freedom N-2	t
1	6.314
2	2.920
3	2.353
4	2.132
5	2.015
6	1.943
7	1.895
8	1.860
9	1.833
10	1.812
11	1.796
12	1.782
13	1.771
14	1.761
15	1.753

APPENDIX V

Pollutant Mass Emissions Calculation Procedure for Gaseous-Fueled Vehicles and for Vehicles Equipped with Periodically Regenerating Trap Oxidizer Systems*

I. Gaseous-Fueled Vehicle Pollutant Mass Emission Calculation Procedure

For 1988 through 1990 model-year gaseous-fueled vehicles. these calculation procedures are to be used in lieu of those in subparagraph 86.144-78, and 86.144-90 Part 86, Title 40, Code of Federal Regulations (CFR) when calculating the mass emissions from vehicles fueled with either liquefied petroleum gas or compressed natural gas. This calculation procedure is based on the "Positive Displacement Pump- Constant Volume Sampler (PDP-CVS)" exhaust sampling system. For 1991 and subsequent model-year gaseous-fueled vehicles, the calculation procedures specified in "California Non-Methane Hydrocarbon Test Procedures" shall apply to all vehicles certified to the emission standards of section 3.b., 3.e, and 3.f. of these test procedures. For all TLEVs, LEVs, and ULEVs, the calculation procedures specified in "California Non-Methane Organic Gas Test Procedures" shall apply.

The reported test results shall be computed by use of the following formulas:

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 1:2.658 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_{2e} = Carbon dioxide concentration of the dilute exhaust sample, in percent.

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

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

$CO_{2\ dens}$ = Density of carbon dioxide is 51.81 g/ft^3 at 68° F and 760 mm Hg pressure.

HC_{dens} = 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 1:2.658 for LPG, at 68° F and 760 mm Hg pressure.

---

* These calculation procedures are based on the Federal CVS-1975 Test Procedure.

$NO_{2\,dens}$= Density of oxides of nitrogen is 54.16 9/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.

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

NOx_d = Oxides of nitrogen concentration of the dilute air as measured, in ppm.

NOx_e = Oxides of nitrogen concentration of the dilute exhaust sample as measured, in ppm.

NOx_{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 temp.

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.

VMIX = Total dilute exhaust volume in cubic feet per test phase corrected to standard conditions (528° 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 hot start test, in grams per test phase.

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

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

D_{ct} = The measured driving distance from the "transient" phase of the cold start test, in miles.

D_{ht} = The measured distance from the "transient" phase of the hot start test, in miles.

D_s = The measured driving distance from the "stabilized" phase of the cold start test, in miles.

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

(a) The mass emissions of each pollutant in grams per mile is:

$$Y_{wm} = 0.43 * \frac{(Y_{ct} + Y_s)}{(D_{ct} + D_s)} + 0.57 * \frac{(Y_{ht} + Y_s)}{(D_{ht} + D_s)}$$

(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} = VMIX x HC_{dens} x (HC_{conc} / 1,000,000)

(2) Oxides of nitrogen mass:

NOx_{mass} = VMIX x $NO_{2\,dens}$ x K_H x (NOx_{conc} / 1,000,000)

K_H = humidity correction factor

(3) Carbon monoxide mass:

CO_{mass} = VMIX x CO_{dens} x (CO_{conc} / 1,000,000)

(4) Carbon dioxide mass:

$CO_{2\,mass}$ = VMIX x $CO_{2\,dens}$ x ($CO_{2\,conc}$ / 100)

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

Hc_{conc} = HC_e - HC_d (1-1/DF)
NOx_{conc} = NOx_e - NOx_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} for natural gas

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

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

K_H = $1 / [1\text{-}0.\text{-}0047(H\text{-}75)]$

H = $(43.478R)(P_d) / P_B - [(P_d \times R_a) / 1]$

DF = $9.77 / [CO_{2e} + (HC_e + CO_e) \times 10\text{-}4]$ for natural gas

DF = $11.7 / [CO_{2e} + (HC_e + CO_e) \times 10\text{-}4]$ for LPG

II. Pollutant Mass Emissions Calculation Procedure for Vehicles Equipped with Periodically Regenerating Trap Oxidizer Systems

Exhaust Emissions

Amend subparagraph 86.144-88(a) in Part 86, Title 40, Code of Federal Regulations (CFR) to read:

The final reported test results shall be computed by the use of the following formula:

(a) For light-duty vehicles and light-duty trucks:

$$Y_{wm} = 0.43\ ((Yct + Ys)/(Dct + Ds)) + 0.57\ ((Yht + Ys)/(Dht + Ds))$$

For purposes of adjusting emissions for regeneration:

$$Re = ((Yr1 - Yct) + (Yr2 - Ys) + (Yr3 - Yht))/(Dct + Ds + Dht)$$

$$Yr = Ywm^{**} + Re$$

Where:

Ywm**= Weighted mass emissions of each pollutant, i.e., HC, CO, NOx or CO , in grams per vehicle mile.

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

Yht = Mass emissions as calculated from the "transient" phase of the hot start test in grams per test phase.

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

Dct = The measured driving distance from the "transient" phase of the cold start test, in miles.

Dht = The measured distance from the "transient" phase of the hot start test, in miles.

** Ywm is derived using the emission data from a test with no regeneration.

Ds = The measured driving distance from the "stabilized" phase of the cold start test, in miles.

Yr = Regeneration emission test.

Re = Mass emissions of each pollutant attributable to regeneration in grams per mile.

Yr1 = Mass emissions, during a regeneration emission test, as calculated from the "transient" phase of the cold start test, in grams per test phase.

Yr2 = Mass emissions, during a regeneration emission test, as calculated from the "stabilized" phase of the cold start test, in grams per test phase.

Yr3 = Mass emissions, during a regeneration emission test, as calculated from the "transient" phase of the hot start test in grams per test phase.

Particulate Emissions

Amend subparagraph 86.145-82(a) in Part 86, Title 40, Code of Federal Regulations (CFR) to read:

(a) The final reported test results for the mass particulate (Mp) in grams/mile shall be computed as follows.

For purposes of adjusting emissions for regeneration:

$$Mp = 0.43(Mp1 + Mp2)/(Dct + Ds) + 0.57\ (Mp3 + Mp2/(Dht + Ds)$$

$$Re = ((Mpr1 - Mp1) + (Mpr2 - Mp2) + (Mpr3 - Mp3))/(Dct+Ds+Dht)$$

$$Mpr = Mp^{***} + Re$$

Where:

(1) Mp1 = Mass of particulate determined from the "transient" phase of the cold start test, in grams per test phase. (See 86.110-82(c)(1) and 86.110-88(d)(1) for determination.)

(2) Mp2 = Mass of particulate determined from the "stabilized" phase of the cold start test, in grams per test phase. (See 86.110-82(c)(1) and 86.110-88(d)(1) for determination.)

(3) Mp3 = Mass of particulate determined from the "transient" phase of the hot start test, in grams per test phase. (See 86.110-82(c)(1) and 86.110-88(d)(1) for determination.)

(4) Dct = The measured driving distance from the "transient" phase of the cold start test, in miles.

(5) Ds = The measured driving distance from the "stabilized" phase of the cold start test, in miles.

*** Mp is derived using the emission data from a test with no regeneration.

(6) Dht = The measured driving distance from the "transient" phase of the hot start test, in miles.

(7) Mpr = Regeneration emission test

(8) Re = Mass of particulate attributable to regeneration in grams/mile.

(9) Mpr1 = Mass of particulate determined, during a regeneration emission test, from the "transient" phase of the cold start test in grams per test phase. (See 86.110-82(c)(1) and 86.110-88(d)(1) for determination.)

(10) Mpr2 = Mass of particulate determined, during a regeneration emission test, from "stabilized" phase of the cold start test, in grams per test phase. (See 86.110-82(c)(1) and 86.110-88(d)(1) for determination.)

(11) Mpr3 = Mass of particulate determined, during a regeneration emission test, from the "transient" phase of the hot start test, in grams per test phase. (See 86.110-82(c)(1) and 86.110-88(d)(1) for determination.)

III. Fuel Economy Calculations for Gaseous Fuels Based on the Cold Start CVS-1975 Federal Test Procedure

Assume the fuel meets HD-5 specifications (95% C_3H_8 , 5% nC_4H_{10} , by volume)

1. Physical constants of Propane and Normal Butane

Component	Mol.Wt.	SP.Gr.	Liquid Density lb/gal @ 60°F	Liquid Density of HD-5 lb/gal @ 60°F
C_3H_8	44.094	0.508	4.235 x (0.95) =	4.0233
nC_4H_{10}	58.12	0.584	4.868 x (0.95) =	.2434
				4.2667

2. Density of the HD-5 fuel

(0.95 X 4.235) + (0.05 X 4.868) = 4.267 lb/gal @ 60°F

3. Molecular Weights

Species	Mol. Wt.
C	12.01115
H	1.00797
0	15.9994
CO	28.01055
CO_2	44.00995
$CH_{2.658}$*	14.6903

* Average ratio of Hydrogen to carbon atoms in HD-5 fuel.

C_3H_8	8/3	=	2.666 x 0.95 (% propane)	=	2.533
nC_4H_{10}	10/4	=	2.5 x 0.05 (% Butane)	=	0.125
					2.658

4. Weight of Carbon in:

CO = wt. of CO x (12.01115/28.01055) = wt CO x (0.429)

CO_2 = wt. of CO_2 x (12.01115/44.00995) wt CO_2 x (0.273)

$CH_{2.658}$ = wt. of $CH_{2.658}$ x (12.01115/14.6903) = wt $CH_{2.658}$ x (0.818)

5. Wt. of Carbon per gallon of LPG

wt. of carbon = 4.2667 lbs/gal x 453.59 gms/lb x 0.818
= 1583 grams C/gal HD-5

6. Fuel economy:

$$\frac{grams\ C/gal}{grams\ C\ in\ exhaust/mi} = miles/gal$$

$$LPG = \frac{1583\ gms\ C/gal}{(0.818)(HC) + (0.429)(CO) + (0.273)(*CO2)}$$

HC = CVS HC in grams/mile
CO = CVS CO in grams/mile
CO_2 = CVS CO_2 in grams/mile

For gasoline: = $2421 / (0.866)(HC) + (0.429)(CO) + (0.273)(CO_2)$
For Natural Gas: = $1535 / (0.759)(HC) + (0.429)(CO) + (0.273)(CO_2)$

APPENDIX VI

Blanket Approval of Running Changes and Field Fixes

Running changes and field fixes meeting the following definitions shall be granted automatic or "blanket" approval by the Executive Officer provided that notification of changes listed in paragraph 1. below are received by the ARB at least five working days before implementation, and notification of changes listed in 2. through 13. below are received by the ARB within two working days after implementation. Such automatic approvals shall be effective when they are approved by EPA.

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

1. The addition of new models to an engine family where the new models differ from previously certified models only in model name and curb weight (same inertia weight class), and where the exhaust, evaporative and fill pipe emission control system specifications do not change.

2. Changes in axle ratio, tire size or tire type, providing that changes to the N/V ratio and/or load horsepower are within 5% of the originally certified values. This includes re-classification of base and optional axle ratios or tires.

3. The deletion of models or vehicle configurations.

4. Changes in fuel tank capacity of less than 10 percent of the originally certified capacity, providing there is no other modification of the evaporative emission control system.

5. Changes to the fuel filler system leaded fuel nozzle restrictor, where EPA preemption is involved.

6. Advance certification of models in the next higher inertia weight class, for use if needed later.

7. Changes in tailpipe length of less than ten inches.

8. The following changes involving spark plugs:

    a. The addition of resistor-type spark plugs if nonresistor spark plugs are standard, or vice-versa, providing the secondary circuit resistance changes less than 5 percent.

b. The addition of alternate heat ranges within one range of the originally certified spark plugs.

c. The change of spark plug gap within 15 percent of originally certified spark plug gap.

9. Changes to component part numbers when there are no changes in the materials used or to the performance specifications (e.g. distributor advance curves, carburetor flow curves, fuel pump supply pressure, etc.). These changes may be the result of parts consolidation, changes in supplier, addition/deletion of peripheral items such as brackets, and minor dimensional changes where the durability and performance are not affected.

10. Changes in the crankcase emission control system where EPA preemption is involved, excluding revisions that could have an interaction effect on exhaust emissions (e.g., PCV purge flow changes).

11. Changes submitted under the alternate or concurrent notification procedure in 40 CFR 86 which would otherwise qualify for automatic or "blanket" status.

12. Changes in the physical location of a vacuum hose connection with no change in the relationship between vacuum, speed, load, or any other vacuum-related parameter, provided that the changes do not render the vacuum hose routing diagram unrepresentative.

13. Changes in exhaust system cross sectional area, if this area equals or exceeds the minimum area in the system.

APPENDIX VII

Calculation of t-Statistic for Deterioration Data Outlier Test

Residual normal deviates to indicate outliers are used routinely and usefully in analyzing regression data, but suffer theoretical deficiencies if statistical significance tests are required. Consequently, the procedure for testing for outliers outlined by Snedecor and Cochran, 6th ed., Statistical Methods, pp. 157-168 will be used. The method will be described generally, then by appropriate formulae, and finally a numerical example will be given.

Linearity is assumed (as in the rest of the deterioration factor calculation procedure), and each contaminant is treated separately. The procedure is as follows:

Calculate the deterioration factor regression as usual, and determine the largest residual in absolute value. Then recalculate the regression with the suspected outlier omitted. From the new regression line calculate the residual at the deleted point, denoted as $(y_i - y_i')$. Obtain a statistic by dividing $y_i - y_i'$ by the square root of the estimated variance of $(y_i - y_i')$. Find the tailed probability, p, from the t-distribution corresponding to the quotient (double-tailed), with n-3 degrees of freedom, with n the original sample size.

This probability, p, assumes the suspected outlier is randomly selected, which is not true. Therefore, the outlier will be rejected only if $1 - (1- p)^n \leq .05$.

The procedure will be repeated for each contaminant individually until no outliers are indicated.

When an outlier is found, the vehicle test log will be examined. If an unusual vehicle malfunction is indicated, data for all contaminants at that test point will be rejected: otherwise, only the identified outlier will be omitted in calculating the deterioration factor.

Procedure for the calculation of the t-statistic for Deterioration Data Outlier Test.

Given a set of n points, (x_1, y_1), $(x_2, y_2)...(x_n, y_n)$.

Where:

x_i is the mileage of the i^{th} data point
y_i is the emission of the i^{th} data point

Assume model:

$$y = \alpha + \beta(x - \bar{x}) + \epsilon$$

I. i) Calculate the regression line.

$$\hat{y} = a + b(x - \bar{x})$$

ii) Suppose the absolute value of the i^{th} residual $(y_i - \hat{y}_i)$ is the largest.

II. i) Calculate the regression line with the i^{th} point deleted.

$$\hat{y}' = a' + b'(x - \bar{x})$$

ii) $$Let\ t = \frac{(y_i - \hat{y}_i')}{\sqrt{\hat{var}\ (y_i - \hat{y}_i')}}$$

Where y_i is the observed suspected outlier and $\hat{y}_i'$ is the predicted value with the suspected outlier deleted.

$$\hat{var}(y_i - \hat{y}_i') = S_2\left(1 + \frac{1}{n-1} + \frac{(x_i - x)^2}{\sum_{j=1}^{n}(x - \bar{x})^2}\right), \quad j \neq i$$

(x is calculated without the suspected outlier)

$$S_2 = \frac{\sum_{j=1}^{n}(y_j - \bar{y}_j')^2}{n-3}, \quad j \neq i$$

iii) Find p form the t-statistic table

Where

P = prob(|t(n-3)| ≥ t)

t(n-3) is a t-distributed variable with n-3 degrees of freedom.

iv) y_i is an outlier if $1 - (1 - p)^n < .05$

Example

x	y	$\hat{y}$	$y-\hat{y}$
8	59	56.14	2.86
6	58	58.17	-0.17
11	56	53.10	2.90

*	-22	53	41.96	11.04
	14	50	50.06	-0.06
	17	45	47.03	-2.03
	18	43	46.01	-3.01
	24	42	39.94	2.06
	19	39	45.00	-6.00
	23	38	40.95	-2.95
	26	30	37.91	-7.91
	40	27	23.73	3.27

Assume model:

$$y = \alpha + \beta(x - \bar{x}) + \epsilon$$

$$y = 45 - 1.013(x - x)$$

* Suspected outlier

Suspected point out of regression:

$$y = 44.273 - 1.053(x - \bar{x})$$

$$y = 44.273 - 1.053(22 - 18.727) = 40.827$$

$$y_i - \hat{y}_i' = 12.173$$

$$\hat{var}(y_i - \hat{y}_i') = S^2\left(1 + \frac{1}{11} + \frac{10.711}{914.182}\right)$$

APPENDIX VIII

Procedure for Determining Vehicle Emission Control Technology Category/Fuel Reactivity Adjustment Factors

The following procedure shall be used by the Executive Officer to establish the reactivity adjustment factor for exhaust emissions of non-methane organic gases (NMOG) and establish the "methane reactivity adjustment factor" for exhaust methane emissions from natural gas vehicles, for the purpose of certifying a vehicle of specific emission control technology category and fuel for sale in California. The NMOG emission results from Transitional Low-Emission Vehicles (TLEVs), Low-Emission Vehicles (LEVs), and Ultra-Low-Emission Vehicles (ULEVs) designed to operate on any available fuel other than conventional gasoline, including fuel-flexible and dual-fuel vehicles when operating on any available fuel other than conventional gasoline, shall be numerically-adjusted to establish a NMOG exhaust mass emission value equivalent, in terms of ozone-forming potential, to the NMOG exhaust mass emissions from conventional gasoline-fueled vehicles of the same vehicle emission control technology category.

(1) The Executive Officer shall determine representative speciated NMOG exhaust emission profiles for light- and medium-duty conventional gasoline-fueled TLEVs, LEVs, and ULEVs according to the following conditions.

a. All testing will be conducted using a specified gasoline blend representative of commercial gasoline and having the specifications listed in (9).

b. Speciated NMOG profiles shall be obtained from a statistically valid number of TLEVs, LEVs, and ULEVs.

c. The speciated NMOG profiles shall identify and quantify, in units of g/mile or mg/mile, as many constituents as possible in accordance with the procedures specified in "California Non-Methane Organic Gas Test Procedures."

(2) The "g ozone potential per mile" of each NMOG identified in the speciated profile shall be determined by multiplying the "g/mile NMOG" emission value of the constituent NMOG by its maximum incremental reactivity given in (10).

(3) The "total g ozone potential per mile" of NMOG exhaust emissions from the vehicle/fuel system shall be the sum of all the constituent NMOG "g ozone potential per mile" values calculated in step (2).

(4) The "g ozone potential per g NMOG" for the vehicle/fuel system shall be determined by dividing the "total g ozone potential per mile" value calculated in step (3) by the "total g/mile of NMOG emissions".

(5) For light- and medium-duty candidate vehicle/fuel systems not powered by conventional gasoline, the Executive Officer shall establish "reactivity adjustment factors" calculated from exhaust emission profiles derived according to the same conditions specified in parts b and c of step (1).

(6) The "g ozone potential per g NMOG" for candidate vehicle/fuel systems not powered by conventional gasoline shall be determined according to steps (2), (3), and (4).

(7) a. The candidate vehicle/fuel "reactivity adjustment factor" shall be determined by dividing the "g ozone potential per g NMOG" calculated in step (6) by the "g ozone potential per g NMOG" value for the vehicle in the same emission control technology category operated on conventional gasoline. The "g ozone potential per g NMOG" values for conventional gasoline vehicles are listed in Section 13.d. of these test procedures or shall be established by the Executive Officer pursuant to Appendix VIII of these test procedures. For candidate vehicle/fuel systems powered by methanol or liquefied petroleum gas, the quotient calculated above shall be multiplied by 1.1. The resulting value shall constitute the "reactivity adjustment factor" for the methanol or liquefied petroleum gas-powered vehicle/fuel system.

b. For candidate vehicle/fuel systems operating on natural gas, a "methane reactivity adjustment factor" shall be calculated by dividing the maximum incremental reactivity value for methane given in (10) by the "g ozone potential per g NMOG" value for the vehicle in the same emission control technology category operated on conventional gasoline as listed in Section 13.d. of these test procedures or established by the Executive Officer pursuant to Appendix VIII of these test procedures.

(8) The Executive Officer shall assign a reactivity adjustment factor unique to a specific engine family at the request of a vehicle manufacturer provided that each of the following occurs:

a. The manufacturer submits speciated NMOG exhaust emission profiles to the Executive Officer obtained from emission testing a minimum of four different vehicles representative of vehicles that will be certified in the engine family. The test vehicles shall include the official emission-data vehicle(s) for the engine family, and the mileage accumulation of each vehicle shall be at or greater than 4000 miles. One speciated profile shall be submitted for each test vehicle. Emission levels of each constituent NMOG shall be measured according to the "California Non-Methane Organic Gas Test Procedures." For the emission-data vehicle(s), the speciated profile(s) shall be obtained from the same test used to obtain the official exhaust emission test results for the emission-data vehicle at

the 4,000 mile test point. The manufacturer shall calculate "g ozone potential per g NMOG" values for each speciated NMOG exhaust emission profile in accordance with the procedures specified in steps (2), (3), and (4) above. By using these "g ozone potential per g NMOG" values, the manufacturer shall calculate a "reactivity adjustment factor" for each test vehicle in accordance with the procedure specified in step (7) above. A "reactivity adjustment factor" for the engine family shall be calculated by taking the arithmetic mean of the "reactivity adjustment factor"' obtained for each test vehicle. The 95 percent upper confidence bound (95% UCB) shall be calculated according to the equation:

$$95\%\ UCB = RAF + 1.96 \times \left[\sum_{i=1}^{n} (RAF_i - RAF_m)^2 / (n-1) \right]^{1/2}$$

where:

RAF_m = mean "reactivity adjustment factor" calculated for the engine family

RAF_i = "reactivity adjustment factor" calculated for the i'th test vehicle

n = number of test vehicles

The 95 percent upper confidence bound of the "reactivity adjustment factor" for the engine family shall be less than or equal to 115 percent of the engine family "reactivity adjustment factor."

b. The manufacturer submits an "ozone deterioration factor" for the engine family. To determine the "ozone deterioration factor," the manufacturer shall perform two tests at each mileage interval for one or more durability vehicle(s) tested in accordance with the procedures and conditions specified in Sections 6 and 10 of these California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles for calculating mass deterioration factors. The Executive Officer shall approve the use of other mileage intervals and procedures if the manufacturer can demonstrate that equivalently representative "ozone deterioration factors" are obtained. One speciated profile shall be submitted for each test. Emission levels of each constituent NMOG shall be measured according to the "California Non-Methane Organic Gas Test Procedures. A mean g/mi NMOG mass value and a mean "g ozone per g NMOG" value shall be calculated by taking the arithmetic mean of each measurement from the speciated profiles. These results shall be multiplied together to obtain a mean "total g ozone potential per mile" value at each mileage interval. A mean "ozone deterioration factor" shall be calculated in accordance with the procedures in Sections 6, 10, and Appendix VIII of these California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles except that the mean total "g ozone potential per mile" value determined at each mileage interval shall be used in place of measured mass emissions. If the "ozone deterioration factor" is determined to be less than 1.00, the "ozone deterioration factor" shall be assigned a value of 1.00.The "ozone deterioration factor"

shall be multiplied by the product of the official exhaust NMOG mass emission results at the 4000 mile test point and the mean "reactivity adjustment factor" for the engine family to obtain the NMOG certification levels used to determine compliance with the NMOG emission standards.

c. The speciated profiles, mean "reactivity adjustment factor" for the engine family, and "ozone deterioration factor" are provided to the Executive Officer with the certification application for the engine family.

(9) Gasoline meeting the specifications listed below shall be used to determine the "g ozone potential per g NMOG" of conventional gasoline:

Fuel Property	Limit
Sulfur, ppm by weight	300 ± 50
Benzene, volume percent	1.6 ± 0.3
Reid vapor pressure, psi	8.7 ± 0.3
Distillation, D-86 degrees F	
10%	115-135
50%, maximum	240
90%	323-333
EP, maximum	420
Hydrocarbon Type, volume percent	
Total Aromatics	32 ± 3.0
Multi-substituted alkyl aromatics	21 ± 3.0
Olefins	12 ± 3.0
Saturates	remainder

(The test methods used for each fuel property shall be the same as the test method for the identical fuel property listed in section 9.a.1. of these test procedures.)

(10) The maximum incremental reactivities to be used in step (2) are provided in the table below. Any manufacturer which intends to use the table shall submit to the Executive Officer a list which provides the specific organic gases measured by the manufacturer and the maximum incremental reactivity value assigned to each organic gas prior to or with the submittal of a request for the use of a reactivity adjustment factor unique to a specific engine family. The Executive Officer may deny such requests if he or she determines that the maximum incremental reactivity value assignments are made incorrectly.

Maximum Incremental Reactivity (MIR) Values
(Units: grams ozone/gram organic gas)

CAS #	COMPOUND	MIR
	Alcohols	
00067-56-1	methanol	0.56
00064-17-5	ethanol	1.34
	Light End and Mid-Range Hydrocarbons (Listed in approximate elution order)	
	methane	0.0148
00074-85-1	ethene	7.29
00074-86-2	ethyne	0.50
00074-84-0	ethane	0.25
00115-07-1	propene	9.40
00074-98-6	propane	0.48
00463-49-0	1,2-propadiene	10.89
00074-99-7	1-propyne	4.10
00075-28-5	methylpropane	1.21
00115-11-7	2-methylpropene	5.31
00106-98-9	1-butene	8.91
00106-99-0	1,3-butadiene	10.89
00106-97-8	n-butane	1.02
00624-64-6	trans-2-butene	9.94
00463-82-1	2,2-dimethylpropane	0.37
00107-00-6	1-butyne	9.24
00590-18-1	cis-2-butene	9.94
00563-45-1	3-methyl-1-butene	6.22
00078-78-4	2-methylbutane	1.38
00503-17-3	2-butyne	9.24
00109-67-1	1-pentene	6.22
00563-46-2	2-methyl-1-butene	4.90
00109-66-0	n-pentane	1.04
00078-79-5	2-methyl-1,3-butadiene	9.08
00646-04-8	trans-2-pentene	8.80
00558-37-2	3,3-dimethyl-1-butene	4.42
00627-20-3	cis-2-pentene	8.80
00689-97-4	1-buten-3-yne	9.24
00513-35-9	2-methyl-2-butene	6.41

CAS #	COMPOUND	MIR
00542-92-7	1,3-cyclopentadiene	7.66
00075-83-2	2,2-dimethylbutane	0.82
00142-29-0	cyclopentene	7.66
00691-37-2	4-methyl-1-pentene	4.42
00760-20-3	3-methyl-1-pentene	4.42
00287-92-3	cyclopentane	2.38
00079-29-8	2,3-dimethylbutane	1.07
01634-04-4	1-methyl-tert-butyl-ether	0.62
00691-38-3	4-methyl-cis-2-pentene	6.69
00107-83-5	2-methylpentane	1.53
00674-76-0	4-methyl-trans-2-pentene	6.69
00096-14-0	3-methylpentane	1.52
00763-29-1	2-methyl-1-pentene	4.42
00592-41-6	1-hexene	4.42
00110-54-3	n-hexane	0.98
13269-52-8	trans-3-hexene	6.69
07642-09-3	cis-3-hexene	6.69
04050-45-7	trans-2-hexene	6.69
00616-12-6	3-methyl-trans-2-pentene	6.69
00625-27-4	2-methyl-2-pentene	6.69
01120-62-3	3-methylcyclopentene	5.65
07688-21-3	cis-2-hexene	6.69
00637-92-3	1-ethyl-tert-butyl-ether	1.98
00922-62-3	3-methyl-cis-2-pentene	6.69
00590-35-2	2,2-dimethylpentane	1.40
00096-37-7	methylcyclopentane	2.82
00108-08-7	2,4-dimethylpentane	1.78
00464-06-2	2,2,3-trimethylbutane	1.32
07385-78-6	3,4-dimethyl-1-pentene	3.48
00693-89-0	1-methylcyclopentene	7.66
00071-43-2	benzene	0.42
03404-61-3	3-methyl-1-hexene	3.48
00562-49-2	3,3-dimethylpentane	0.71
00110-82-7	cyclohexane	1.28
00591-76-4	2-methylhexane	1.08
00565-59-3	2,3-dimethylpentane	1.51
00110-83-8	cyclohexene	5.67
00589-34-4	3-methylhexane	1.40
02532-58-3	cis-1,3-dimethylcyclopentane	2.55
00617-78-7	3-ethylpentane	1.40
00822-50-4	trans-1,2-dimethylcyclopentane	1.85
00592-76-7	1-heptene	3.48

CAS #	COMPOUND	MIR
00540-84-1	2,2,4-trimethylpentane	0.93
14686-14-7	trans-3-heptene	5.53
00142-82-5	n-heptane	0.81
02738-19-4	2-methyl-2-hexene	5.53
03899-36-3	3-methyl-trans-3-hexene	5.53
14686-13-6	trans-2-heptene	5.53
00816-79-5	3-ethyl-2-pentene	5.53
00107-39-1	2,4,4-trimethyl-1-pentene	2.69
10574-37-5	2,3-dimethyl-2-pentene	5.53
06443-92-1	cis-2-heptene	5.53
00108-87-2	methylcyclohexane	1.85
00590-73-8	2,2-dimethylhexane	1.20
00107-40-4	2,4,4-trimethyl-2-pentene	5.29
01640-89-7	ethylcyclopentane	2.31
00592-13-2	2,5-dimethylhexane	1.63
00589-43-5	2,4-dimethylhexane	1.50
00563-16-6	3,3-dimethylhexane	1.20
00565-75-3	2,3,4-trimethylpentane	1.60
00560-21-4	2,3,3-trimethylpentane	1.20
00108-88-3	toluene	2.73
00584-94-1	2,3-dimethylhexane	1.32
00592-27-8	2-methylheptane	0.96
00589-53-7	4-methylheptane	1.20
00589-81-1	3-methylheptane	0.99
15890-40-1	(1a,2a,3b)-1,2,3-trimethylcyclopentane	1.94
00638-04-0	cis-1,3-dimethylcyclohexane	1.94
02207-04-7	trans-1,4-dimethylcyclohexane	1.94
03522-94-9	2,2,5-trimethylhexane	0.97
00111-66-0	1-octene	2.69
14850-23-8	trans-4-octene	5.29
00111-65-9	n-octane	0.61
13389-42-9	trans-2-octene	5.29
02207-03-6	trans-1,3-dimethylcyclohexane	1.94
07642-04-8	cis-2-octene	5.29
01069-53-0	2,3,5-trimethylhexane	1.14
02213-23-2	2,4-dimethylheptane	1.34
02207-01-4	cis-1,2-dimethylcyclohexane	1.94
01678-91-7	ethylcyclohexane	1.94
00926-82-9	3,5-dimethylheptane	1.14
00100-41-4	ethylbenzene	2.70

CAS #	COMPOUND	MIR
03074-71-3	2,3-dimethylheptane	1.14
00108-38-3	m-&p-xylene	7.64
02216-34-4	4-methyloctane	1.14
03221-61-2	2-methyloctane	1.14
02216-33-3	3-methyloctane	1.14
00100-42-5	styrene(ethenylbenzene)	2.22
00095-47-6	o-xylene	6.46
00124-11-8	1-nonene	2.23
00111-84-2	n-nonane	0.54
00098-82-8	(1-methylethyl)benzene	2.24
15869-87-1	2,2-dimethyloctane	1.01
04032-94-4	2,4-dimethyloctane	1.01
00103-65-1	n-propylbenzene	2.12
00620-14-4	1-methyl-3-ethylbenzene	7.20
00622-96-8	1-methyl-4-ethylbenzene	7.20
00108-67-8	1,3,5-trimethylbenzene	10.12
00611-14-3	1-methyl-2-ethylbenzene	7.20
00095-63-6	1,2,4-trimethylbenzene	8.83
00124-18-5	n-decane	0.47
00538-93-2	(2-methylpropyl)benzene	1.87
00135-98-8	(1-methylpropyl)benzene	1.89
00535-77-3	1-methyl-3-(1-methylethyl)benzene	6.45
00526-73-8	1,2,3-trimethylbenzene	8.85
00099-87-6	1-methyl-4-(1-methylethyl)benzene	6.45
00496-11-7	2,3-dihydroindene(indan)	1.06
00527-84-4	1-methyl-2-(1-methylethyl)benzene	6.45
00141-93-5	1,3-diethylbenzene	6.45
00105-05-5	1,4-diethylbenzene	6.45
01074-43-7	1-methyl-3-n-propylbenzene	6.45
01074-55-1	1-methyl-4-n-propylbenzene	6.45
00135-01-3	1,2-diethylbenzene	6.45
01074-17-5	1-methyl-2-n-propylbenzene	6.45
01758-88-9	1,4-dimethyl-2-ethylbenzene	9.07
00874-41-9	1,3-dimethyl-4-ethylbenzene	9.07
00934-80-5	1,2-dimethyl-4-ethylbenzene	9.07
02870-04-4	1,3-dimethyl-2-ethylbenzene	9.07
01120-21-4	n-undecane(hendecane)	0.42
00933-98-2	1,2-dimethyl-3-ethylbenzene	9.07
00095-93-2	1,2,4,5-tetramethylbenzene	9.07
03968-85-2	(2-methylbutyl)benzene	1.07

CAS #	COMPOUND	MIR
00527-53-7	1,2,3,5-tetramethylbenzene	9.07
01074-92-6	1-(1,1-dimethylethyl)-2-methylbenzene	5.84
00488-23-3	1,2,3,4-tetramethylbenzene	9.07
00538-68-1	n-pentylbenzene	1.70
00098-19-1	1-(1,1-dimethylethyl)-3,5-DMbenzene	7.50
00091-20-3	naphthalene	1.18
00112-40-3	n-dodecane	0.38
	Carbonyl Compounds	
00050-00-0	formaldehyde	7.15
00075-07-0	acetaldehyde	5.52
00107-02-8	acrolein	6.77
00067-64-1	acetone	0.56
00123-33-6	propionaldehyde	6.53
00123-72-8	butyraldehyde	5.26
00066-25-1	hexanaldehyde	3.79
00100-52-7	benzaldehyde	-0.55
00078-93-3	methyl ethyl ketone (2-butanone)	1.18
00078-85-3	methacrolein	6.77
04170-30-3	crotonaldehyde	5.42
00110-62-3	valeraldehyde	4.41
00620-23-5	m-tolualdehyde	-0.55