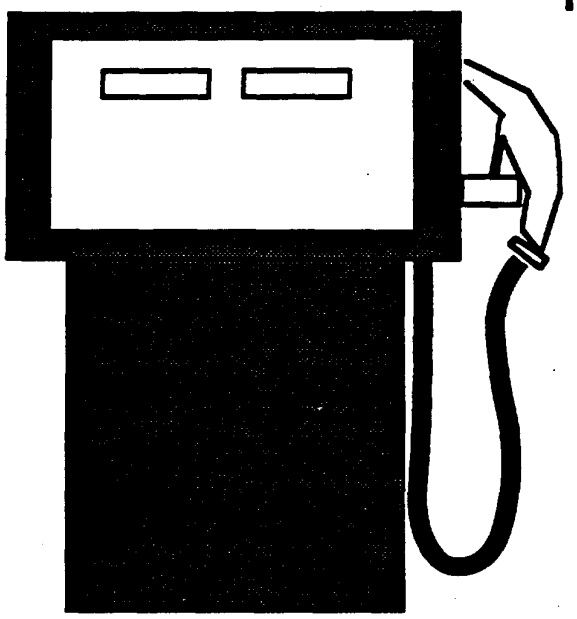
California Air Resources Board

California Phase 2 Reformulated Gasoline Specifications

Volume 1
Proposed Regulations for California Phase 2 Reformulated Gasoline



Staff Report

Release Date: October 4, 1991

State of California
Air Resources Board

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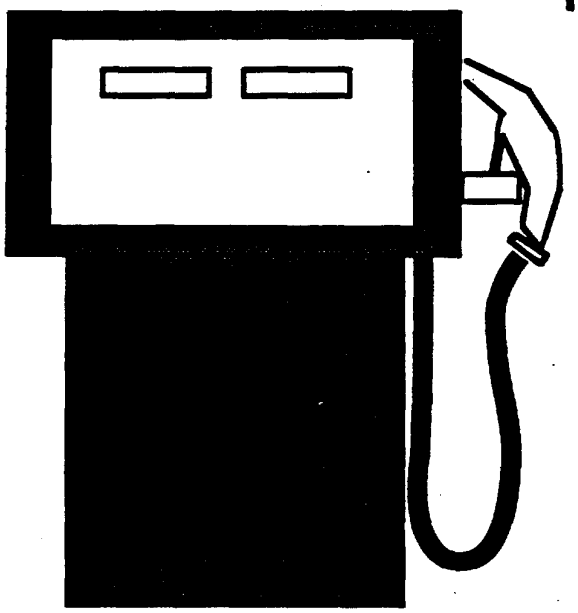

Staff Report

Release Date: October 4, 1991

State of California
Air Resources Board

State of California
AIR RESOURCES BOARD
Stationary Source Division

Initial Statement of Reasons

PUBLIC HEARING TO CONSIDER THE ADOPTION OF AND AMENDMENTS TO REGULATIONS REGARDING REFORMULATED GASOLINE (PHASE 2 GASOLINE SPECIFICATIONS), AND THE WINTERTIME OXYGEN CONTENT OF GASOLINE

Volume 1

Proposed Regulations for California
Phase 2 Reformulated Gasoline

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I.

INTRODUCTION AND SUMMARY

A. INTRODUCTION

This report presents proposed specifications for California Phase 2 reformulated gasoline. These proposed specifications are an integral component of the Air Resources Board's ("ARB" or "Board") overall program to reduce emissions from motor vehicles and are designed to carry out the requirements of the California Clean Air Act and the Federal Clean Air Act Amendments.

Two major elements of the program have been initiated in the last few years. The first element is the low emission vehicles/clean fuels program adopted by the Board in September 1990. This program requires the phase-in of vehicles meeting stringent exhaust emission standards and making available alternative fuels for these vehicles. The second element is reformulating gasoline to reduce emissions in the existing vehicle fleet.

The reformulation of gasoline is being implemented in two phases. Phase 1 reformulated gasoline specifications were adopted by the Board, also in September 1990. The Phase 1 specifications are those that can be implemented in a relatively short time and would achieve emission reductions without requiring fuel producers to make substantial capital investments. Phase 1 specifications included a moderate reduction in the Reid vapor pressure, requirements for deposit control additives, and the phase-out of leaded gasoline. Phase 1 reformulated gasoline will be required in California beginning January 1, 1992.

Phase 2 reformulated gasoline, the subject of this report, is a proposal for a comprehensive set of specifications designed to achieve maximum reductions in criteria and toxic pollutants and in the mass and reactivity (ozone-forming potential) of emissions from gasoline-fueled vehicles. A further objective is to meet these emission reduction goals in a manner that provides flexibility for fuel producers to provide the "cleanest" possible gasoline at the least cost to the consumer.

The staff is also proposing a regulation which addresses the use of oxygenates in the wintertime to reduce emissions of carbon monoxide from motor vehicles. This regulation is discussed in a companion report to this report, and is entitled "Volume 2, Proposed Regulation for the California Wintertime Oxygenates Program."

B. REPORT SUMMARY

1. Why does the ARB need to regulate further gasoline composition?

a. Ambient Air Quality

California has severe air quality problems and emissions from motor vehicles are a major contributor to these problems. The state ambient air quality standards for ozone and particulate matter less than 10 microns equivalent aerodynamic diameter (PM10) are widely exceeded throughout California. The state standard for carbon monoxide (CO) is also exceeded throughout the state, though less frequently. The state standard for nitrogen dioxide (NO2) is currently exceeded in the South Coast Air Basin. Table I-1 shows the number of days in 1989 that the state standards for ozone, PM10, carbon monoxide (CO) and nitrogen dioxide were exceeded in California's major air basins.

Table I-1

Number of Days in Which the State Ambient Air Quality Standards Were Exceeded in Selected Air Basins During 1989

	Number of Days Standard Exceeded			
Air Basin	Ozone	PM10	CO	NO2
South Coast	211	306	66	8
San Francisco	22	95	10	0
San Diego	158	136	6	0
Sacramento Valley	67	144	20	0
San Joaquin Valley	148	274	23	0

Source: California Air Quality Data, Summary of 1989 Air Quality Data, Volume XXI, 1989.

A variety of toxic air contaminants and potentially toxic air contaminants are also detected in the air. These include benzene, acetaldehyde, formaldehyde, and 1,3-butadiene. These pollutants are found in motor vehicle emissions.

b. Emissions

Mobile sources account for a substantial portion of the total emissions from all sources in California. In 1987, mobile sources accounted for over 50 percent of the total statewide emissions of volatile organic compounds (VOC) and oxides of nitrogen (NOx), which are the major precursors to ozone formation. In addition, mobile sources accounted for about 60 percent of the PM10 precursor emissions, and about 70 percent of the carbon monoxide emissions. Gasoline-powered motor vehicles accounted for almost 35 percent of the total emissions of ozone and PM10 precursors, and almost 60 percent of the carbon monoxide emissions.

In the future, gasoline-powered motor vehicles will continue to comprise a major portion of the total emission inventory. For example, in the year 2000, gasoline-powered motor vehicles will account for about 25 percent of the total emissions of ozone precursors and 75 percent of the total emissions of carbon monoxide.

In addition to criteria pollutants, a variety of toxic air contaminants and potentially toxic air contaminants are emitted by motor vehicles. These include benzene, acetaldehyde, formaldehyde, and 1,3-butadiene. Continuous exposure to toxic air contaminants from gasoline-powered vehicles at the concentrations typical of the late 1980s would correspond to about 9,000 potential lifetime (over a 70 year period) cancer cases in the state. Emissions from gasoline-powered motor vehicles account for over 90 percent of the total statewide emissions of benzene and about 80 percent of the total statewide emissions of 1,3-butadiene. Benzene emissions in the year 2000 are expected to decrease by about 40 percent relative to 1986 because of increasingly stringent emission standards and fleet turnover. Nevertheless, gasoline-powered motor vehicles will continue to be a significant source of benzene emissions.

c. California Clean Air Act

The ARB needs to take action to reduce further emissions from motor vehicles to improve air quality and to fulfill statutory requirements. The California Clean Air Act (CCAA) requires the ARB to achieve the maximum degree of emission reductions possible from vehicular and other mobile sources in order to attain the state ambient air quality standards at the earliest practicable date. In addition, the CCAA requires the ARB to take actions that are necessary, cost-effective, and technologically feasible to reduce emissions of volatile organic compounds by 55 percent and oxides of nitrogen by 15 percent from motor vehicles with respect to a 1987 baseline inventory. The ARB is also required to take actions to achieve the maximum feasible reductions for particulate matter, carbon monoxide, and toxic air contaminants from vehicular sources. These reductions are to be attained by December 31, 2000.

To achieve these objectives, the CCAA requires that the ARB adopt control measures which will result in the most cost-effective combination of control measures on all classes of motor vehicles and motor vehicle fuels, including but not limited to, all of the following:

- Reductions in motor vehicle exhaust and evaporative emissions;
- Reductions from in-use motor vehicles through improvements in emissions system durability and performance;
- Requiring the purchase of low-emission vehicles by state fleet operators; and
- Specification of vehicular fuel composition.

d. Toxic Air Contaminants

The toxic air contaminant element of the proposed regulations was developed in response to the requirements of Health and Safety Code sections 39655 et seq. (AB 1807). These statutes require the Board to assess the need for controlling emissions of toxic air contaminants and to adopt control measures as necessary. For a pollutant lacking an identifiable safe ambient concentration, state law requires the Board to adopt the best available control technology. Further, the Board is required by Health and Safety Code section 39667 (AB 4392) to consider the adoption of revisions in the emission standards for vehicular sources and regulations specifying the content of motor vehicle fuel, in order to achieve the maximum possible reduction in the public's exposure to toxic air contaminants. These regulations may include, but are not limited to, the modification, removal, or substitution of vehicle fuel, vehicle fuel components, or fuel additives.

e. Federal Clean Air Act

The 1990 amendments to the Federal Clean Air Act (FCAA) require the Environmental Protection Agency (EPA) to adopt regulations regarding reformulated gasoline. The regulations are to achieve reductions in emissions of ozone-forming volatile organic compounds and toxic air contaminants through the reformulation of conventional gasoline, taking into consideration cost, health and environmental impacts, and energy requirements. The regulations are to apply starting in 1995 in nine high ozone areas in the United States. In California, the regulations will apply in the South Coast Air Basin, San Diego Air Basin, and Ventura County.

The federal regulations require a minimum 2.0 percent by weight oxygen content (with certain exceptions), a maximum 1.0 percent by volume benzene content, and limits on heavy metals. The FCAA also specifies performance standards for volatile organic compounds during high ozone periods and toxic air contaminants throughout the year. The performance standards are based on the reduction in emissions which must be achieved from baseline vehicles using a specified baseline fuel. The performance standard will represent the more stringent of the emission reductions resulting from the use of a "formula" fuel, or a specified percent reduction--15 percent in 1995 increasing to 25 percent in the year 2000 and will be determined separately for volatile organic compounds and toxic air contaminants. The EPA Administrator may adjust the 25 percent minimum performance standard upward or downward in consideration of cost and technological feasibility, but in no case shall a value less than 20 percent be allowed. The federal act also specifies that these reformulated fuels not result in an increase in oxides of nitrogen emissions. EPA is required to adopt regulations for the 1995 program by November 15, 1991.

2. <u>What is the staff proposing for Phase 2 reformulated gasoline specifications?</u>

The proposed California Phase 2 reformulated gasoline specifications are a comprehensive set of specifications that all gasoline sold in California will have to meet beginning January 1, 1996. The proposed Phase 2 specifications address:

- Reid Vapor Pressure (RVP)
- Sulfur content
- Benzene content
- Olefin content
- Oxygen content
- 90 percent distillation temperature (T90, the temperature at which 90 percent of the gasoline will evaporate)
- 50 percent distillation temperature (T50)
- Aromatic hydrocarbon content

The proposed specifications are designed to result in the "cleanest" burning gasoline possible to give the maximum reduction in emissions of criteria and toxic air pollutants from the existing fleet of vehicles. The proposed specifications and data on the average values for present California gasoline are given in Table I-2.

Table I-2

Proposed Specifications for California Phase 2 Reformulated Gasoline

Fuel Parameter	Typical California Gasoline	Flat Limit For Producers	Standard for Producers Using Averaging	"Cap" For All Gasoline a/
Sulfur, ppmw	150	40	30	80
Benzene, vol %	2.0	1.00	0.80	1.20
Olefins, vol %	9.9	5.0	---	10.0
Oxygen, wt %	0	1.8-2.2	---	2.7 (max) 1.8 (min) b/
T90 (°F)	330	300	---	330
T50 (°F)	220	210	---	220
Aromatic HC, vol %	32	25	20	30
RVP, psi c/	8.5	7.0	---	7.0

a/ Applies to all gasoline throughout the distribution system, including fuels qualified under modeling or testing options.
b/ Applies to the wintertime control periods only.
c/ Applies to the summertime control periods only.
--- Averaging is not proposed for these parameters.

The "caps" would apply to all gasoline throughout the distribution system. In addition, producers and importers would be subject to more stringent standards applicable to gasoline when it is supplied from their production or import facility. Producers and importers could comply either with a flat limit applicable to all gasoline they produce or they can meet a more stringent limit on average. The average approach allows some flexibility in the refining of gasoline as some batches of gasoline can be above or below the average specifications. Discussion of other features in the proposed regulation is presented in sections 5 and 6.

3. What benefits will be realized from the staff's proposal?

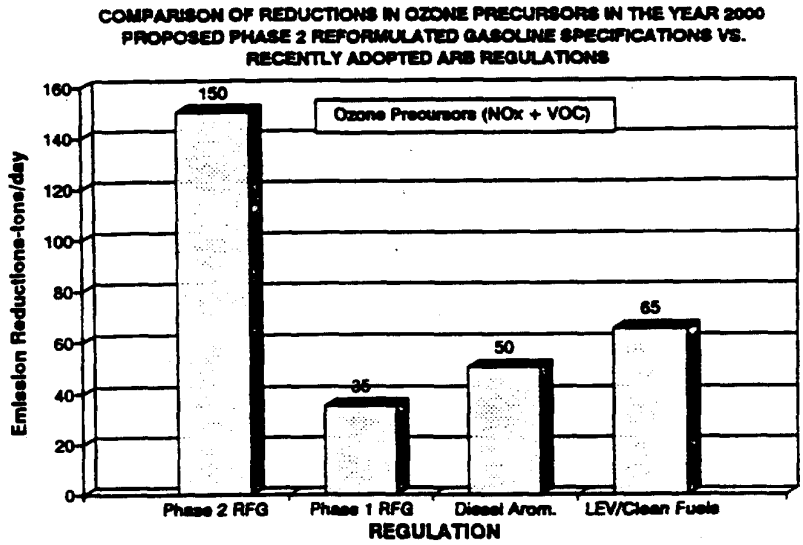
Implementation of the proposed California Phase 2 reformulated gasoline specifications will result in the following reductions in criteria pollutant emissions during the first year of implementation (1996) and for the year 2000.

	Emission Reductions, tons/day	
Criteria Pollutants	1996	2000
Volatile organic compounds	130	110
Oxides of nitrogen	50	40
Carbon monoxide	1,300	930
Sulfur dioxide	30	30

Compared to motor vehicles using gasoline meeting Phase 1 reformulated gasoline specifications in the year 1996, we expect to achieve about a ten percent reduction in ozone precursor emissions (15 percent reduction in emissions of volatile organic compounds, a six percent reduction in emissions of oxides of nitrogen), a 17 percent reduction in emissions of carbon monoxide, and an 80 percent reduction in emissions of sulfur dioxide. In terms of emissions from all sources (mobile and stationary) in the year 1996, the staff's proposed specifications will reduce the total emissions of volatile organic compounds by four percent, the total emissions of oxides of nitrogen by two percent, and the total emissions of carbon monoxide by ten percent.

The projected emission reductions from this control measure are significant, particularly when compared to other measures recently adopted by the ARB. Figure I-1 shows a comparison of the reductions of volatile organic compounds from this measure compared to other measures recently adopted by the ARB. As can be seen, the low emission vehicle/clean fuels program is expected to achieve a 65 ton per day reduction in ozone precursors in the year 2000. These reductions are significantly less than the reductions in ozone precursors expected from California's proposed Phase 2 reformulated gasoline specifications, which are estimated to be about 150 tons per day of ozone precursors.

Figure I-1



During the past few years, a number of independent investigators have conducted studies that assert that the inventory of volatile organic compounds in urban areas may be underestimated by substantial amounts. Investigations conducted during the last year by the ARB staff have shown that these underestimates are in the neighborhood of 50 to 100 percent. Staff believes that the on-road motor vehicle portion of the inventory is underestimated by at least as much as the overall inventory; however, studies to date have not been able to establish error bands for specific categories of the inventory. Efforts towards improving both the mobile and stationary source portions of the inventory continue and a major effort is underway to obtain improved emission rates and vehicular activity data for the on-road motor vehicle emission estimates. To the extent the motor vehicle inventory is underestimated, the emission reductions for the proposed specifications are underestimated. The actual emission reductions from this measure could be 50 to 100 percent greater, or more, than currently estimated.

In addition to reductions in mass emissions, staff expects that the Phase 2 gasoline specification would also reduce the reactivity of the exhaust and evaporative emissions. Based on preliminary results, staff expects that the Phase 2 reformulated gasoline specifications will reduce the reactivity of exhaust emissions per mile by 30 to 40 percent. Reducing the reactivity of evaporative emissions is dependent on reducing olefins, aromatic hydrocarbon content, and T90. Since we are reducing these compounds, staff expects that a reduction in the reactivity of evaporative emissions will be achieved. Our evaluation of the potential for these benefits is continuing.

The staff's proposed specifications will also result in substantial reductions in toxic air contaminant emissions. These include reductions in 1,3-butadiene, acetaldehyde, and benzene. Overall, the potency-weighted emissions of toxic air contaminants will be reduced by 25 percent. The potential cancer incidence will be reduced by 35 cases per year from 1996 to 2010.

4. <u>What is the estimated cost of the proposal?</u>

The staff estimates that these reductions will be achieved at an overall cost-effectiveness of approximately $8,000/ton ($4.00/pound) to $12,000/ton ($6.00/pound). If the emissions inventory is underestimated by even 50 percent, the cost-effectiveness would improve to about $6,000/ton ($3.00/pound) to $8,000/ton ($4.00/pound). For toxic air contaminants, the cost-effectiveness of the proposed regulation is about 35 million dollars per cancer case avoided.

The cost-effectiveness of the proposed regulation is within the range of other control measures adopted by the Board or the Districts. The cost-effectiveness of measures that have been recently adopted by the Board or the districts ranges from $1,300/ton to $32,000/ton for criteria pollutants, and one million dollars per cancer case avoided to 50 million dollars per cancer case avoided for toxic air contaminants.

If the entire cost is passed on to the consumer, the cost of gasoline to the consumer could increase by 14 to 20 cents per gallon. This estimates includes a small fuel economy penalty because of the lower energy content of Phase 2 gasoline. To an average consumer, the increased gasoline price would result in an increase of 12 to 17 percent in annual fuel cost which represents about a two percent increase in the annual cost of operating a vehicle.

The preliminary estimated total capital investment costs for the refiners is in the range of four to seven billion dollars.

At the time this report was released, we had not yet received specific cost information from the Western States Petroleum Association and some individual refiners who indicated that they were assessing the impacts of the staff's proposed specifications. We will evaluate this data as it becomes available. We are also continuing work on the development of our own linear refinery program models to better quantify costs of the proposal. In addition, we are currently evaluating the financial impact of the proposed specifications on small refiners. Based on the outcome of that analysis, we may propose modifications to the regulations at the Board hearing concerning small refiners.

5. <u>What flexibility will producers have to make gasoline?</u>

Under the proposed regulations, gasoline producers will be allowed three options for compliance. Producers can choose to: (1) produce gasoline that meets all of the proposed specifications; (2) develop a unique fuel formula and demonstrate through testing that this new formula will provide

the equivalent emission reductions as the staff's proposed specifications; or (3) develop alternative specifications by taking advantage of models, to be developed by ARB staff, to calculate alternative specifications which will provide equivalent emission reductions as the staff's proposed specifications. This should allow producers the ability to adjust the specifications to take advantage of existing refinery technology and the properties of their current source of crude oil. These alternatives can also lower the cost of compliance.

6. What other provisions are included in the proposal?

The proposal includes provisions to allow averaging of the proposed sulfur, aromatic hydrocarbon, and benzene specifications. Under these provisions, fuel producers would be allowed flexibility to periodically exceed the proposed standards, provided that the exceedance of the standard is offset with other blends below the standard. The limit for averaging is somewhat lower than the flat limit. The fuel must still not exceed the specified per gallon "caps" for sulfur, aromatic hydrocarbons, or benzene, as appropriate. Generally, the criteria to be used if a fuel producer elects to do averaging are similar to the criteria contained in the regulations for the aromatic hydrocarbon content of diesel fuel adopted by the Board in November 1988.

A general variance provision for the new specifications is included. Generally, EPA does not recognize variances. However, as a result of the recent negotiated rulemaking process on federal reformulated gasoline, EPA is recommending provisions to allow a refiner under extreme and unusual circumstances to distribute, for short periods of time, noncomplying fuels. Staff believes that the proposed variance provision will meet EPA's suggested criteria.

The proposal also contains a provision requiring compliance plans from refiners and a provision that exempts small quantities of gasoline for research purposes. Finally, specifications for sampling and test methods are also proposed.

7. How do the emission reductions from the proposed California Phase 2 reformulated gasoline specifications compare to the program being developed by EPA to satisfy the 1990 Amendments to the Federal Clean Air Act?

Table I-3 shows the expected emission reductions of criteria pollutants in the South Coast Air Basin from the proposed 1995 federal reformulated gasoline specifications and the emission reductions expected from the proposed California Phase 2 reformulated gasoline specifications in 1996. This analysis assumes that California Phase 1 reformulated gasoline is the baseline fuel.

Table I-3

Emission Reductions of Criteria Pollutants from the Use of EPA Reformulated Gasoline Versus the Use of California Phase 2 Reformulated Gasoline in 1996 for the South Coast Air Basin

	Emissions Reductions in 1996 (Tons/Day)			
	VOC	CO	NOx	SO2
Proposed EPA Phase 1 Reformulated Gasoline a/	35	460	5	0
Proposed California Phase 2 Reformulated Gasoline b/	60	530	21	10
Increase in Emission Reductions	+25	+70	+15	+10
Percent Increase	+70	+15	+30	--

Base fuel: California Phase 1 Reformulated Gasoline

a/ RVP = 7.2 psi; Oxygen = 2.0 % by wt.; Aromatic Hydrocarbons = 25 vol. %
b/ RVP = 7.0 psi; Oxygen = 2.0 % by wt.; Aromatic Hydrocarbons = 20 vol. %
Sulfur = 30 ppmw; Olefins = 5.0 vol. %; T90 = 300 deg. F;
T50 = 210 deg F.

As shown in the table, the proposed California Phase 2 reformulated gasoline specifications will result in substantially greater emission reductions than the federal program, achieving over one and one-half times the emission reductions of volatile organic compounds, four times the emission reductions of oxides of nitrogen, and about a 15 percent increase in the emission reductions of carbon monoxide. Unlike the proposed California Phase 2 gasoline specifications, the federal program will not achieve any emission reductions in sulfur dioxide because the sulfur content will not be regulated in 1995. Due to the nature of the proposed California Phase 2 reformulated gasoline specifications, we also expect to achieve additional reductions in toxic air contaminants and in the ozone-forming potential of the emissions as compared to the federal program.

The FCAA requires that the federal reformulated gasoline meet specified performance standards in the years 1995 and 2000. A direct comparison of the ability of the proposed California Phase 2 reformulated gasoline specifications to meet these performance standards can be assessed using the criteria outlined in the FCAA. Using EPA's proposed models, our assessment indicates that our proposed specifications will meet or exceed the FCAA year 2000 performance standard of a 25 percent reduction in emissions of volatile organic compounds specified in the FCAA. Depending on the baseline used for

comparison, the proposed Phase 2 specifications will give a 26 percent or 44 percent reduction in volatile organic compound emissions, in addition to other benefits.

The FCAA regulations are to be effective beginning on January 1, 1995, which is one year earlier than the the proposed implementation for the staff's proposed Phase 2 reformulated gasoline specifications. Therefore, fuel sold in the South Coast Air Basin, San Diego Air Basin, and Ventura County must meet the federal regulations beginning in 1995. Beginning on January 1, 1996, refiners will have to comply with both sets of requirements, although, in effect, the California Phase 2 reformulated gasoline specifications will replace the federal reformulated gasoline.

Staff does not believe that implementation of the federal program one year earlier than the proposed implementation date for California Phase 2 gasoline specifications will cause any adverse economic or environmental impacts on the refiners. The FCAA requirements essentially involve reducing RVP, aromatic hydrocarbons, and benzene, and adding oxygenates. These modifications can be made primarily by modifying refinery operating conditions. Capital costs may be incurred for reducing benzene; however, we believe this can be done to be consistent with our proposal. Therefore, no additional costs should be necessary to meet the proposed California Phase 2 specification for benzene.

8. About this report.

In developing the proposed California Phase 2 reformulated gasoline regulations, the ARB staff held two workshops to solicit public comment. Staff also held numerous meetings with representatives from industry to discuss their special concerns and solicited information regarding costs and the effects on emissions of various proposals. Staff intends to hold another workshop in mid-October and expects to have further discussions with industry representatives. Staff is continuing to solicit and evaluate information from affected parties and other sources. Should these continuing evaluations warrant any changes to the staff proposal, staff will recommend appropriate changes at the hearing.

This report presents a summary of the background information for the proposed regulations for the Phase 2 specifications and is accompanied by a Technical Support Document (TSD). The TSD contains detailed discussions of the information presented in this report.

C. RECOMMENDATION

We recommend that the Board adopt or amend as appropriate the following sections of Title 13, California Code of Regulations:

- Section 2250. Degree of Unsaturation for Gasolines Sold Before January 1, 1996.

- Section 2251.5. Reid Vapor Pressure of Gasoline Sold After January 1, 1992, and Before January 1, 1996.
- Section 2252. Sulfur Content of Gasoline, Represented as Unleaded Sold Before January 1, 1996.
- Section 2260. Definitions.
- Section 2261. Applicability of Standards; Additional Standards.
- Section 2262.1. Standards for Reid Vapor Pressure.
- Section 2262.2 Standards for Sulfur Content.
- Section 2262.3. Standards for Benzene Content.
- Section 2262.4. Standards for Olefin Content.
- Section 2262.5. Standards for Oxygen Content.
- Section 2262.6. Standards for Distillation Temperatures.
- Section 2262.7. Standards for Aromatic Hydrocarbon Content.
- Section 2263. Sampling and Test Methods.
- Section 2264. Designated Alternative Limits.
- Section 2265. [Reserved for Certified Gasoline Formulations Resulting in Equivalent Emission Reductions Based on a Predictive Model].
- Section 2266. Certified Gasoline Formulations Resulting in Equivalent Emission Reductions Based on Motor Vehicle Emission Testing.
- Section 2267. Exemptions.
- Section 2268. Liability of Persons Who Commit Violations Involving Gasoline That Has Not Yet Been Sold or Supplied to a Motor Vehicle.
- Section 2269. Submittal of Compliance Plans.
- Section 2270. Testing and Recordkeeping.
- Section 2271. Variances.

II.

NEED FOR EMISSION REDUCTIONS

A. AIR QUALITY

Motor vehicles and their fuels are major contributors to the air pollution problem in California. Motor vehicle emissions are the primary source of compounds which react in the atmosphere to form ozone or smog. Vehicle emissions also contain toxic air contaminants that increase the potential risk of cancer to residents of the state.

Past regulatory actions to reduce motor vehicle emissions have improved air quality in some areas of California and prevented deterioration of air quality in other areas. However, further reductions in vehicle emissions are needed to offset the continuing increase in vehicle use. To attain healthful air quality throughout the state, the ARB must implement an aggressive program to dramatically reduce motor vehicle emissions. Without large reductions in motor vehicle emissions, the air quality standards in many urban areas will not be met.

1. Criteria Pollutants

Criteria pollutants are those pollutants for which ambient air quality standards have been established, either by the EPA or the ARB. These pollutants may be present in the atmosphere in the form in which they are emitted from a source, such as carbon monoxide, or they may, like ozone, be formed in the atmosphere from precursor substances (in the case of ozone, from volatile organic compounds and oxides of nitrogen) that are directly emitted from a source.

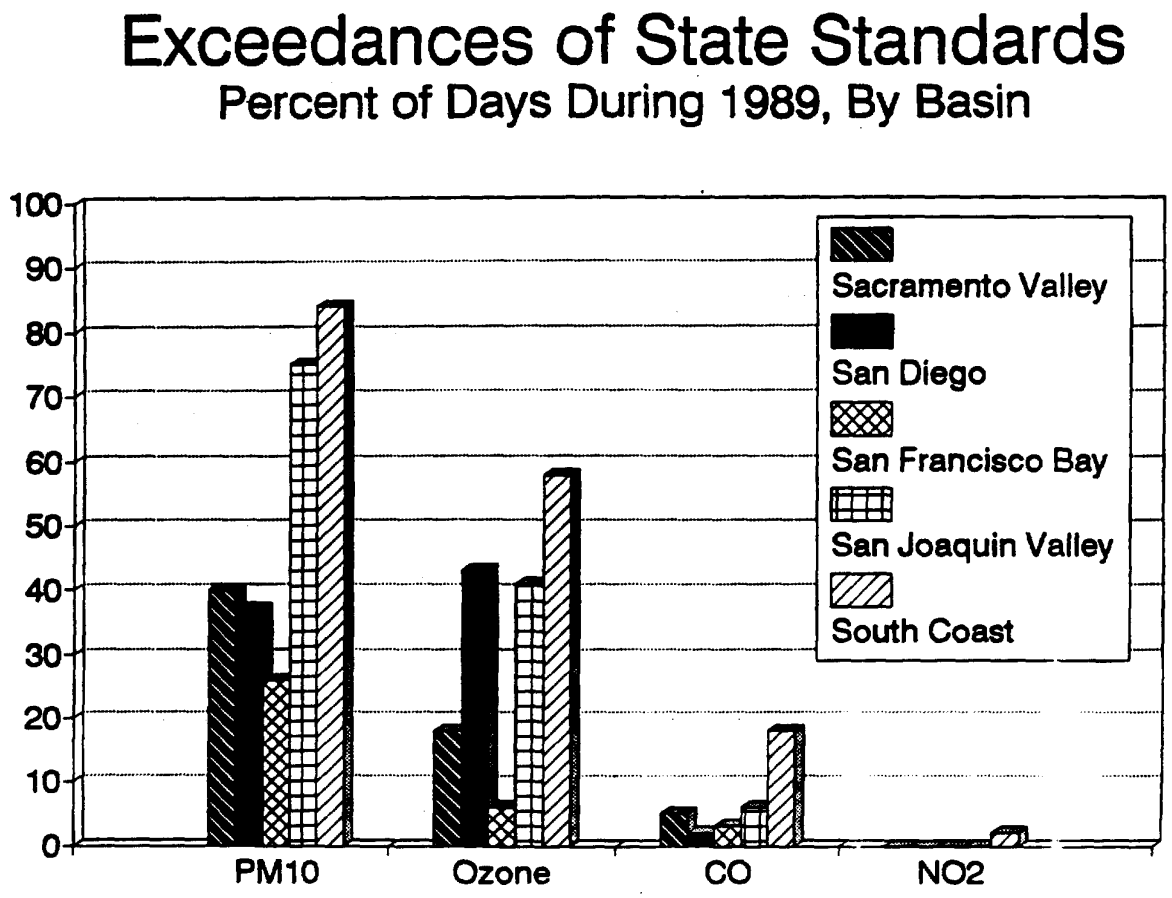
The ambient air quality standards are exceeded in varying degree by pollutant and by location throughout California, but a high percentage of Californians live in air basins that experience exceedances of one or more of the criteria pollutant standards. Figure II-1 shows the percentage of days for which state ambient standards were exceeded in 1989 for five of California's most populous air basins. As shown in this figure, the state ambient air quality standards for ozone and PM10 are widely exceeded in the state.

Motor vehicles contribute significantly to ambient concentrations of almost all criteria pollutants. Motor vehicles are the major source of carbon monoxide emissions and the precursors to atmospheric ozone. Oxides of nitrogen emissions contribute to the atmospheric burden of nitrogen dioxide, PM10, and visibility-reducing particles. Sulfur compounds emitted from motor vehicles are precursors to ambient sulfur dioxide, atmospheric sulfate, PM10, and visibility-reducing particles.

2. Toxic Air Contaminants

A variety of toxic air contaminants and potentially toxic air contaminants are emitted by motor vehicles. These include benzene, acetaldehyde, formaldehyde, and 1,3-butadiene. Toxic air contaminants are also present in gasoline vapors that are released during vehicle fueling and operation, and during the storage and transport of gasoline. Exposure to toxic compounds from gasoline-powered vehicles accounts for about 9,000 potential lifetime (over a 70 year period) cancer cases in the state.

Figure II-1


Exceedances of State Standards
Percent of Days During 1989, By Basin
100
90
80
70
60
50
40
30
20
10
0
PM10
Ozone
CO
NO2
Sacramento Valley
San Diego
San Francisco Bay
San Joaquin Valley
South Coast

B. EMISSIONS

1. Criteria Pollutant Emissions

Motor vehicle fuel-related emissions are a significant source of carbon monoxide, volatile organic compounds, and oxides of nitrogen. These latter two pollutants are also precursors to ozone formation. Other criteria pollutants emitted from motor vehicles include PM10, visibility reducing particles, and sulfur dioxide.

The importance of reducing the emissions from gasoline-powered vehicles in order to eliminate exceedances of the state and federal air quality standards can be shown by examining the statewide emissions inventory. Figures II-2 and II-3 depict the 1987 statewide emissions inventory for volatile organic compounds, oxides of nitrogen, carbon monoxide, precursors to PM10 which include oxides of nitrogen, sulfur dioxide, and volatile organic compounds.

In 1987, gasoline-powered vehicles contributed 35 percent of the volatile organic compounds, 57 percent of the carbon monoxide, 38 percent of the oxides of nitrogen, and 11 percent of the sulfur dioxide in the statewide emissions inventory. While gasoline-powered motor vehicles only contributed 0.2 percent of the directly emitted PM10, they were significant contributors of oxides of nitrogen and sulfur dioxide, which are precursors of the sulfate and nitrate components of PM10.

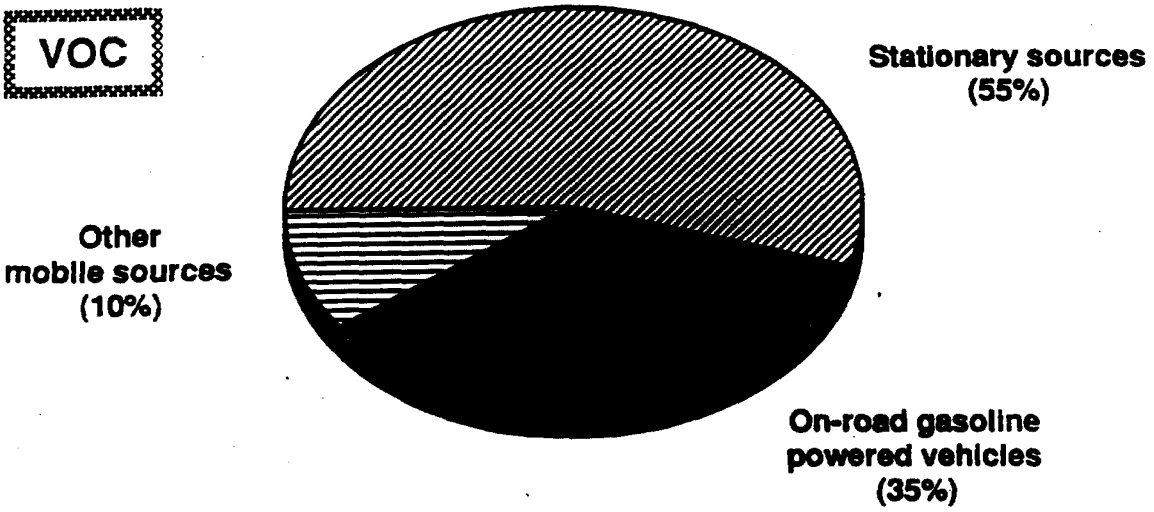
Figures II-4 and II-5 show the future trend in emissions of volatile organic compounds and oxides of nitrogen, respectively. From these figures, it is apparent that future gasoline-powered vehicles will continue to comprise a significant portion of the total inventory. In the year 2000, gasoline-powered vehicles will account for about 17 percent of the total emissions of volatile organic compounds and 25 percent of the total emissions of oxides of nitrogen. Gasoline-powered vehicles will continue to account for the majority of carbon monoxide emissions.

During the past few years, a number of independent investigators have conducted studies that assert that the inventory of volatile organic compounds in urban areas may be underestimated. Investigations by staff have shown that these underestimates are on the order of 50 to 100 percent. Staff believe that the on-road motor vehicle portion of the inventory is underestimated by at least as much as the overall inventory; however, studies to date have not been able to establish error bands for specific categories of the inventory. Efforts toward improving both the mobile and stationary source portions of the inventory continue and a major effort is underway to obtain improved emission rates and vehicular activity data for the on-road motor vehicle emission estimates.

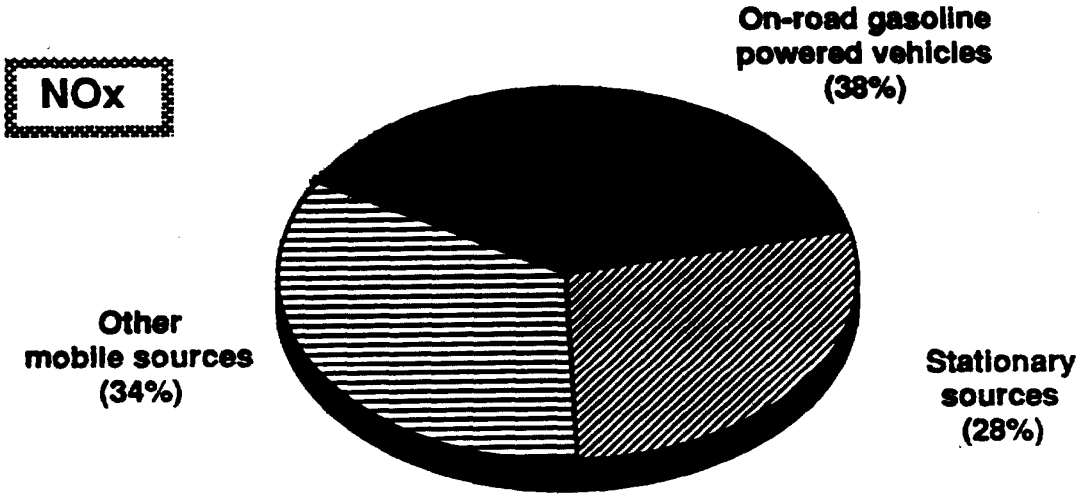
Figure II-2

STATEWIDE VOC AND NOX EMISSIONS

1987 BASELINE INVENTORY



Total VOC Emissions = 4,100 tons/day

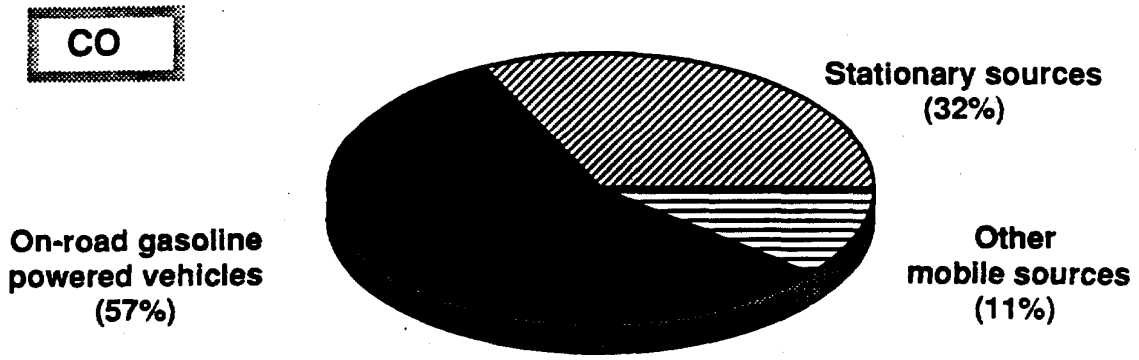


Total NOx Emissions = 3,400 tons/day

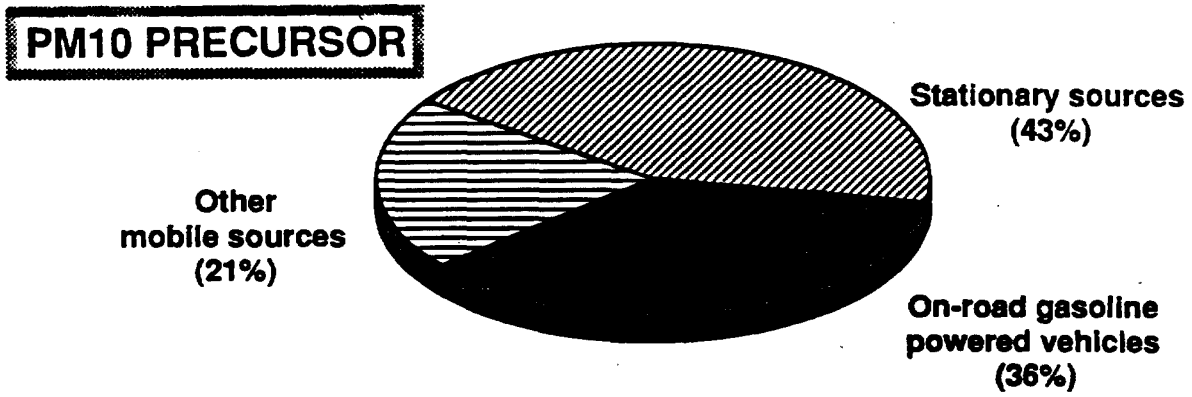
Figure II-3

STATEWIDE CO, PM10 PRECURSOR, AND SOx EMISSIONS

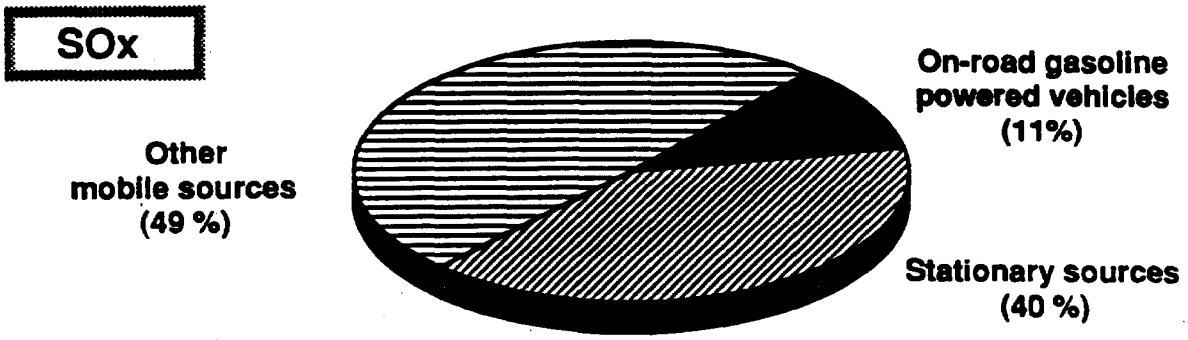
1987 BASELINE INVENTORY



Total CO Emissions = 19,000 tons/day

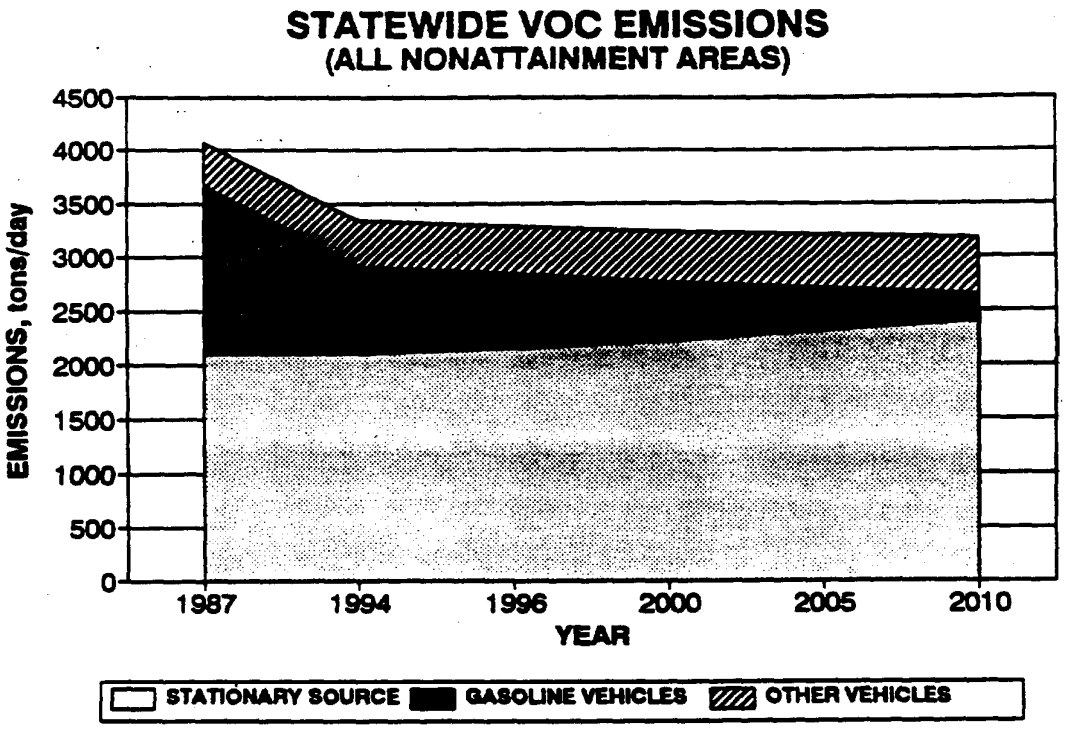


Total PM10 Precursor Emissions = 8,000 tons/day
(PM10 PRECURSORS ARE VOC, NOx AND SOx)



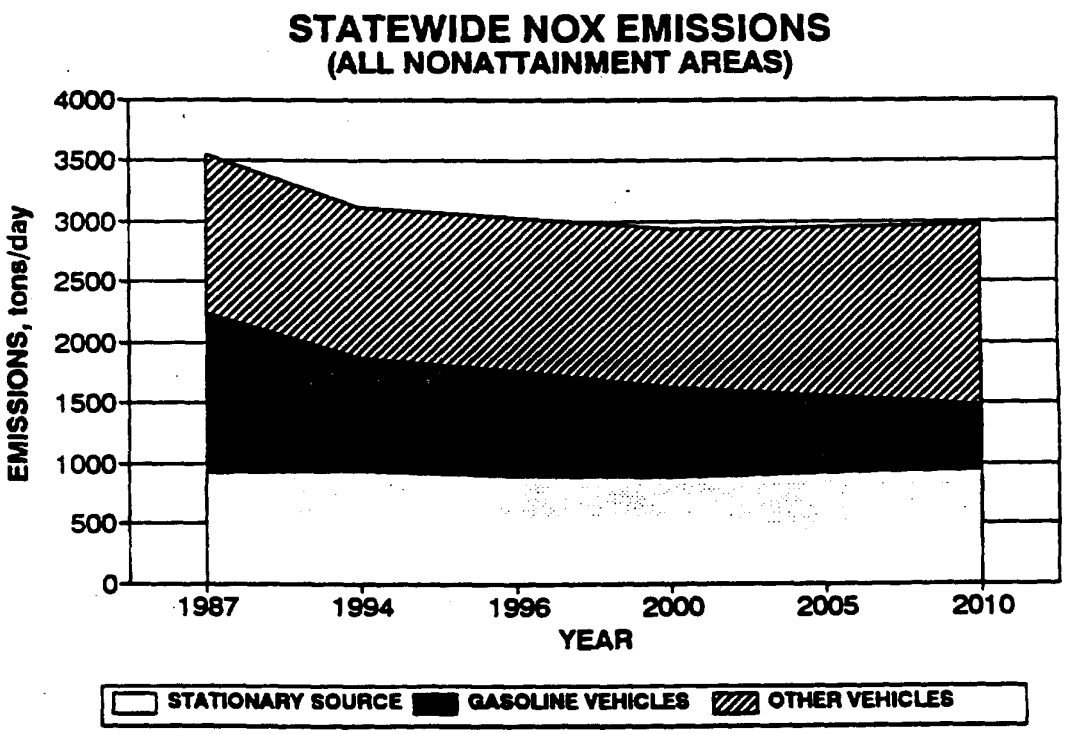
Total SOx Emissions = 520 tons/day

Figure II-4



Source: ARB ozone planning inventory, 1991

Figure II-5



Source: ARB ozone planning inventory, 1991

2. Toxic Air Contaminant Emissions

a. Toxic Air Contaminants Emitted From Gasoline-Powered Vehicles

Gasoline-powered vehicles are a significant source of known and suspected toxic air contaminants. Table II-1 shows the four toxic substances that are emitted in the greatest amounts from gasoline-powered vehicles. As shown in Table II-1, gasoline-powered vehicles account for 90 percent of the benzene emissions in the state and almost 80 percent of the 1,3-butadiene emissions. While a variety of other toxic air contaminants are also emitted from gasoline-powered vehicles, they are emitted only in trace amounts.

These emissions can be related to potential cancer incidence. Table II-2 shows the estimated potential cancer cases per year and the percentage of all cases from each compound that are due to gasoline-powered vehicles for the four main toxic substances. As seen in Table II-2, benzene and 1,3-butadiene are the most significant contributors, accounting for over 95 percent of the total estimated potential cancer cases due to gasoline-powered vehicle emissions.

Table II-1

Statewide Emissions from Gasoline-Powered Vehicles of the Four Main Toxic Compounds

Substance	Tons/Year	Percent of Total Statewide Emissions
Benzene	25,000	91
1,3-Butadiene	2,900	78
Formaldehyde	8,900	5
Acetaldehyde	2,600	5

Source: Motor Vehicle Toxics Control Plan, ARB, 1990, with updates.

Table II-2

Potential Cancer Cases Due to Gasoline-Powered Vehicles for the Four Main Toxic Compounds a/

Substance	Estimated Cases Per Year	Percent of Gasoline-Powered Vehicle-Related Cancer Cases
Benzene	89	69
1,3-Butadiene	34	26
Formaldehyde	3	2
Acetaldehyde	0.2	0.5

a/ Based on typical ambient concentrations measured in the late 1980's and a population of 27 million.

Source: Motor Vehicle Toxics Control Plan, ARB, 1990, with updates.

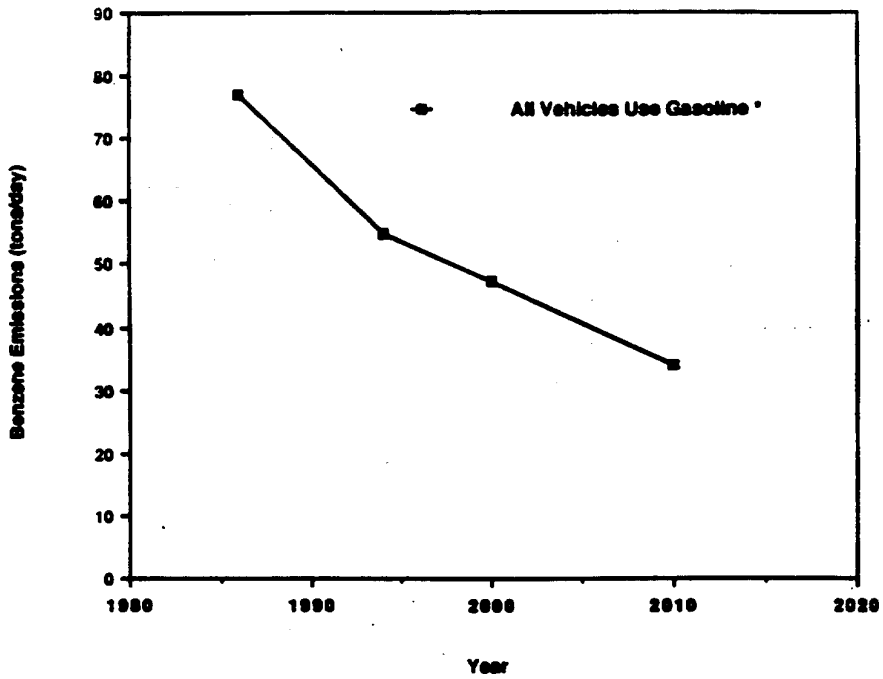
b. Benzene Emissions

Figure II-6 shows the staff's estimates of recent and future benzene emissions in California. The benzene emission estimates for future years include the effects of all regulations adopted to date, including the low-emission vehicle standards adopted in 1990. Since it is not clear to what extent gasoline will be used in low emission vehicles, we have analyzed two cases: one in which gasoline is the only fuel for low emission vehicles and one in which gasoline is used in one-half of the low emission vehicles. These scenarios yield different benzene emissions because alternative, non-gasoline fuels contain very little or no benzene.

Figure II-6 shows that benzene emissions in 2000 are expected to decrease by about 40 percent relative to 1986 because of increasingly stringent volatile organic compound emission standards and fleet turnover. They are expected to continue to decrease through 2010.

Figure II-6

Projected Statewide Benzene Emissions From Gasoline-Powered Vehicles



* To the extent vehicles use alternative clean fuels, benzene emissions will be lower.

Source: Proposed Regulations for Low Emission Vehicles and Clean Fuels, ARB Staff Report, August, 1990.

c. Potential Cancer Risk Due to Benzene

Since most benzene is emitted from gasoline-powered vehicles, it is present in the air everywhere there is traffic. Thus, virtually everyone in the state is exposed to some concentration of benzene. Table II-3 shows the concentrations estimated for various future years on the assumption that the concentrations will be proportional to the total estimated benzene emissions. As shown in Table II-3, the estimated ambient benzene levels decline by more than half between 1986 and 2000, mostly due to the turnover of the fleet to lower emitting vehicles. Also, the differences in benzene emissions between the two scenarios for low emission vehicles fuel is small. This is because the majority of the benzene emissions come from non-low

Table II-3

Estimated Average Ambient Benzene Concentrations
(population-weighted, ppb)

	1986	1994	2000	2010
If all low emission vehicles use gasoline	2.7	1.9	1.7	1.2
If one-half of the low emission vehicles use gasoline	2.7	1.9	1.6	1.1

emission vehicles on-road vehicles and other mobile sources, such as boats and off-road vehicles.

Table II-4 shows the estimates of potential cancer cases due to benzene emissions from all sources. The potential cancer incidence is decreasing but will remain substantial through 2010. Fleet turnover to lower emitting vehicles, particularly low emission vehicles, accounts for most of the decline. To reduce further the potential cancer cases due to toxic emissions, measures other than vehicular controls will be necessary. Changing the specifications of gasoline to reduce benzene emissions is one effective way of reducing emissions from the existing fleet of vehicles and from other mobile sources, which will remain an important source of benzene emissions well into the future.

Table II-4

Total Potential Cancer Cases/Year Due to
Benzene Emissions From All Sources a/

	If all low emission vehicles use gasoline (cases/year)	If 1/2 of the low emission vehicles use gasoline (cases/year)	Gasoline-related cases as percent of all cases
1986:	97	97	91
1994:	84	84	88
2000:	80	79	86
2010:	65	59	78

a/ These represent the number of potential 70-year lifetime cases that would result from the statewide population breathing that year's benzene concentration, divided by 70.

C. CALIFORNIA CLEAN AIR ACT REQUIREMENTS

The ARB needs to take action to reduce further emissions from motor vehicles to improve air quality and to fulfill statutory requirements. The California Clean Air Act (CCAA) requires the ARB to achieve the maximum degree of emission reductions possible from vehicular and other mobile sources in order to attain the state ambient air quality standards at the earliest practicable date. In addition, the CCAA requires the ARB to take actions that are necessary, cost-effective, and technologically feasible in order to reduce emissions of reactive organic gases by 55 percent and oxides of nitrogen by 15 percent from motor vehicles with respect to a 1987 baseline inventory. The ARB is also required to take actions to achieve the maximum feasible reductions for particulate matter, carbon monoxide, and toxic air contaminants from vehicular sources. These reductions are to be attained by December 31, 2000.

To achieve these objectives, the CCAA requires that the ARB adopt control measures which will result in the most cost-effective combination of control measures on all classes of motor vehicles and motor vehicle fuels, including but not limited to, all of the following:

- Reductions in motor vehicle exhaust and evaporative emissions;
- Reductions from in-use motor vehicles through improvements in emissions system durability and performance;
- Requiring the purchase of low-emission vehicles by state fleet operators; and
- Specification of vehicular fuel composition.

D. FEDERAL CLEAN AIR ACT REQUIREMENTS

The 1990 amendments to the Federal Clean Air Act (FCAA) require the EPA to adopt regulations regarding reformulated gasoline. The regulations are to achieve reductions in emissions of ozone-forming volatile organic compounds and toxic air contaminants achievable through the reformulation of conventional gasoline, taking into consideration cost, health and environmental impacts, and energy requirements.

The FCAA specifies performance standards for volatile organic compounds and toxic air contaminants which require that the emissions from baseline vehicles be reduced relative to the emissions from a specified baseline fuel. The performance standard applies to volatile organic compounds emissions during the high ozone season and toxic air contaminants year round. The reductions for volatile organic compounds are quantified by comparing the emission reductions resulting from the use of a "formula" fuel with a specified percent reduction, relative to emissions resulting from the use of the baseline gasoline. The more stringent emission reduction becomes the standard. The performance standard is a 15 percent reduction in 1995 increasing to a 25 percent minimum reduction for volatile organic compounds and toxic compounds by the year 2000. The Administrator may adjust the

25 percent performance standard in either direction considering cost and technological feasibility, but in no case shall a value less than 20 percent be allowed.

In developing the regulations, EPA used the process of regulatory negotiation. In this process, EPA convened a negotiating committee that consisted of representatives from EPA and all affected interests. The EPA convened the negotiating committee (referred to as the Clean Fuels Advisory Committee) on March 14, 1991. The ARB participated on the committee as part of the governmental agency caucus.

An Agreement in Principle (Agreement) was reached in August with all parties. For the affected areas in California, the Agreement specifies the following general requirements:

RVP, psi	7.2 psi, flat limit 7.1 psi, average 7.4 psi, maximum
Oxygen Content	2.0 wt. %, average 1.5 wt. %, minimum per gallon 2.1 wt. %, maximum per gallon for oxygenates other than MTBE 2.7 wt. %, maximum per gallon for MTBE
Benzene Content	1.0 vol %, flat limit 0.95 vol %, average 1.3 vol %, maximum

In addition, gasoline must meet toxic air contaminant performance standard for 15 percent reduction considering its benzene, oxygenate and aromatic hydrocarbon content using EPA's simple models for toxic air contaminants.

These requirements are to be effective on January 1, 1995, and apply to the South Coast Air Basin, Ventura County, and the San Diego Air Basin. Note that the oxygen specifications were set to prevent any increase in oxides of nitrogen. The FCAA specifies that the emissions of oxides of nitrogen from the 1990 model year baseline vehicles may be no greater when using reformulated gasoline than when using the baseline gasoline.

EPA is proposing to issue a proposed rule by November 30, 1992, which will address the year 2000 performance standards. This rulemaking will include a complex model to evaluate vehicle emissions performance against different fuel parameters. The complex model will include at least the following parameters: sulfur, olefins, RVP, oxygen, aromatic hydrocarbons, benzene, and the 90 percent distillation temperature. This rule is to be finalized by March 1, 1993. Reformulated gasoline produced on or after March 1, 1997, must be recertified using the complex model, to meet the 15 percent reduction requirement.

III.

TECHNICAL BASIS FOR PROPOSED REGULATIONS

A. CRITERIA POLLUTANTS

1. Typical Properties of California Gasoline

The properties of gasoline are important from the perspective of establishing a baseline for determining emission reductions and estimating the cost and cost-effectiveness of any proposed regulation. Staff have been collecting detailed data from refiners on the chemical composition and physical properties of California gasoline. The program, referred to as the Voluntary Gasoline Properties Reporting Program, was initiated late last year. Data have been reported by almost all California refiners during the period from January 1991 through June 1991. The production-weighted averages for a number of important fuel properties are presented in Table III-1. Since summer and winter gasoline often have somewhat different properties, the values in Table III-1 do not necessarily reflect year-round typical values. Staff is collecting additional data and will report these data as they are available.

Table III-1

Summary of Typical California Unleaded Gasoline Properties
(January - June 1991)

Sulfur	150 ppm by weight
Aromatic hydrocarbons	32 percent by volume
Olefins	10 percent by volume
90 percent distillation temperature	330 degrees Fahrenheit
50 percent distillation temperature	212 degrees Fahrenheit
Reid vapor pressure	
Summer	8.5 psi
Winter	11.0 psi

2. Impact of Gasoline Properties on Criteria Pollutant Emissions

The purpose of this section is to present a brief overview of the gasoline properties which form the basis for the California Phase 2 reformulated gasoline specifications, their relative effects on vehicle performance and emissions, and a general discussion of what changes to a refinery are necessary to change the gasoline property. Additional details are presented in the Technical Support Document.

a. Reid Vapor Pressure

Evaporative emissions of volatile organic compounds from gasoline have been reduced significantly in California by limiting the maximum Reid vapor pressure (RVP) of motor vehicle gasoline during the summer ozone season. The Reid vapor pressure is a measure of the ability of a fuel to evaporate and is an important parameter in starting motor vehicles. A minimum RVP is necessary to provide the vaporization of gasoline that is required for cold starting, warm-up operations and acceleration. In September 1990, the Board adopted regulations which reduced the summertime limit from an RVP of 9.0 pounds per square inch (psi) adopted in 1970 to 7.8 psi. The 7.8 psi RVP limit will become effective during the spring of 1992.

At the September 1990 hearing, staff committed to conduct additional studies in cooperation with the affected industries on the effects of lowering RVP as part of the development of regulations for Phase 2 reformulated gasoline. The staff did not propose a lower RVP limit at the September hearing because of concerns about potential increases in exhaust emissions of volatile organic compounds. The preliminary results of a cooperative study between General Motors (GM), Western States Petroleum Association (WSPA), and the ARB show that the RVP can be reduced to 7.0 psi without causing an increase in exhaust emissions, with proper control of other distillation characteristics of the fuel. The RVP is reduced by excluding from the fuel "light" hydrocarbons such as butane and pentane.

Staff estimates that about a 20 percent reduction in evaporative emissions of volatile organic compounds can be achieved by reducing the RVP from 7.8 psi to 7.0 psi.

b. Distillation Temperatures

A distillation curve represents gasoline in terms of the percent of the gasoline which evaporates at different temperatures. For example, in a typical distillation curve, 10 percent of the fuel will have evaporated at 130 degrees Fahrenheit, 50 percent of the fuel will have evaporated at 215 degrees Fahrenheit, and 90 percent of the fuel will have evaporated at 330 degrees Fahrenheit. These points on the distillation curve are represented as the T10, T50, and T90 distillation temperatures, respectively. The RVP of the gasoline primarily affects the T10 distillation temperature. The heavier molecular weight, less volatile compounds, primarily affect T90.

The results of the Auto/Oil Air Quality Improvement Research Program (AQIRP) indicate that reducing T90 results in substantial reductions in exhaust emissions of volatile organic compounds, but that some marginal adverse effects on both carbon monoxide and oxides of nitrogen emissions may occur. The precise mechanism as to why exhaust emissions are reduced is not known at this time. One theory holds that by eliminating the heavier components of gasoline, both fuel vaporization and air-to-fuel mixing prior to entrance into the combustion chamber are improved, thus improving combustion efficiency. Based on the Auto/Oil AQIRP results, the staff estimates that a 30 degree reduction in T90 will result in a two to nine percent decrease in exhaust emissions of volatile organic compounds. For a similar change in T90, there was no to a three percent increase in carbon monoxide and about a one percent increase in oxides of nitrogen.

Reducing the T90 of gasoline will require fuel producers to separate the heavy hydrocarbon streams from the fuel by selectively fractionating the gasoline blendstocks. This process will significantly reduce aromatic hydrocarbons, since many of these compounds are found in the T90 distillation range.

The Auto/Oil AQIRP did not consider the effects of lowering T50 on emissions. However, both Toyota and Unocal have conducted studies showing that reducing T50 results in a decrease in emissions of volatile organic compounds and carbon monoxide, and has no significant effect on emissions of oxides of nitrogen. The Unocal results indicate that a 10 degree reduction in T50 results in a nine percent decrease in volatile organic compound emissions and a five percent decrease in carbon monoxide emissions.

The preliminary results of the GM/WSPA/ARB volatility study also show that controlling the distillation characteristics of the gasoline is important, and that T50 is one of the major parameters to consider. Too low of a T50 might result in adversely affecting evaporative emissions, whereas too high of a T50 may result in higher exhaust emissions. The staff estimates that the T50 of gasoline should be in the range of 180 to 210 degrees Fahrenheit to minimize both evaporative and exhaust emissions of volatile organic compounds, and exhaust emissions of carbon monoxide.

The addition of oxygenates to gasoline will reduce T50 to a certain extent. If additional reductions in T50 are necessary, the fuel producers will have to fractionate selected gasoline blendstocks to meet the desired specification.

c. Sulfur

The Auto/Oil AQIRP and other recent studies have convincingly demonstrated that sulfur in small amounts causes significant deactivation of motor vehicle catalysts, resulting in increases in emissions of carbon monoxide, volatile organic compounds, and oxides of nitrogen. Sulfur in gasoline also results in vehicular sulfur dioxide emissions.

For example, results of the Auto/Oil AQIRP show that emissions of volatile organic compounds, oxides of nitrogen, and carbon monoxide were reduced by 16 percent, nine percent, and 13 percent, respectively, when the fuel sulfur content was reduced from 466 parts per million by weight (ppmw) to 46 ppmw. Additional testing is underway as part of the Auto/Oil AQIRP to determine if the emissions benefits are linear as the sulfur content is reduced. These results are expected in early October.

The blendstocks in gasoline which contribute the most to gasoline sulfur levels are gasoline blendstocks obtained from the fluid catalytic cracking unit (FCCU) and, to a lesser extent, gasoline blendstocks obtained from the coker. These blendstocks have high sulfur because they are produced from the heavier components of the crude oil which have higher sulfur contents. The sulfur is removed by hydrotreating either the feed to the FCCU or fractionating and hydrotreating the heavier components of the products from the FCCU or the coker.

d. Oxygen Content

The addition of oxygenates to gasoline is expected to reduce exhaust emissions of carbon monoxide and volatile organic compounds, without adversely affecting oxides of nitrogen emissions unless high levels of oxygenate are used. The studies conducted to date show that an oxygen content of two percent will result in about a 15 percent decrease in carbon monoxide, a five percent decrease in exhaust emissions of volatile organic compounds, and no significant increase in oxides of nitrogen emissions. The addition of oxygenates to fuel is discussed in the companion report to this report, entitled "Volume 2, Proposed Regulations for California Wintertime Oxygenates Program." The reader is referred to that report and the Technical Support Document for additional information.

e. Olefins

Olefins are hydrocarbons having one or more double bonds. They are created by the refining process of cracking napthas or other petroleum fractions at high temperatures. The olefin content in gasoline sold in the South Coast Air Basin has been limited for many years because olefins have high ozone reactivity potential and contribute to the reactivity of evaporative emissions.

Recent studies now indicate that olefins are an important contributor to oxides of nitrogen emissions. Results from the Auto/Oil AQIRP indicate that reducing olefins from the current level of ten percent to a five percent level would result in a one or two percent reduction in oxides of nitrogen emissions.

Olefins in gasoline are derived principally from the FCCU. Reducing olefins depends on the particular refinery configuration. Some refiners may be able to meet an olefin standard by changing the operating conditions of the FCCU. Other fuel producers may have to hydrotreat the FCCU gasoline to reduce sulfur, which in turn will reduce the olefin content.

f. Aromatic Hydrocarbons

Aromatic hydrocarbons are hydrocarbons that contain one or more benzene rings. Their presence in the fuel has been connected with the formation of volatile organic compounds, oxides of nitrogen, and carbon monoxide in exhaust emissions. Aromatic hydrocarbons have higher combustion temperatures, therefore, their presence in the fuel could increase oxides of nitrogen emissions. Higher aromatic hydrocarbon levels in fuel also result in higher aromatic hydrocarbon levels in the exhaust because the volatile organic compound composition of engine-out emissions follows closely the fuel composition. The presence of aromatic hydrocarbons in the vehicle exhaust could have an adverse impact on the reactivity of the exhaust emissions because some of the aromatic hydrocarbon components and especially heavy aromatic hydrocarbons (C_8+ aromatic hydrocarbons) are highly reactive.

The results of the Auto/Oil AQIRP on the benefits derived from reducing aromatic hydrocarbons indicate that the benefits from reducing aromatic hydrocarbons are vehicle dependent. For older vehicles (1983-1985), reducing aromatic hydrocarbons by 12 percent by volume results in a five percent reduction in oxides of nitrogen emissions, and a six percent increase in volatile organic compounds emissions. For newer vehicles (1986 and later), similar aromatic hydrocarbon reductions would achieve a two percent reduction in volatile organic compound emissions, a seven percent reduction in carbon monoxide emissions, and little impact on oxides of nitrogen emissions.

The reduction of aromatic hydrocarbons in a refinery is a multifaceted strategy. The addition of oxygenates will reduce aromatic hydrocarbons by dilution. Reducing T90 will also remove from the gasoline pool a significant part of the heavier aromatic hydrocarbons. Fuel producers basically have three options to reduce aromatic hydrocarbons. Since most of the aromatic hydrocarbons in gasoline are derived from the reformate, the fuel producer could choose to operate the reformer at a less severe condition, thereby decreasing the level of aromatic hydrocarbons in the reformate blendstock. A second option is to remove aromatic hydrocarbons through separation or decrease aromatic hydrocarbons through saturation. A third option is to add new process units to produce blendstocks which are high in octane and low in aromatic hydrocarbons. The ultimate choice is refinery dependent.

B. TOXIC AIR CONTAMINANTS

As discussed in Chapter II, the predominant toxic air contaminant emissions from gasoline-powered vehicles are benzene and 1,3-butadiene. These two compounds are responsible for 95 percent of the estimated potential cancer risk from gasoline-powered vehicles. Most of the remaining risk is from formaldehyde and acetaldehyde. Benzene was identified by the ARB in 1987 as a toxic air contaminant. Formaldehyde and 1,3-butadiene are currently undergoing review for listing as potential toxic air contaminants. These compounds are scheduled for Board hearings in the spring of 1992. Acetaldehyde is in the beginning stages of the identification process.

While benzene, 1,3-butadiene, formaldehyde and acetaldehyde are all emitted from gasoline-powered vehicles, only benzene can be directly controlled by limiting its concentration in gasoline. Benzene is a hydrocarbon that occurs naturally in crude oil and forms when oil is refined into gasoline.

Motor vehicle emissions of benzene result from the following: 1) evaporation of benzene from gasoline in vehicles, 2) the passage of benzene in gasoline through the engine and catalyst without destruction, and 3) the combustion of other aromatic hydrocarbons in gasoline--of which one product is benzene. The precursors of benzene emissions are clear: benzene and other aromatic hydrocarbons. Limiting the benzene content of gasoline is an effective way of reducing both exhaust and evaporative benzene emissions.

Mobile sources account for approximately 80 percent of all 1,3-butadiene emissions in California. 1,3-butadiene is not present in gasoline, except in trace quantities. It is produced as a result of incomplete combustion of petroleum fuels, although its precursors are not precisely known. Thus, the staff are not able to propose specifications on gasoline for the specific purpose of reducing 1,3-butadiene emissions. However, some of the proposed specifications to reduce criteria pollutant emissions are also expected to reduce 1,3-butadiene emissions.

Formaldehyde and acetaldehyde are not present in gasoline but are products of combustion and are emitted directly into the atmosphere from vehicle exhaust. However, greater amounts of both compounds are formed in the air from photochemical reactions of other organic gases from vehicles and stationary sources. Since specific gasoline precursors to aldehyde emissions (other than oxygen) are not known, the staff cannot propose specifications directed at reducing aldehyde emissions.*

Emissions of benzene can be reduced by regulating the benzene content of gasoline. Reducing benzene from the current level of about 2.0 percent by volume to a level of 0.80 percent by volume would prevent an estimated 15 potential cancer cases per year over a 15-year period. The proposed Phase 2 gasoline specifications are expected to significantly reduce emissions of benzene and 1,3-butadiene and increase somewhat emissions of formaldehyde and acetaldehyde. When the cancer-causing potential of the four toxic air contaminants is considered, the Phase 2 gasoline specifications are expected to result in a reduction of 35 potential cancer cases per year (including the benefits of a 0.80 percent by volume limit) over a 15-year period.

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* One way to restrict formaldehyde emissions would be to not allow oxygen in gasoline. However, oxygen provides significant reductions in carbon monoxide and volatile organic compounds emissions. Because any increase in formaldehyde emissions would be more than offset by the reduced toxic risk due to the entire package of Phase 2 gasoline specifications, the staff does not recommend limiting the use of oxygen to control formaldehyde emissions.

Toxic air contaminant emissions from vehicles are also generally controlled by any measures designed to reduce hydrocarbon emissions. For example, new vehicle emissions standards, the Inspection and Maintenance program, and the requirement for on-board diagnostic equipment on vehicles all help to reduce toxic emissions to the extent that they reduce hydrocarbon emissions.

Most benzene in gasoline results from chemical processes used to improve the octane value of gasoline. As a result of past regulations, such as reductions in lead and lower limits on the volatility (Reid vapor pressure) of gasoline, refiners have turned to processes which increase the aromatic hydrocarbon content (which includes benzene) of gasoline as a means of improving octane.

The benzene in gasoline can be reduced substantially by standard processing techniques. Most refiners have suggested that they would distill certain blending stocks to isolate most of the benzene into smaller volumes of liquid. These distillates would then be either reacted with hydrogen (hydrotreated) to convert benzene to cyclohexane or extracted with a solvent to remove the aromatic hydrocarbons. In the latter case, the aromatic hydrocarbons would be distilled to separate the benzene from the other aromatic hydrocarbons, which would be returned to gasoline blending. The benzene would then be shipped to purchasers, probably in the Gulf Coast. In either case, the volume and octane value that had been provided by the benzene would have to be replaced.

IV.

SUMMARY OF THE PROPOSED REGULATIONS

A. ORGANIZATION OF THE BOARD'S MOTOR VEHICLE FUELS REGULATIONS

In order to facilitate incorporation of new regulations pertaining to Phase 2 reformulated gasoline, the ARB recently made editorial changes to the numbering and organization of its fuels and associated regulations. These editorial changes were approved by the Office of Administrative Law on September 17, 1991. The general organization of revised Subchapter 5, Standards for Motor Vehicle Fuels, is listed below:

Subchapter 5 - Standards for Motor Vehicle Fuels

Article 1 - Standards for Gasoline

Article 2 - Standards for Diesel Fuel

Article 4 - Sampling and Test Procedures

In this regulatory action, staff is proposing that the ARB's existing standards for gasoline be placed in a subarticle 1 within Article 1, and that a new subarticle 2 be added establishing the requirements for California Phase 2 reformulated gasoline. In addition, staff is proposing that several existing regulations regarding gasoline be modified. These changes are discussed below. The complete text of the proposed regulations is included as Appendix A.

B. STANDARDS FOR CALIFORNIA PHASE 2 REFORMULATED GASOLINE AND OVERALL STRUCTURE OF THE REGULATIONS

The proposed California Phase 2 reformulated gasoline regulations will require that all gasoline sold or made available as a motor vehicle fuel in California (hereafter referred to as "California gasoline"), meet specified standards for sulfur content, benzene content, aromatic hydrocarbon content, olefin content, RVP, oxygen content, 90 percent distillation temperature (T90), and 50 percent distillation temperature (T50). These standards would be applicable beginning January 1, 1996.

There would be only one RVP standard, generally applicable to all gasoline whenever it is sold or supplied throughout the distribution system during the RVP season. The standards for the properties other than RVP would include at least two tiers--an absolute limit (often referred to as a "cap") that would apply to all gasoline whenever it is sold or supplied throughout the distribution system, and a more stringent standard that would apply to gasoline when it is initially sold or supplied from the facility at which the producer or importer produced or imported the gasoline.[1] As discussed below, the regulations provide for the certification of alternative gasoline formulations resulting in equivalent emissions reductions. Gasoline that is timely reported as a certified alternative formulation would be subject to the caps (and the RVP standard). However, this gasoline would not be subject to the more stringent standards applicable to gasoline when it is supplied from the production facility. Instead, the gasoline would have to meet the alternative specifications for the formulation as identified in the certification of the formulation.

In the case of the sulfur, benzene, and aromatic hydrocarbon limits, producers would have an additional option in complying with the standards applicable to their gasoline when it is first supplied from the production facility. They could choose either a flat limit or a more stringent limit that can be met on average through a "designated alternative limit" process. This averaging option is described below.

The proposed standards for Phase 2 reformulated gasoline are presented below in Table IV-1. The rationale for the numerical values selected is explained elsewhere in this report.

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1. The provisions in the regulations applicable to producers and the gasoline they sell or supply from their production facilities also generally apply to persons who import California gasoline into the state ("importers") and the gasoline they sell or supply from their import facilities. To simply the discussion of the regulations in this report, references to "producers" apply to both producers and importers unless otherwise indicated.

Table IV-1

Proposed Standards for California Phase 2 Reformulated Gasoline

Property	Units	"Cap" for All Gasoline	Flat Limit for Producers	Limit for Producers Using Averaging
Sulfur	ppm by wt.	80	40	30
Benzene	vol. %	1.2	1.00	0.80
Aromatic	vol. %	30.0	25	20
Olefin	vol. %	10.0*	5.0	N/A
RVP	psi	7.0**	N/A	N/A
Oxygen	wt. %	1.8(min) 2.7(max)	1.8 - 2.2	N/A
T90	° F	330	300	N/A
T50	° F	220	210	N/A

* Applicable during summertime control periods only.
** Applicable during wintertime control periods only.

Staff believe that it is appropriate to have a set of standards for specified gasoline properties as the central feature of the regulations. Any gasoline regulations designed to to reduce emissions from motor vehicles must ultimately involve the identification of specifications, because that is the only way commercial gasoline in the field can be measured and compared. Even a "performance standard" expressed as a required emissions reduction must necessarily be implemented by comparing selected properties of a commercial gasoline against a matrix of specifications determined to yield the necessary emissions reduction. We believe that sufficient studies on the emissions effects of various characteristics of gasoline have now been conducted to justify the selection of a set of specifications which can result in maximum feasible emission reductions. At the same time, the provisions on alternative gasoline formulations will help enable refiners to achieve the anticipated emission reductions in the most cost-effective manner.

Staff also believe that it is important to identify caps, applicable throughout the distribution system, for the various gasoline properties being controlled. Caps enable enforcement personnel to determine compliance by sampling and testing gasoline in the field. The ability to detect violations through field testing can be a significant deterrent to intentional violations, and can encourage more vigorous quality control pr$rams. Further, in enforcing a cap through field testing there is no need to require extensive recordkeeping or to conduct complicated audits. Caps also help avoid temporal or geographic "spikes" in various properties. The advantages of caps are sufficiently great that we are proposing an absolute limit for each of the regulated properties. Because RVP has been shown to have a major effect on emissions and we believe it is technologically feasible for refiners to meet a 7.0 psi standard without

averaging, the proposal is for a single 7.0 psi RVP standard that would generally apply to to all gasoline during the RVP control periods. For the other properties, the caps have been proposed at levels which should permit a meaningful field enforcement program while allowing appropriate variations under the averaging and alternative gasoline formulation provisions.

Many refiners have urged that an averaging program would give them substantially more flexibility in their refinery operations. With averaging they would not have to structure their operations to meet the same flat standard for every gallon of gasoline; when equipment or supply constraints make it necessary to produce batches of gasoline exceeding the standard they could average those with batches below the standard. The refiners indicate that such flexibility is particularly necessary during scheduled maintenance or turnarounds, and would allow them to significantly reduce their costs. We are concerned that averaging makes effective enforcement more difficult and necessitates complex requirements on testing, recordkeeping and reporting. However, staff also recognize the advantages of greater flexibility. Accordingly, staff have evaluated the processing needs for each standard, and the relative benefit that averaging would provide. As a result, staff recommend that averaging be permitted for compliance with the sulfur, benzene, and aromatic hydrocarbon standards. With regard to the other properties, the potential processing benefits of averaging do not appear to justify the adverse impact on enforcement.

It is important that the averaging provisions not result in overall greater emissions than would result from the flat limit. Producers who choose to meet the flat limit would not produce all gasoline at the maximum permitted levels. The average would be less than the permitted standard. Therefore, staff propose that producers choosing to comply with the producer standards for sulfur, benzene or aromatic hydrocarbons through averaging must meet a standard somewhat more stringent than the "flat" limit for producers to assure equivalent emissions reductions.

C. APPLICATION OF THE STANDARDS FOR PRODUCERS AND IMPORTERS

The standards other than the caps are imposed on the producer or importer. This is the party that has primary control over the specifications of the gasoline, and that can make most use of the options of complying through averaging or alternative formulations. The standards apply to gasoline when it is supplied by a producer or importer from its production or import facility. This provides a distinct and uniform point in the distribution process at which compliance can be evaluated and verified, before the gasoline is commingled with other gasoline. A provision is included under which the limits for gasoline supplied from a production or import facility do not apply to a party that did not produce or import the gasoline. In that case the party that previously produced or imported the gasoline was subject to the limits, when the gasoline was supplied from that party's facility.

Imposing prohibitions on the "producer" of the gasoline makes it important to identify just who is the producer of a given quantify of gasoline. "Produce" is generally defined as converting liquid compounds

that are not gasoline into gasoline. When a person blends volumes of blendstocks which are not gasoline with volumes of gasoline acquired from another person, and the resulting blend is gasoline, the person conducting such blending has produced only the portion of the blend which was not previously gasoline. When a person blends gasoline with other volumes of gasoline, without the addition of blendstocks which are not gasoline, the person does not produce gasoline.

There are two exceptions to this general definition of "produce." First, a refiner who acquires gasoline from another party and agrees both to further process it at the refiner's refinery and to be treated as the producer will be deemed the producer. This is consistent with another provision that exempts the party initially supplying the gasoline under such circumstances from being treated as the producer.

Second, a person who blends oxygenates into gasoline that has already been supplied from the production or import facility, and does not alter the quality or quantity of the gasoline in any other way, will not be considered to have produced gasoline. This approach is proposed because it avoids having to subject downstream oxygen blenders to all of the requirements applicable to gasoline producers. It also avoids the difficulties inherent in calculating the specifications of the proportion of a gasoline blend that was "produced" by a person who adds oxygenate. Staff do not believe it is necessary to assign a particular "producer" to that portion of the gasoline blend because the oxygenate blender will not have caused an increase in any of the regulated properties other than oxygen content (e.g. there would be no increase in sulfur content, benzene content etc.).

One consequence of this approach to oxygenate blenders, however, is that while the downstream addition of oxygenate should dilute and thus reduce properties such as sulfur and benzene content, no producer can take credit for this dilution. In order to address the implications of downstream blending, EPA is proposing to allow refiners and importers to sell "reformulated gasoline blendstock for oxygenate blending" ("RBOB") as long it will meet the reformulated gasoline requirements after a specific type and quantity of oxygenate is added. The federal requirements in this area are quite complex. Staff have not yet identified a practical mechanism under which the producer limits could be enforced at the production facility level while accounting for the dilution effects of downstream oxygenate blending.

D. PROVISIONS UNIQUE TO THE RVP AND OXYGENATE STANDARDS

The RVP standard. Because the RVP regulation only applies during specified regulatory control periods, it contains various provisions not applicable to the other standards. The proposed regulation is very closely patterned after the Phase 1 RVP regulation adopted after the September 1990 Board hearing. The regulatory control periods are identical to those in the Phase 1 regulation except that Ventura County will be included with the South Coast Air Basin rather than the South Central Coast Air Basin; this will treat Ventura County the way it had been in the original 9.0 psi RVP regulation. Air quality data indicate that Ventura County has a similar

climate and geography as the South Coast Air Basin and experiences a number of ozone exceedances in April.

The proposed RVP regulation continues the requirements in the Phase 1 regulation that the RVP limits apply one month earlier for gasoline being transferred from a refinery or import facility than for gasoline in the downstream parts of the distribution system. This will help assure that by the time the limits apply to retailers, there has been sufficient replacement of their higher RVP gasoline with lower RVP gasoline. Again like the Phase 1 regulation, the proposed RVP regulation includes provisions intended to clarify the applicability of the standard when gasoline is sold upstream in one control area or time period and dispensed into vehicles in a different area or time period. There would be no liability for otherwise covered upstream transactions if the seller demonstrates that reasonably prudent precautions have been taken to assure that the gasoline will only be delivered to a retail outlet when it is not subject to RVP limits and is not covered by the refiner or importer controls.

The oxygen content standards. The oxygen content caps and standards applicable to producers include limits on both maximum and minimum oxygen content.

It is expected that methyl-tertiary-butyl-ether ("MTBE") and ethanol will be the primary oxygenates in the near term. Ethanol is typically not added to gasoline before it reaches the terminal. While gasoline supplied from a production or import facility would initially be subject to both the oxygen content caps and the producer limits, transactions before the final distribution facility would be exempt from the minimum oxygenate requirements if specified steps are taken to assure that the gasoline meets the oxygenate requirements before it is supplied from the distribution facility. This feature is discussed in more detail in the wintertime oxygenates staff report.

Gasoline would be permitted to have an oxygen content between 2.2 percent by weight and 2.7 percent by weight only if it has been reported as a certified alternative gasoline formulation having an oxygen content specification within that range. Gasoline could also be certified to have less than 1.8 percent by weight oxygen content during times other than the winter control periods. Staff propose a provision to assure that downstream oxygenate blenders are permitted to increase the oxygen content of gasoline above 2.2 percent by weight only when consistent with an alternative formulation. Persons would be prohibited from adding oxygenates to gasoline produced by another person where the resulting oxygen content exceeds 2.2 percent by weight unless the person adding the oxygenates demonstrates that the gasoline has been reported as an alternative gasoline formulation, the gasoline has not been commingled, the person adding the oxygenates is doing so at the express request of the producer, and the oxygen content does not exceed the oxygen content specification for the alternative formulation.

E. DESIGNATED ALTERNATIVE LIMITS

As indicated above, an averaging program provides refiners with additional flexibility in complying with the standards. However, the drawback with most averaging approaches is that compliance is entirely dependent on self-reporting and verifying the accuracy and completeness of reported data is very difficult. Therefore, staff is recommending the same sort of "designated alternative limit" approach as is contained in the diesel fuel aromatic hydrocarbon content regulation adopted by the Board in 1988. The two primary features of this approach are that producers notify the ARB of alternative limits being assigned to various batches of gasoline they produce, and that batches exceeding the basic standard be offset with batches below the basic standard. These features enable enforcement personnel to sample gasoline at the refinery in order to determine whether it meets the assigned limit. The designated alternative limit mechanism would be available as an option for complying with the benzene, sulfur, and aromatic hydrocarbon content standards applicable to gasoline being supplied from the production or import facility.

Since producers using the designated alternative limit option would be subject to a more stringent standard than those complying with the flat limit, all producers would have to elect which compliance option they will be subject to. The elections would apply for a minimum of one year and would effective in calendar year increments. The initial election would have to be made by September 1, 1995, and subsequent changes would have to be made by October 1 of the preceding year. Producers electing to use the averaging option for one property would not have to choose it for the others that could be averaged.

Assignment of designated alternative limits. Producers electing the averaging option could assign designated alternative limits to final blends being supplied from their production facility. If no alternative limit is assigned, the blend would be subject to default limits of 0.80 percent by volume benzene content, 30 ppm by weight sulfur content, or 20 by volume aromatic hydrocarbon content. The designated alternative limit could not be lower than the property of the gasoline as shown by the testing that the producer is required to conduct.

The producer would have to notify the Executive Officer of the final blend's designated alternative limit and volume. ARB compliance staff would probably set up a 24-hour system for notification by telephone. The notification would have to be received before the start of physical transfer of the gasoline from the production facility, and in no case before the producer either completes physical transfer or commingles the blend. The ARB needs to be notified in sufficient time to have the opportunity to verify compliance by sampling some part of the blend before it has left the facility. At the same time, it would be unduly burdensome for refiners to have to hold a final blend for a substantial period before it is shipped out. Staff believe that the proposal strikes an appropriate balance between these two objectives. Notifications of designated alternative limit batches would be permitted after the specified time periods if the Executive Officer

determines the delay was not caused by the intentional or negligent conduct of the producer or importer.

As in the diesel aromatic hydrocarbons regulation, the timeliness of offsets would be calculated from the start of physical transfer of blends exceeding the basic standard and from the completion of physical transfer of blends below the basic standard. These events are reasonable and readily identifiable. The producer would be required to timely notify the Executive Officer when these events have occurred.

The regulations would expressly authorize the use of protocols between the Executive Officer and an individual producer to specify how the designated alternative limit requirements are applied to the producer's operations. The diesel aromatic hydrocarbons regulation includes essentially identical provisions.

The specific offsetting requirements would depend on whether the applicable standard is (a) sulfur or aromatic hydrocarbon content, or (b) benzene content. For the sulfur and aromatic hydrocarbon standards, offsets would be calculated as they are in the existing diesel aromatic hydrocarbons regulation. A producer could supply a final blend with a designated alternative limit in excess of the basic standard from a production facility as long as the producer offsets the blend 90 days before or after by supplying sufficient quantities of gasoline with a designated alternative limit below the standard from the production facility.

The averaging approach for benzene would involve the establishment of credit account for each production facility. Credits would be deposited for blends with designated alternative limits less than 0.80 percent by volume, and would be withdrawn for blends with designated alternative limits above the basic standard. In order to avoid potentially lengthy periods of production of high-benzene gasoline, the quantity of credits that could be in an account at any time would be limited to 1.20 percent times one-half the volume of gasoline produced by that producer during the most recent calendar year for which data have been reported to the Energy Commission. The 1.20 percent value equals the reduction in the average benzene content in California gasoline from its estimated current average value of 2.0 percent. If at any time the credit balance in an account is insufficient to allow the withdrawal of the amount of credits needed by a batch of gasoline with a designated alternative limit above the basic standard, that batch will not have been offset.

Producers would be prohibited from selling or supplying gasoline which has been reported pursuant to the designated alternative limit provisions if it does not meet the designated limit, or if the excess benzene, sulfur, or aromatic hydrocarbon content is not fully offset. The regulation would prohibit selling gasoline in a blend with a designated alternative limit above a basic standard if the total volume of the blend sold exceeds the volume reported. It would similarly prohibit selling vehicular diesel fuel in a blend with a designated alternative limit below a basic standard if the total volume of the blend sold is less than the volume reported. These

provisions would protect against misreporting volumes of diesel fuel to which a designated alternative limit has been assigned.

Producers electing a designated alternative limit option would be subject to testing and recordkeeping requirements patterned closely after those in the diesel aromatic hydrocarbon regulation. They would be required to sample and test each final blend of gasoline for the appropriate property, and maintain specified records for two years records. Producers would be required to provide the records to the ARB within 20 days of a written request. We believe that these provisions are necessary to enable ARB staff to conduct compliance audits, particularly since the designated alternative limit provisions make field testing potentially less effective. Producers would be authorized to enter into protocols with the Executive Officer to specify alternative sampling, recordkeeping, or reporting requirements. This would afford flexibility to tailor the requirements to special operational needs.

F. ALTERNATIVE GASOLINE SPECIFICATIONS

Staff is proposing that instead of meeting the specific limits for gasoline being supplied from the production facility, producers be allowed the option of selling alternative gasoline formulations that result in equivalent emission reductions. Ultimately, two alternatives could be available for certifying alternative formulations--the application of a predictive model and emission testing. These two potential approaches are discussed below. The emission testing is included in the regulatory text now being proposed. The predictive model component will be separately proposed in the near future.

1. Predictive Model

A predictive model is a set of equations based on the results of a number of motor vehicle emission tests which provide information about how different fuel specifications affect exhaust emissions. There have been several models developed within the last year based on limited emissions data. These data are being complied into a comprehensive database which will allow a thorough statistical evaluation of the effects of gasoline composition on emissions. The data from many of these studies have only recently been made available to the ARB. Therefore, our analysis is not yet complete. It is our intention to develop a comprehensive model that can be used as an alternative method of complying with the proposed regulation. We expect that this model will include all of the identified specifications in the proposed regulation, and that no alternative specification will be allowed to exceed the absolute limit specified in Table IV-1. The contemplated statistical approach that we plan on using is discussed in the Technical Support Document.

The following studies will form the basis of the statistical analysis:

- The Auto/Oil AQIRP-Phase I Studies
- Unocal Parametric Study
- Chevron Study on Aromatic Hydrocarbons and Driveability

- ARB Oxygenate Study
- American Petroleum Institute RVP/Oxygenate Study
- ARCO Clean Fuels Study
- General Motors/Western States Petroleum Association/ARB Study on RVP and Driveability Index
- General Motors/ARB Reformulated Gasoline Confirmation Tests
- EPA Emission Factor Data Base
- API Exhaust Benzene Study
- NIPER/ARB Benzene Study
- NIPER/CRC Study

We expect to return to the Board no later than early next year to request adoption of the predictive model.

2. Emission Testing Procedure

The proposed regulations would allow a gasoline producer to apply for certification of an alternative gasoline formulation found through emission testing to result in emissions equivalent to gasoline meeting the Phase 2 reformulated gasoline flat limits. A certification by the Executive Officer would include the identification of an alternative set of specifications. A producer supplying a batch of gasoline from its production facility could notify the Executive Officer that the gasoline is an alternative gasoline formulation in essentially the same way as batches are reported under the designated alternative limit provisions. Gasoline so reported would have to meet the alternative set of specifications rather than the regulatory limits for gasoline being supplied from a production facility. This approach is intended to give producers more flexibility and to provide an opportunity to produce gasoline achieving the targeted emission reductions in the most cost-effective manner.

The central concept is the evaluation and certification of gasoline with an alternative specification, as long as the gasoline sold under the certification does not exceed the specification of the tested gasoline, or exceed the absolute limit specified in Table IV-1. This concept would permit a very careful scrutiny of the test gasoline, coupled with reasonable assurance that the commercial product should have similar emission characteristics when produced to the test fuel specifications.

The test fuel would be compared directly to the reference fuel which meets the Phase 2 gasoline flat limits, and the results would be statistically analyzed. The comparison would be made by testing a group of vehicles, in vehicle categories that reflect the on-road fleet mix, on both the test and the reference fuel. To be certified, a test fuel must result in exhaust emissions of carbon monoxide, oxides of nitrogen, non-methane organic gases (NMOG) on a mass basis, NMOG on an ozone-forming potential basis and the potency-weighted sum of toxic pollutants that do not individually exceed the emissions of the same pollutants when the reference fuel is used.

To receive approval for alternative specifications, an applicant would have to test a fleet of at least 20 vehicles. The fleet would be comprised

of vehicles (ranging from older, non-catalyst vehicles to low-emission vehicles) in the categories that are most prevalent in the on-road fleet. A test plan would be submitted to the executive officer in advance of the testing, specifying the vehicles selected for testing and describing the properties of the test fuel.

Each of the vehicles must be tested on both the test fuel and the reference fuel (Phase 2 gasoline). The difference in emissions between the test fuel and Phase 2 gasoline would be computed for each test vehicle and then averaged over all vehicles within each of the vehicle categories in the test fleet. These average differences by category would be combined into a mileage-weighted mean that serves as an estimate of the difference in average emissions between the test fuel and Phase 2 gasoline in the on-road vehicle fleet. A statistical upper bound for this mileage-weighted estimate would be computed from the standard deviations of emission differences in the several vehicle categories. A mileage-weighted estimate of average emissions from Phase 2 gasoline among the on-road vehicle fleet would also be computed, using the same weights. For each pollutant, the statistical upper bound for the average difference in emissions would be compared to one percent of the average emissions of that pollutant from Phase 2 gasoline. If the upper bound value were greater than the latter number, for any pollutant, the alternative specifications could not be approved.

The less the statistical variability in the test measurements, the greater the chances of passing an equivalent fuel. This variability depends on the design of the test program and the inherent variability of the emission measurements. In general, the greater the number of vehicles tested (a decision made by the applicant) and the more precise the measurements (partly controllable by the applicant), the less the variability and, thus, the greater the chances of passing an equivalent fuel.

The initial approval would last five years. At that time, and every subsequent five years, the upper confidence limit would be re-calculated using the then-current estimates of the miles travelled within each of the on-road vehicle categories. The emission data used in the new calculations would be the original data, any additional data volunteered by the applicant, and any new data required for new vehicle categories. For re-approval, the test fuel would have to pass the same emission criterion discussed above for each pollutant measure. If the test fuel should not pass all the criteria, the alternative specifications could not be used following a two-year grace period.

The details of how the comparison should be performed, what type of vehicles should be tested, and how the data should be analyzed are contained in the California Test Procedures for Evaluating Alternative Specification for Gasoline (Appendix B).

G. TEST METHODS AND SAMPLING

The following test methods would apply to determining compliance with the standards (other methods found by the Executive Officer to yield equivalent results could also be used):

RVP	ASTM D 323-58 or 13 CCR Section 2297
Sulfur Content	ASTM D 2622-87
Benzene Content	ASTM D 3606-87
	ARB MLD 116 (if ethanol is present)
Olefin Content	ASTM D 1319-88
Oxygen Content	ASTM D 4815-88
T90 and T50	ASTM D 86-82
Aromatic Hydrocarbons	ARB MLD 116

Industry representatives have suggested that industry and staff work together to improve the accuracy and precision of the test methods. Staff believe that this is a good suggestion and intends to work cooperatively with industry to develop improvements to the test methods. As appropriate, we will recommend changes to the Board concerning test methods prior to the implementation date of the proposed regulations.

The specified sampling method would generally be the ARB's current procedures on sampling for RVP. In the case of samples for properties other than RVP, T90 and T50, references in the RVP sampling method to the required use of a cooling bath would be deleted.

H. VARIANCES

The executive officer would be authorized to issue variances from the various standards in essentially the same manner as in various other ARB fuels regulations. We believe that a variance provision is needed to mitigate, in appropriate instances, extraordinary hardships that are beyond the reasonable control of regulated parties.

I. OTHER ELEMENTS OF THE REGULATIONS

The proposed regulations will authorize the executive officer to exempt gasoline being used for research purposes from the Phase 2 gasoline specifications. The maximum volume allowed will be 5000 gallons per application. This provision is needed to allow continuing research efforts on gasoline and allow the production of test fuels for the emission testing option discussed in section F.2. This is similar to a provision contained in the RVP regulation adopted by the Board in 1990.

The regulations would provide that each retail sale of gasoline for use in a motor vehicle, and each dispensing of gasoline into a motor vehicle fuel tank, is also deemed a sale by any person who previously sold the fuel in violation of the substantive standards. This provision would help assure that Health and Safety Code Section 43016 "per vehicle" penalties will apply to persons who sell noncomplying diesel fuel to distributors, service

stations or bulk purchaser-consumers. It is based on essentially identical language in several other ARB fuels regulations.

The proposed regulations require producers to provide, periodically, schedules for complying with the regulation. The first plan is due January 1993 with updates provided in January of 1994 and 1995. This provision allows ARB staff to closely follow the refiners' plans to comply with the regulation.

J. PROPOSED MODIFICATIONS TO EXISTING REGULATIONS

We are proposing to make several additional changes to existing regulations. The purpose of these changes is to update provisions to the latest standards, or to ensure that the regulations are consistent with the proposed new regulations. The following changes are proposed:

- Add January 1, 1996, expiration clauses to the following regulations:

  Section 2250 - Degree of Unsaturation for Gasolines
  Section 2251.5 - Reid Vapor Pressure of Gasoline Sold After January 1, 1992
  Section 2252 - Sulfur Content of Gasoline Represented as Unleaded

  These changes will ensure that the existing regulations will not conflict with the new regulations.

- Modify the RVP limit in Section 2251.1 to be 7.80 psi instead of 7.8 psi.

  This change will make the existing limit consistent with the test method requirement of reporting to the nearest 0.05 psi.

- Include Ventura County with the South Coast Air Basin in Section 2251.5, and exclude Ventura County from the South Central Coast Air Basin in Section 2251.5.

  When the 7.8 psi RVP regulation was adopted following the September 1990 hearing, this designation was inadvertently deleted. The proposed change will reinsert this provision in Section 2251.5.

- Change the test method in Section 2252 to 2622-87.

  This change will ensure that the most recent and accurate test method is used to determine compliance with the sulfur content limit.

V.

EMISSION REDUCTIONS DUE TO THE PROPOSED REGULATIONS

A. CRITERIA POLLUTANTS

1. Emission Reductions of Criteria Pollutants

In a single measure, the proposed California Phase 2 reformulated gasoline specifications will achieve significant reductions in emissions of volatile organic compounds, oxides of nitrogen, carbon monoxide, and sulfur dioxide. These emission reductions will be obtained by reducing exhaust and evaporative emissions from on-road mobile sources. Additional reductions will be achieved by reducing evaporative emissions from other mobile sources and petroleum marketing operations.

In the first year of implementation, staff estimates that the Phase 2 gasoline specifications will reduce emissions from gasoline-powered motor vehicles by about 15 percent for volatile organic compounds, six percent for oxides of nitrogen, 17 percent for carbon monoxide, and 80 percent for sulfur dioxide. Staff estimates that there will be about a six percent reduction in evaporative emissions of volatile organic compounds from other mobile sources, and a 12 percent reduction in evaporative emissions of volatile organic compounds from petroleum marketing operations. Overall, in the first year of implementation, the Phase 2 gasoline specifications will reduce volatile organic compound emissions from all sources by four percent, oxides of nitrogen emissions by about two percent, and carbon monoxide emissions by about 10 percent.

Figures V-1 and V-2 present the emission reductions of ozone precursors (volatile organic compounds plus oxides of nitrogen) for the years 1996, 2000, 2005, and 2010 in all nonattainment areas and the South Coast Air Basin. As shown in the figures, first year implementation of the Phase 2 gasoline specifications will reduce ozone precursors by almost 180 tons per day for all nonattainment areas and about 80 tons per day in the South Coast Air Basin. The emission reductions are less in future years because newer

Figure V-1

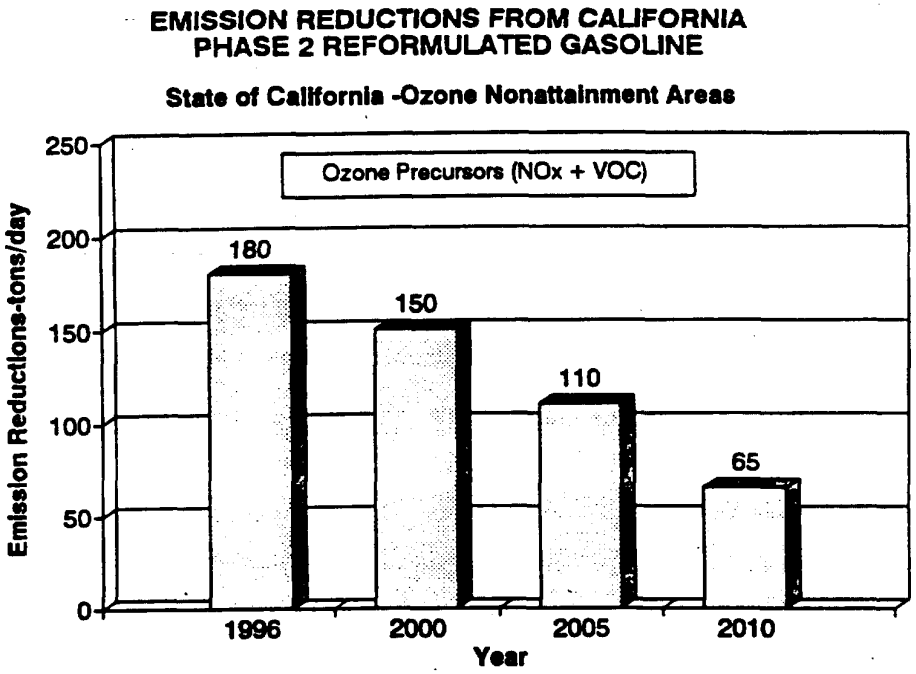
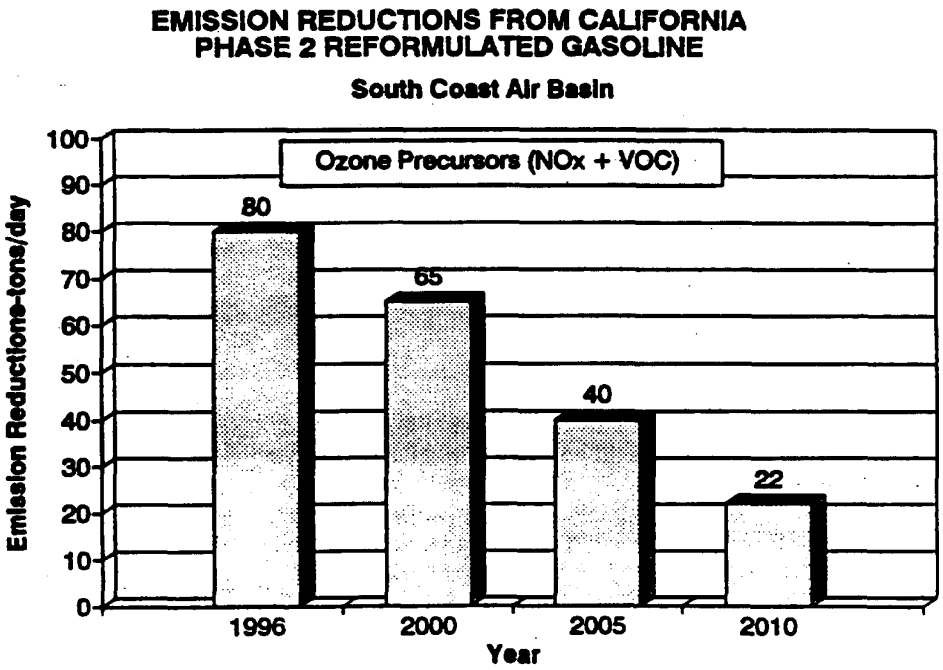


Figure V-2



vehicles meet stricter emission standards than older vehicles and the turnover of the fleet causes a net emissions decrease over time, despite expected continued growth in the number of vehicles and their use. Staff has assumed that the Phase 2 gasoline will be used as a certification fuel for new vehicles beginning in 1996. Even though reformulated gasoline produces an emissions benefit in these vehicles, vehicle manufacturers would have to meet future vehicle standards anyway. Therefore, no emission reduction benefits are assumed for criteria pollutants for any post-1995 model year vehicle.

For all nonattainment areas and the South Coast Air Basin, Table V-1 presents the emission reduction estimates for volatile organic compounds and oxides of nitrogen due to the implementation of the Phase 2 reformulated gasoline specifications. Table V-2 presents estimates of emission reductions for carbon monoxide and sulfur dioxide for both areas.

Actual emission reductions are expected to be greater than shown in the table. During the past few years, a number of independent investigators have conducted studies that assert that the inventory of volatile organic compounds in urban areas may be underestimated by substantial amounts. Investigations conducted during the last year by the ARB staff have shown that these underestimates are in the neighborhood of 50 to 100 percent. Staff believes that the on-road motor vehicle portion of the inventory is underestimated by at least as much as the overall inventory; however, studies to date have not been able to establish error bands for specific categories of the inventory. Efforts towards improving both the mobile and stationary source portions of the inventory continue and a major effort is underway to obtain improved emission rates and vehicular activity data for the on-road motor vehicle emission estimates.

To the extent the motor vehicle emissions inventory is underestimated, the emission reductions for the proposed specifications are underestimated. The actual emission reductions could be 50 to 100 percent greater, or more than currently estimated. This would mean that the emission reductions could increase from about 200 to 250 tons per day for volatile organic compounds, 75 to 100 tons per day for oxides of nitrogen, and 2000 to 2500 tons per day for carbon monoxide.

Staff also believes that the Phase 2 gasoline specifications will reduce exhaust emissions from other gasoline-powered mobile sources such as off-road vehicles, trains, ships, aircrafts, and utility equipment. Estimates of emission reductions from these sources are not addressed here because of a lack of emission test data on which to base emission reduction estimates, so they are not included in the tables.

In addition to reductions in mass emissions, the proposed Phase 2 gasoline specifications would reduce the reactivity of the exhaust and evaporative emissions. Exhaust reactivity would be affected by reductions in olefins, aromatic hydrocarbons, and T90. The preliminary results of the GM/WSPA/ARB study show that the reactivity potential of the exhaust expressed in grams of ozone per gram of exhaust volatile organic compounds

Table V-1

Reductions in Ozone Precursor Emissions (VOC and NOx) Resulting from the Use of California Phase 2 Reformulated Gasoline (Based on the Ozone Planning Inventory a/)

Ozone Nonattainment Area	Emission Reductions (tons/day)			
	1996	2000	2005	2010
All Nonattainment Areas				
Volatile Organic Compounds				
Evaporative Emissions				
On-road Vehicles	40	25	15	5
Other Mobile Sources	14	15	15	20
Stationary Sources	16	20	20	20
Exhaust Emissions	60	50	30	10
Total VOC	130	110	80	55
Oxides of Nitrogen				
Exhaust Emissions				
On-road Vehicles	50	40	30	10
Total Ozone Precursors	180	150	110	65
South Coast Air Basin				
Volatile Organic Compounds				
Evaporative Emissions				
On-road Vehicles	20	10	5	2
Other Mobile Sources	4	5	5	5
Stationary Sources	6	10	10	6
Exhaust Emissions	30	20	10	4
Total VOC	60	45	30	17
Oxides of Nitrogen				
Exhaust Emissions				
On-road Vehicles	20	20	10	5
Total Ozone Precursors	80	65	40	22

a/ The ozone planning inventory represents typical summertime episodic day emissions in a nonattainment area. These days are typically hot days when motor vehicle evaporative control systems tend to fail.

Table V-2

Reductions in Sulfur Dioxide and Carbon Monoxide Emissions Resulting from the Use of California Phase 2 Reformulated Gasoline Based on the Ozone Planning Inventory a/

Ozone Nonattainment Area	Emission Reductions (tons/day)			
	1996	2000	2005	2010
All Nonattainment Areas				
Sulfur Dioxide	30	30	30	30
Carbon Monoxide	1,300	930	540	200
South Coast Air Basin				
Sulfur Dioxide	10	10	10	10
Carbon Monoxide	530	390	220	90

a/ Note that staff used the ozone planning inventory to estimate the emissions for carbon monoxide. These emissions are about 20 percent less than those presented in the carbon monoxide planning inventory due to differences in the ambient temperature used to estimate emissions. Therefore, the emission reductions expected in the wintertime carbon monoxide season are expected to be about 20 percent greater than reported.

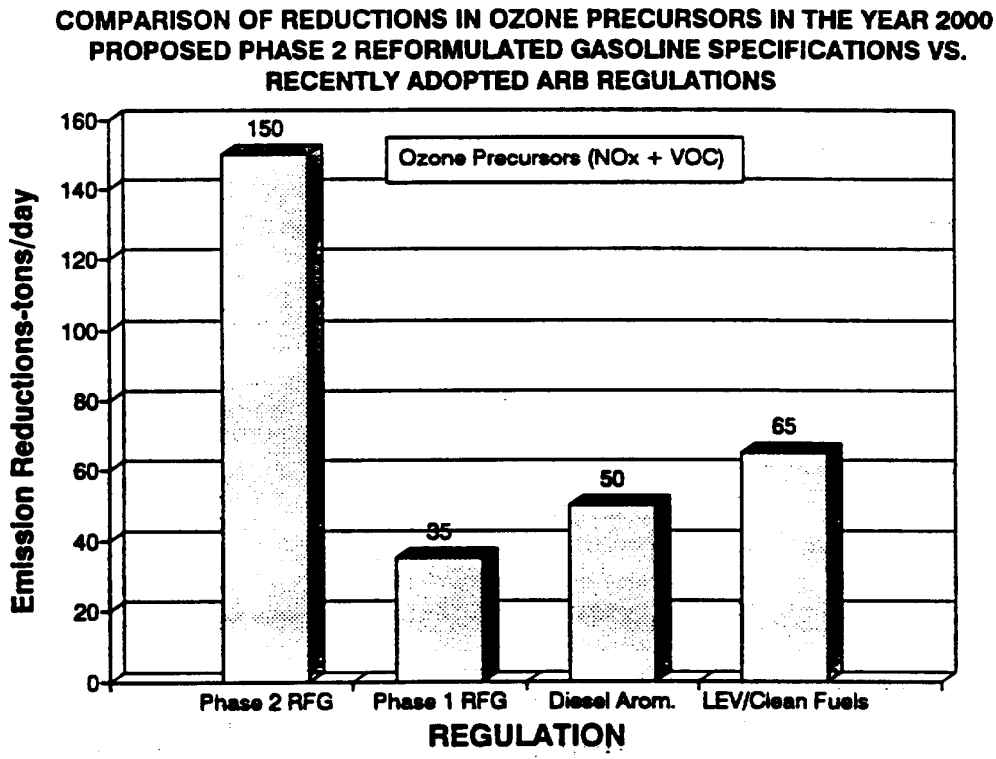
is reduced by approximately five percent when a fuel similar to current average California gasoline is replaced by a gasoline approximating the Phase 2 gasoline specifications. Similarly, the results of the ARCO study show a reduction of about eight percent when the industry average fuel is replaced by a fuel similar to Phase 2 gasoline. The results of the Auto/Oil AQIRP relate reduction of reactivity in the exhaust to reductions in T90. On a grams ozone per mile basis, staff expects the Phase 2 specifications will result in a 30 to 40 percent reduction in the reactivity of exhaust emissions.

The limits proposed for olefins and aromatic hydrocarbon content would reduce these compounds from the evaporative emissions which contribute disproportionately to the reactivity. Although the benefits cannot be quantified at this time, we expect that they would be proportional to the reductions.

2. Comparison to Other Recently-Adopted Control Measures

The projected emission reductions from this control measure are significant. For comparison, Figure V-3 shows the emissions reductions of ozone precursors estimated for the year 2000 from the proposed Phase 2 reformulated gasoline specifications relative to other recently adopted regulations by the Board. As shown in the figure, the emission reductions expected from the Phase 1 reformulated gasoline specifications in the year 2000 were projected to be about 35 tons per day of ozone precursors. The Board's adopted regulation for the reduction of aromatic hydrocarbons in diesel fuel is expected to achieve about a 50 ton per day reduction in ozone precursors. The low emission vehicle/cleans fuel program is expected to achieve a 65 ton per day reductions in ozone precursors. These reductions are significantly less than the reductions in ozone precursors and carbon monoxide expected from California's proposed Phase 2 reformulated gasoline specifications, which are estimated to be about 150 tons per day of ozone precursors.

Figure V-3



3. Brief Description of Methodology Used to Determine Emission Reductions

The detailed methodology used to determine the reductions in emissions of hydrocarbons, oxides of nitrogen, and carbon monoxide that will result from the use of California Phase 2 reformulated gasoline is presented in the Technical Support Document. In summary, staff projected the emissions from light-duty vehicles, medium-duty trucks, and heavy-duty trucks for the years 1996, 2000, 2005, and 2010. For the light-duty vehicles, the emissions for each year were categorized into the following vehicle model year groups that reflect a dominant emission control technology:

Year	Dominant Emission Control Technology
Pre 1975	Non-catalyst vehicles
1975 - 1980	Open loop oxidizing catalyst
1981 - 1985	Early closed loop three way catalyst
1986 - 1990	Current closed loop three way catalyst
1991 - 1995	Closed loop three way catalyst
Post 1995	

Medium-duty and heavy-duty trucks were included and are categorized as simply non-catalyst or catalyst-equipped vehicles.

For the groups of vehicles in any given year, the exhaust and evaporative emission rates for were calculated using the EMFAC7EP data base. Baseline emissions are defined as those emissions from vehicles operating on Phase 1 reformulated gasoline, with typical California gasoline properties. The ozone planning inventory was used as the baseline inventory for estimating emission reductions. The planning inventories represent "typical episodic day" emissions in a nonattainment area. A "typical episodic day" is based on the ten worst air quality days of a particular air pollutant. These days are typically hot days when motor vehicle evaporative control systems tend to fail.

a. Exhaust Emission Reductions

The range of exhaust emission reductions resulting from the Phase 2 reformulated gasoline specifications have been estimated using the emission results of various test programs. Staff have used two approaches to arrive at the expected emission reductions. The first approach uses the Auto/Oil AQIRP regression models, modified to include linear effects of sulfur on catalyst performance, to estimate expected reductions in volatile organic compounds, oxides of nitrogen, and carbon monoxide. The second approach is based on actual emission testing done on fuels which have properties similar to the proposed Phase 2 reformulated gasoline specifications. Staff has used results of the ARCO testing of the EC-X fuel on newer vehicles, and confirmation testing done for the ARB by General Motors on the ARCO EC-X fuel on a full range of light duty vehicles as the basis for determining emission reductions.

The first approach generally results in lower emission reductions than does the actual emission testing, particularly for oxides of nitrogen. For example, the regression equation analysis predicts for light duty vehicles that emissions of volatile organic compounds and oxides of nitrogen would be reduced by about 13 percent and four percent statewide in the year 1996, whereas the emission testing approach yields reductions of 17 percent in volatile organic compounds and eight percent for oxides of nitrogen.

The ARB, again in cooperation with General Motors, is testing a version of the EC-X fuel which has a lower oxygen content than the original EC-X fuel. The baseline fuel for this study will be a California average fuel, which was available from the GM/WSPA/CARB volatility study. The results from this study are expected in mid-October.

The emission reductions from medium and heavy duty trucks were based on an average of the non-catalyst vehicles and the 1975-1980 model year vehicles. This is because the technology for these vehicles is not as advanced as the later model light duty vehicles.

b. Evaporative Emission Reductions

Evaporative emission reductions are achieved from gasoline-powered on-road vehicles, other gasoline-powered vehicles, and petroleum marketing operations through reductions in the volatility (RVP) of gasoline.

The methodology for estimating evaporative emissions for on-road vehicles generally follows the methodology used to determine emission reductions for California Phase 1 reformulated gasoline. The methodology has been modified to include the effects of reducing the RVP on running losses.

Off-road mobile sources include motorcycles, snowmobiles, pleasure boats, light and heavy duty farm equipment and residential and commercial utility engines. The evaporative emissions from off-road mobile sources are assumed to be directly proportional to the true vapor pressure of the gasoline. Staff also assumed that 50 percent of the volatile organic emissions are due to evaporative losses.

Evaporative hydrocarbon emissions occur from a number of stationary sources. Most of the emissions that can be reduced by reducing RVP occur from vehicle fueling operations, gasoline storage and transfer operations, and storage tank working losses and breathing losses. For the purposes of this study, staff assumed that the evaporative losses from these sources is directly proportional to the true vapor pressure of the gasoline.

B. TOXIC AIR CONTAMINANTS

1. Benzene Limit

From the results of the 1988 survey of refiners, follow-up workshops and discussions, the staff believes that reducing the average benzene content of gasoline to 0.80 percent by volume (the proposed limit) is technologically feasible. Achieving a benzene content of less than 0.80 percent by volume could force some refiners to turn to methods that are not commercially demonstrated and that would have technical drawbacks. For example, some refiners might have to remove benzene from streams and in the process significantly reduce other high octane compounds which the refiner just produced in order to raise the octane content of the blend.

Reducing the benzene content of gasoline will decrease the benzene in vehicular hydrocarbon emissions. Table V-3 shows the reduction in estimated average ambient benzene concentrations due to a 0.80 percent by volume limit on benzene in gasoline. The table shows the effects for the two scenarios: 1) all low emission vehicles use gasoline and 2) one-half of the low emission vehicles use gasoline. If low emission vehicles use alternative fuels (most of which contain no, or only very little, benzene), instead of gasoline, benzene emissions will be lower for future years. However, because most of the effect of the benzene limit for gasoline is in non-low emissions vehicles, on-road vehicles and other mobile sources, the reduction in benzene emissions does not differ much between the two scenarios.

An appropriate measure of the benefits of the benzene limit is the calculation of the number of potential lifetime (70-year) cancer cases that would be avoided as a result of the limit. To look at the total number of cancer cases avoided over a 70-year period would, in this case, be difficult because of the constantly changing ambient concentration and population over the years. (Benzene concentrations change so much year-to-year because they are associated with mobile-source hydrocarbon emissions, which change steadily over time due to fleet turnover.) Therefore, staff have calculated the number of cases that will be avoided over a much shorter period, 1996 to 2010. As shown in Table V-4, the benzene limit is expected to achieve a reduction of about 15 potential cancer cases per year for this 15-year period. This is a 22 percent reduction in the baseline risk due to ambient benzene concentrations.

In addition to the reductions in the exposure to benzene in the ambient air, reducing the benzene in gasoline would reduce exposures that have not been quantified here. For example, employees and customers in service stations would breathe less concentrated benzene during vehicle fueling, and people who contact gasoline directly (for example, while filling fuel tanks on their lawn mowers) would be expected to contact less benzene.

Table V-3

Estimated Average Ambient Benzene Concentrations
With and Without the Benzene Limit
(population-weighted, ppb)

	2000	2010
If all low emission vehicles use gasoline:		
without benzene limit	1.7	1.2
with benzene limit	1.3	1.0
If one-half of the low emission vehicles use gasoline:		
without benzene limit	1.6	1.1
with benzene limit	1.4	0.9

Table V-4

Reduction in Potential Cancer Cases Due to the Benzene Limit
1996 - 2010

	Baseline Lifetime Cancer Cases Per Year Due to Total Benzene Emissions 1996-2010	Reduction in Cancer Cases Per Year, Due to Benzene Limit
If all low emission vehicles use gasoline:	75	16 a/
If one-half of the low emissions vehicles use gasoline:	72	16 a/

a/ The reductions in potential cases for both scenarios represent a 22 percent reduction in the baseline cancer cases.

2. Effects of Other Phase 2 Reformulated Gasoline Specifications on Toxic Air Contaminant Emissions

The following sections discuss the effects on vehicular toxic air contaminant emissions of the proposed Phase 2 gasoline specifications for aromatic hydrocarbon content, oxygen content, T90 distillation temperature, sulfur content, RVP, and olefin content. The effects of the proposed limit on the benzene content of gasoline were presented in Section 2. of this chapter. The staff has no specific information on the effects on toxic emissions from changes to T50 distillation temperature or oxygen content using compounds other than MTBE. To the extent that these two properties reduce volatile organic compound emissions, toxic air contaminant emissions would tend to be reduced. Any other effects on toxic air contaminant emissions are not known.

We have compared the predicted potency-weighted emission rates of benzene, 1,3-butadiene, formaldehyde, and acetaldehyde from vehicles using Phase 1 gasoline (gasoline meeting the specifications already adopted by the ARB) to the predicted potency-weighted emission rates from vehicles using Phase 2 reformulated gasoline. Table V-5 lists the values of the aromatic content, oxygen content, olefin content, sulfur content, and distillation temperatures that were used to compare the emissions between the gasolines.

The staff has used the Auto/Oil study regression models to estimate emissions of benzene, 1,3-butadiene, formaldehyde, and acetaldehyde as a function of the first four variables in Table V-5. One model estimates emissions for the 1989 model year vehicles while the other estimates emissions for older (1983-1985) vehicles.

The common effects of individual variables in both 1989 vehicles and the older vehicles are:

- Reducing the aromatic content of gasoline reduces benzene emissions (an effect previously seen in several studies) but increases formaldehyde and acetaldehyde emissions.

- Reducing the olefin content of gasoline reduces 1,3-butadiene emissions but not the other three pollutants.

- Decreasing T90 reduces all four toxic air contaminants in the 1989 vehicles but only 1,3-butadiene emissions in the older vehicles.

- Increasing MTBE has no significant effect on acetaldehyde emissions, but increases formaldehyde emissions.

Table V-5

Values of Gasoline Properties Used in the Comparison

	Proposed Phase 2	Baseline Phase 1
Aromatics (vol.%)	20	32
Oxygen (wt.%)	2 a/	0
Olefins (vol.%)	5	10
90% Distillation Temperature (°F)	300	330
Sulfur (ppm)	30	150

a/ Expressed as 11 percent MTBE in the models.

When all four fuel variables are changed simultaneously the following effects are noted. Effects of low sulfur content would be additional.

- Benzene and 1,3-butadiene emissions are each reduced by 26 to 29 percent. This does not include any effect of reducing the benzene content of gasoline.
- Formaldehyde emissions increase by 17 percent in the 1989 vehicles and by 53 percent in the older vehicles.
- Acetaldehyde emissions increase by 15 percent in the older vehicles, while there is only a slight increase for 1989 vehicles.
- The potency-weighted sum of the four pollutants decreases for both sets of vehicles.

Table V-6 shows the effects of the proposed Phase 2 gasoline specification changes on the potency-weighted toxic air contaminant emissions. The change in potency-weighted sum is calculated by multiplying each compound's percent change in emissions by its unit value of cancer risk (risk per concentration) and summing the four values. The sources used for the potencies are as follows: the California Department of Health Services (DHS) best estimate for benzene, the DHS/ARB 1991 draft report's best

estimate for 1,3-butadiene and formaldehyde, and the California Air Pollution Control Officers Association risk assessment guidelines' value for acetaldehyde. The potency values for 1,3-butadiene, formaldehyde, and acetaldehyde are preliminary and subject to change. However, they are the best values available at this time.

As indicated above, formaldehyde emissions are expected to increase as a result of the changes in gasoline specifications. These increased formaldehyde emissions are more than offset--both on a mass basis and on a potency-weighted basis--by reductions in other toxic compounds. For example, according to the model for 1989 vehicles, formaldehyde would increase about 0.3 mg/mile (a 17 percent increase), but benzene and 1,3-butadiene emissions would decrease by about 3.7 mg/mile combined. Benzene and 1,3-butadiene are more potent carcinogens than formaldehyde. Therefore, despite the increases in formaldehyde due to the proposed gasoline specifications, there will be a significant decrease in overall potential risk even without considering the benefits of the proposed benzene limit, which is not accounted for within Auto/Oil AQIRP models.

As shown in Table V-6, the overall reduction in potency-weighted emissions resulting from the aromatic hydrocarbon, olefin, oxygen, and T90 specifications for Phase 2 reformulated gasoline is estimated to be 25 percent for the 1989 vehicles and eight percent for the older vehicles. The total change in the potency weighted sum of emissions when all four fuel variables are changed is greater than the sum of the changes of the individual variables due to interactive effects because the models contain interactive effects among the variables. Benefits of the proposed benzene and sulfur limits would be additional.

Table V-6

Sum of Percent Changes in Potency-Weighted Emissions of Toxic Air Contaminants

	Phase 2 Limit Met Separately				
	Aromatic Hydrocarbons	Oxygen	Olefins	T90	All Four Limits Met Simultaneously
1989 Vehicle Model	-14	0	-3	-8	-25
Older Vehicle Model	-7	+17	-5	-1	-8

a. The Effects of Phase 2 Reformulated Gasoline Specifications for Sulfur on Toxic Air Contaminant Emissions

The Auto/Oil study found a 16 percent reduction of hydrocarbon emissions when the sulfur content of gasoline was changed from 466 to 49 ppm. Because it compared only two sulfur contents in gasoline, the functional relationship of exhaust emissions to the fuel sulfur level is not known. It is assumed here that the relationship of exhaust emissions and sulfur content is linear. The reduction in hydrocarbon mass emissions resulting from lowering gasoline sulfur content from 150 ppm current average to 30 ppm (proposed Phase 2 gasoline specification) is estimated at five percent.

Emission data for toxic compounds have not been published for the sulfur study. However, it is commonly seen in other studies that the toxic emissions are reduced by about the same factor as the volatile organic compound emissions. Therefore, we have assumed that reductions of about five percent in the remaining benzene, formaldehyde, and acetaldehyde emissions would result from a reduction of sulfur content in gasoline. This assumption is not made for 1,3-butadiene, which appears to be formed nearly exclusively during the period before a cold catalyst becomes warm enough to function. Since the effect of sulfur on emissions is due to its role as a catalyst poison, the staff has assumed that 1,3-butadiene emissions would not be affected by reducing the sulfur in gasoline.

b. The Effects of RVP, T50 and Non-MTBE Oxygenate on Toxic Air Contaminant Emissions

No reduction of toxic emissions is anticipated from lowering the RVP limit from Phase 1 to Phase 2 gasoline specifications. As discussed earlier, the effects of the changing T50, and adding non-MTBE oxygenate compounds cannot be addressed quantitatively because of lack of specific data.

c. Overall: Effects of Phase 2 Specifications on Toxic Air Contaminant Emissions

The total potential cancer incidence attributed to emissions from gasoline vehicles will decline as a result of the Phase 2 gasoline specifications. The Auto/Oil results for the effects of the aromatic hydrocarbon content (non-benzene), 90 percent temperature, olefins, and oxygen content suggest decreases of eight to 25 percent in the potency-weighted sum of emissions of benzene, 1,3-butadiene, acetaldehyde, and formaldehyde. Additional reductions in the overall potency-weighted toxic compound emissions would result from the effects of less sulfur and less benzene in gasoline. The overall reduction in potency-weighted toxic emissions from gasoline-powered vehicles is estimated to be about 25 percent: ten percent due solely to the benzene limit and 15 percent due to the other Phase 2 specifications.

We estimate that, cancer over the period 1996 to 2010, a total of about 35 potential cases per year will be avoided as a result of the Phase 2 gasoline specifications. Of the 35 cases, about 15 cases per year are due to the benzene limit and the rest are due to the other Phase 2 gasoline specifications. It is logical that these other specifications would be expected to reduce the risk by such a significant amount since the hydrocarbon emissions reductions associated with the Phase 2 specifications (compared to Phase 1 gasoline) are about 15 percent, and toxic air contaminant emissions generally decline with hydrocarbon emission reductions in volatile organic compound emissions.

C. COMPARISON OF THE EMISSION EFFECTS OF CALIFORNIA PHASE 2 REFORMULATED GASOLINE SPECIFICATIONS WITH FEDERAL CLEAN AIR ACT REQUIREMENTS

1. Criteria Pollutants

In the workshops held by staff prior to the release of this Staff Report, several commenters have indicated that ARB should adopt the proposed EPA specifications statewide, and not adopt additional specifications until EPA finalizes the year 2000 performance standards. The staff does not believe this approach will provide the most environmental benefit to California. In the following analysis, a comparison of the benefits of the EPA's proposed regulation will be compared to the proposed California Phase 2 reformulated gasoline specifications in order to demonstrate that the proposed specifications will provide substantial additional benefits over the EPA requirements. This comparison will be performed using California's emissions inventory and California Phase 1 reformulated gasoline as a baseline fuel. In addition, a second analysis will be presented which demonstrates that the proposed California Phase 2 reformulated gasoline will exceed the FCAA requirements for the year 2000.

a. Comparison of Emission Reductions

Table V-7 shows the expected emission reductions of criteria pollutants in the South Coast Air Basin from the the proposed 1995 federal reformulated gasoline specifications and the emission reductions expected from the proposed California Phase 2 reformulated gasoline specifications in 1996. This analysis is based on the emissions inventory developed for the South Coast Air Basin by the ARB and assumes that California Phase 1 reformulated gasoline is the baseline fuel from which emission reductions are calculated.

Table V-7

Emission Reductions of Criteria Pollutants from the Use of EPA Reformulated Gasoline Versus the Use of California Phase 2 Reformulated Gasoline in 1996 for the South Coast Air Basin

	Emissions Reductions in 1996 (Tons/Day)			
	VOC	CO	NOx	SO2
Proposed EPA Phase 1 Reformulated Gasoline a/	35	460	5	0
Proposed California Phase 2 Reformulated Gasoline b/	60	530	20	10
Increase in Emission Reductions	+25	+70	+15	+10
Percent Increase	+70	+15	+300	--

Base fuel: California Phase 1 Reformulated Gasoline

a/ RVP = 7.2 psi; Oxygen = 2.0 % by wt.; Aromatic Hydrocarbons = 25 vol. %
b/ RVP = 7.0 psi; Oxygen = 2.0 % by wt.; Aromatic Hydrocarbons = 20 vol. %
Sulfur = 30 ppmw; Olefins = 5.0 vol. %; T90 = 300 deg. F;
T50 = 210 deg F.

As shown in the table, the proposed California Phase 2 reformulated gasoline specifications will result in substantially greater emission reductions than the federal program, achieving over one and one-half times the emission reductions of volatile organic compounds, four times the emission reductions of oxides of nitrogen, and about a 15 percent increase in the emission reductions of carbon monoxide. Unlike the proposed California Phase 2 gasoline specifications, the federal program will not achieve any emission reductions in sulfur dioxide because the sulfur content will not be regulated in 1995. Due to the nature of the proposed California

Phase 2 reformulated gasoline specifications, we also expect to achieve additional reductions in toxic air contaminants and in the ozone-forming potential of the emissions as compared to the federal program.

b. Comparison to FCAA Performance Standards

The FCAA requires that the federal reformulated gasoline meet specified performance standards in the years 1995 and 2000. A direct comparison of the ability of the proposed California Phase 2 reformulated gasoline specifications to meet these performance standards can be assessed using the criteria outlined in the FCAA. As discussed in Chapter II, EPA is considering proposing standards for RVP and oxygen content in order to meet the FCAA 15 percent emission reduction requirement for the year 1995. Table V-8 compares the California Phase 2 gasoline specifications for RVP and oxygen content to the EPA specifications and shows the estimated percent reductions that would occur based on an RVP of both 8.7 psi and 7.8 psi in the baseline fuel. The higher RVP baseline represents the baseline specified in the FCAA, whereas the lower RVP represents the baseline fuel agreed upon during the negotiated rulemaking process. Note that these percent reductions are based on EPA's emissions inventory estimates.

Table V-8

Comparison of EPA and ARB Specifications for RVP and Oxygen Content and Percent Reduction in Volatile Organic Compound Emissions from EPA Baseline

Specifications	Percent Difference From EPA Baseline RVP = 7.8 psi	RVP = 8.7 psi
EPA (7.2 psi, 2.0 wt % O2)	-15	-30
ARB (7.0 psi, 2.0 wt % O2)	-18	-33

As the table shows, the ARB's lower volatility specification will result in greater emission reductions.

The next step is to compare how California's proposed Phase 2 specifications will compare to the FCAA year 2000 performance standard. To perform this analysis, we have used the baseline gasoline specified in the FCAA in conjunction with the Auto/Oil regression equation for the current vehicle fleet. The results of this analysis are presented in Table V-9.

Table V-9

Percent Reduction in Volatile Organic Compound Emissions from EPA Baseline When Using California Phase 2 Reformulated Gasoline Specifications

Specifications	Percent Difference From EPA Baseline RVP = 7.8 psi	RVP = 8.7 psi
ARB Phase 2 Reformulated Gasoline	-26	-44

This comparison shows that our proposed specifications will result in a 44 percent reduction in emissions of volatile organic compounds from the FCAA baseline fuel with an RVP of 8.7 psi, and a 26 percent reduction in emissions of volatile organic compounds from a baseline fuel which has an RVP representative of California Phase 1 reformulated gasoline. Therefore, the proposed California Phase 2 reformulated gasoline specifications will exceed the FCAA emission performance standard requirement of 25 percent reduction for the year 2000.

For several reasons, this assessment is not particularly relevant to the actual emission reductions which will be achieved in California. One, the baseline fuel represents a nationwide industry average fuel, which has specifications which are generally less stringent than existing California Phase 1 reformulated gasoline. This difference will make compliance with the performance standards easier, and will tend to reduce the benefits of any future federal fuel regulations in California. In addition, EPA is using an emissions inventory which currently assigns much greater emissions to evaporative losses than does the current California emissions inventory. This difference allows for much greater benefits to be derived from changing the RVP of the fuel. For example, ten percent of the required performance standard of 15 percent for volatile organic compounds in the year 1995 is achieved by simply changing the RVP from 7.8 psi to 7.2 psi. The likely impact of these differences is that EPA will not need to proposed future fuel specifications that are as stringent as our proposed California Phase 2 reformulated gasoline specifications in order to meet the year 2000 requirements of the FCAA.

2. Toxic Air Contaminants

The Federal Clean Air Act Amendments of 1990 require that the benzene content of gasoline not exceed an average of 1.0 percent by volume in the most severe ozone nonattainment areas. EPA has proposed an average benzene limit of 0.95 percent by volume with an absolute limit of 1.3 percent by volume. The ARB staff's proposed basic limit of 0.80 percent by volume benzene, and the alternative flat limit of 1.00 percent by volume and the absolute limit of 1.2 percent by volume are consistent with, but more restrictive than the federal regulation.

The Federal Clean Air Act Amendments also require that if the benzene content limit does not result in a 15 percent reduction in the mass emissions of five toxic pollutants (benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and polycyclic organic material), then additional reductions must be made such that toxic emissions are reduced by 15 percent in the severe ozone non-attainment areas by 1995. Our proposal is expected to result in a decline in mass toxics emissions well in excess of 15 percent, which would more than satisfy the federal requirement. From the initial data we have seen for the federal model that will be used to determine this percentage reduction, it appears that the federal 1.0 percent by volume benzene requirement will be enough to meet the 15 percent toxics reduction. Therefore, simply meeting the federal benzene standard should be enough to assure compliance in 1995.

3. Timing of FCAA Requirements

The FCAA regulations are to be effective beginning on January 1, 1995, which is one year earlier than the the proposed implementation for the staff's proposed Phase 2 reformulated gasoline specifications. Therefore, fuel sold in the South Coast Air Basin, San Diego Air Basin, and Ventura County must meet the federal regulations beginning in 1995. Beginning on January 1, 1996, refiners will have to comply with both sets of requirements, although, in effect, the California Phase 2 reformulated gasoline specifications will replace the federal reformulated gasoline.

Staff does not believe that implementation of the federal program one year earlier than the proposed implementation date for California Phase 2 gasoline specifications will cause any adverse economic or environmental impacts on the refiners. The FCAA requirements essentially involve reducing RVP, aromatic hydrocarbons, and benzene, and adding oxygenates. These modifications can be made primarily by modifying refinery operating conditions. Capital costs may be incurred for reducing benzene; however, we believe this can be done to be consistent with our proposal. Therefore, no additional costs will be necessary to meet the proposed California Phase 2 specification for benzene.

VI.

ECONOMIC IMPACTS OF THE PROPOSED REGULATIONS

A. BACKGROUND

The California refining industry includes a total of thirty individual refineries and altogether processed a total of approximately 1.9 million barrels of crude oil per operating day during 1990. Of the thirty refineries, sixteen facilities produce approximately ninety-seven percent of the gasoline sold in California.

In order to fully comply with the proposed California Phase 2 reformulated gasoline specifications, refiners will increase their flexibility to produce various blendstocks with specific chemical properties. The challenge facing refiners in the future will be to produce a gasoline with much stricter specifications while simultaneously trying to maintain control on octane and other performance qualities at a cost which would not be prohibitive to the refiner and result in a loss of competitive advantage in the marketplace. The more complex refineries will be at a better advantage to increase their flexibility than less complex refineries.

In developing the cost estimates for this chapter, staff has generally relied on information presented to us by the refiners. Prior to the hearing, staff expects to perform additional linear programming analyses of selected refinery types. The results of these analyses will be used to improve upon the cost estimates presented in the chapter.

B. COSTS OF COMPLIANCE

Each individual refiner in order to comply with the proposed regulatory requirements would have to develop an individual investment strategy based on processing and operating capability. To evaluate the economic impacts to the refining industry, staff is in the process of developing four economic models of California refineries with different complexity which would represent the spectrum of the California refining industry. Because the results of this study are not yet available, staff has developed the cost analysis based on cost data provided by six refiners. Three of these refiners are large complex refineries and the remaining can be classified as small refineries. Table VI-1 shows the capital and operating costs as provided by these refiners together with the staff's analysis of the cost per gallon and their analysis of the cost per gallon.

Table VI-1

Estimated Cost of Compliance for Six California Refineries

Refinery	Capital Investment Cost (Million $)	Operating Costs (Million $/yr)	Cost per gallon (cents/gallon) Staff's Estimates	Refiner's Estimate
A	100	N/A	12	30
B	178	65	16	18
C	1,000	275	12	16
D	53	26 a/	14	N/A
E	N/A	N/A	N/E	15
F	147	50 b/	4 b/	N/A

N/A - Not Available, N/E - Not Estimated.
a/ The staff assumed 50 percent of capital cost to be operating expenses.
b/ This is the cost for meeting the olefin and sulfur limits only.

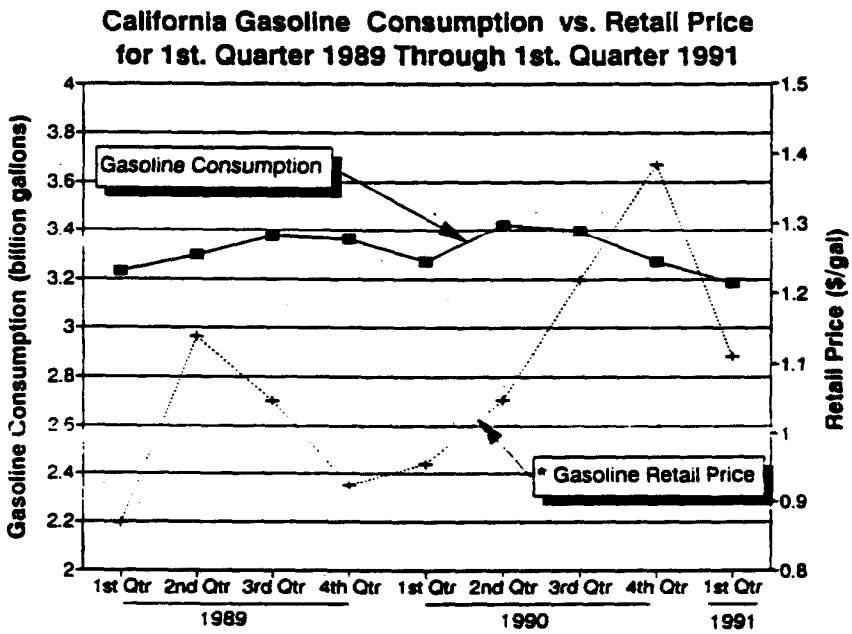
The staff used the capital investment data shown in Table VI-1 and the refiner's gasoline production to make a preliminary estimate of the capital investment cost required. The capital investment cost ranges from 13 dollars to 21 dollars per barrel-day of gasoline produced. This capital investment cost was then applied to about 900,000 barrels per day of gasoline produced in California to estimate a capital investment cost from four to seven billion dollars.

Staff's analysis also indicates that the cost per gallon of gasoline produced would range from 12 to 16 cents per gallon. The staff assumed a 10 year capital recovery with a 10 percent rate of return for large refiners and a 13 percent rate of return for the small refiners. The differences between refiners' and staff's cost estimates are the result of differences in assumptions on rates of return, time for capital recovery, exclusion of

federal and state tax credits and the fact that some refiners' estimates include the fuel economy penalty to the consumer of about 2 to 4 cents per gallon. If this fuel economy penalty is added to the staff's estimate the range of cost would be about 14 cents to 20 cents per gallon.

Fluctuations in gasoline prices in the near past indicate that changes in gasoline prices by about 15 cents to 20 cents a gallon did not have a significant impact in gasoline consumption. As Figure VI-1 shows, significant changes in gasoline prices for the years 1989 and 1990 did not change gasoline consumption with the exception of normal seasonal variations. In fact, during the Valdez Oil spill, exemplified by the period between the first quarter 1989 to the second quarter 1989 on the graph, prices increased by 25 cents per gallon; however, consumption increased by two percent. The period on the graph between the second quarter of 1990 and the fourth quarter of 1990 corresponds to Iraq's invasion of Kuwait. During this period, gasoline prices rose by 32 cents per gallon, yet, consumption again remained stable with the exception of an expected decrease in consumption over the winter months.

Figure VI-1



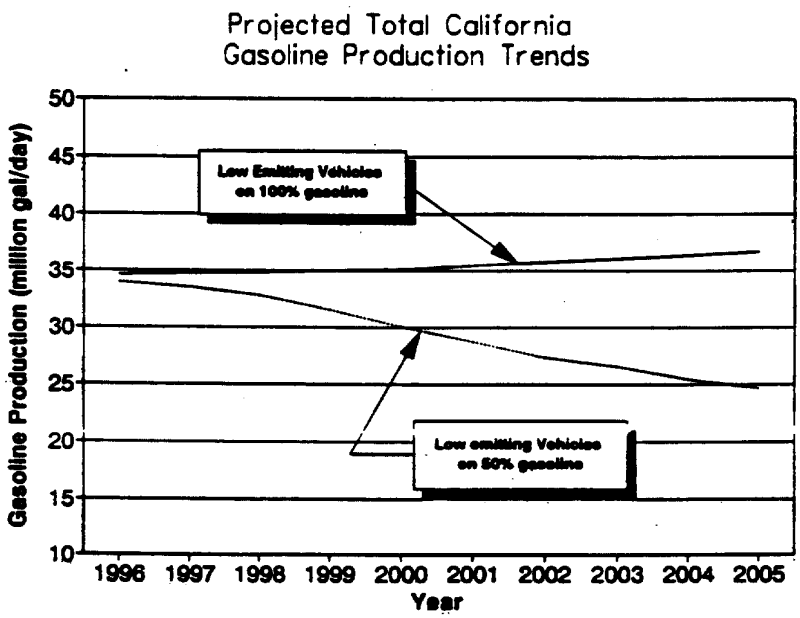
*Prices are for self serve unleaded regular

Sources: 1. Quarterly Oil Report, California Energy Commission, May and July, 1991.

2. Interoffice memo dated August 28, 1991, from the Board of Equalization, Office of Research and Statistics, to ARB.

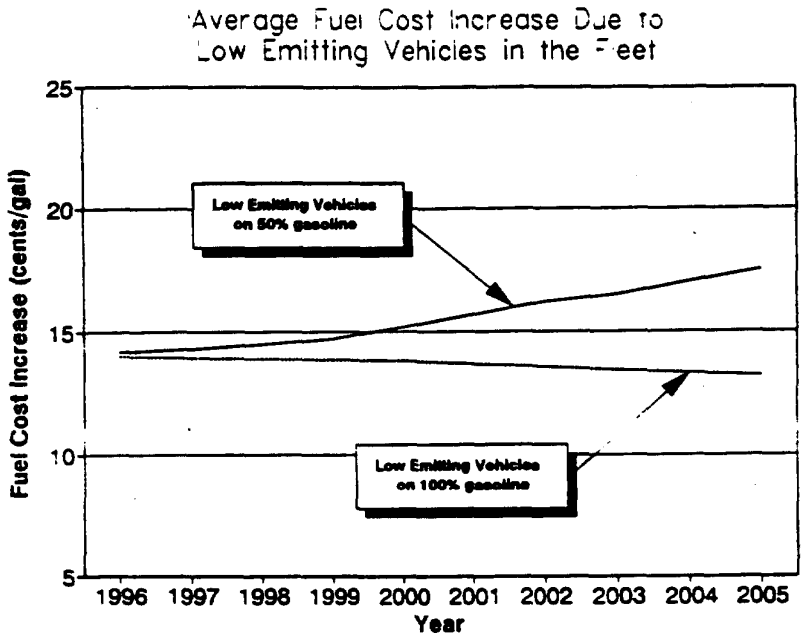
The staff's evaluation of the cost per gallon assumes that Phase 2 gasoline would be clean enough so that all low emission vehicles could use gasoline. Low emission vehicles using other clean fuels will decrease the amount of gasoline used. If the total cost of the regulation is distributed over only the gasoline product, the cents per gallon cost projection will increase. Therefore, staff evaluated a scenario where 50 percent of the low emission vehicles use gasoline and 50 percent of the low emission vehicles use other clean fuels. Under this scenario, the staff estimated that the gasoline demand would be reduced by about 30 percent for the year 2005 as shown in Figure VI-2. Figure VI-3 shows that gasoline costs in this case could increase from 14 cents per gallon to about 18 cents per gallon for the year 2005. Thus, over a ten year period, a substantial penetration of low emission vehicles will not significantly affect the cost of gasoline to the consumer.

Figure VI-2



Sources: ARB Ozone Planning Inventory, 1996-2010
Low Emission Vehicle/Clean Fuels Staff Report, August 1990.

Figure VI-3



Sources: ARB Ozone Planning Inventory, 1996-2010
ARB Technical Support Document, Proposed Regulations for California Phase 2 Reformulated Gasoline, October 4, 1990.

C. COST-EFFECTIVENESS

1. Criteria Pollutants

Staff performed a number of analyses for cost-effectiveness by using the emission reductions shown in Tables V-1 and V-2 and the estimated cost of production of about 12 cents to 16 cents per gallon. The cost-effectiveness analysis is shown in Table VI-2 for the two compliance costs. In this analysis, cost-effectiveness was based on distributing the costs equally between criteria pollutants and toxic air contaminants. To better understand the resultant impact on cost-effectiveness to the consumer, the fuel economy penalty of two to four cents per gallon was considered and cost-effectiveness was recalculated. These cost-effectiveness results are also shown in Table VI-2.

Table VI-2

Cost-Effectiveness for California Phase 2 Reformulated Gasoline for Criteria Pollutants a/

	Cost-Effectiveness ($/Ton)	
Costs of Compliance	1996 Emissions Benefits	Emissions Benefits Averaged 1996-2005
Production Costs		
12 cents/gal	5,100	6,800
16 cents/gal	6,800	9,100
Cost to the Consumer		
14 cents/gal	5,900	8,000
20 cents/gal	8,400	12,000

a/ Based on 50% of costs attributed for VOC, NOx, 1/7CO, & SO2 reductions and 50% of costs for reductions in toxic air contaminants.

Table VI-2 shows an average range of cost-effectiveness of the proposed Phase 2 gasoline specifications from about three to five dollars per pound of pollutant reduced based on the refiner's production cost, and four to six dollars per pound of pollutant reduced including the small fuel economy penalty. In the staff's cost-effectiveness analysis, cost was factored into total aggregate pollutant reductions including carbon monoxide. However, for vehicular measures carbon monoxide emissions typically exceed other pollutant emissions by a factor of seven. Therefore, staff discounted carbon monoxide emissions benefits by 6/7 according to the Board's guidance document entitled, "California Clean Air Act Cost-Effectiveness Guidance", published in September 1990. Emissions reductions used are averages for each year and integrated from the year 1996 to the year 2005.

If the emissions inventory is underestimated by 50 to 100 percent as discussed in Chapter V, the cost-effectiveness of this measure would be improved. Assuming a 50 percent increase in emissions for average emission reduction benefits over the 1996-2005 year timeframe, and using the projected cost to the consumer of 14 to 20 cents per gallon, the cost-effectiveness would change from four to six dollars per pound to about three to four dollars per pound.

Staff also calculated the cost-effectiveness based on assigning a one-fifth cost to each of four criteria pollutants and a one-fifth cost to the toxic air contaminants. Using the emissions benefits averaged over the 1996-2005 time period, the cost-effectiveness, based on projected costs of 14 cents to 20 cents per gallon, ranges from about six to nine dollars per pound of pollutants reduced.

To add perspective to consumer costs resulting from reformulated gasoline, staff calculated costs of vehicle operation and compared it with current costs. These results are shown in Table VI-3. Cost of vehicle operation includes operating and ownership costs. Operating costs are those costs which arise from vehicle usage and include: gasoline and oil, maintenance and tire wear. Ownership costs are those costs which a person would incur even if the vehicle is not used and include: registration fees, insurance coverage, license fees, depreciation, taxes and finance charges. The overall effect of reformulated gasoline use to the average consumer would increase the cost of operation of a vehicle by 1.6 percent to 2.1 percent on a cost per mile basis.

Table VI-3

Impact of Phase 2 Reformulated Gasoline Regulations on the Cost of Operating a Vehicle a/

	Current Costs	Costs After Regulation @ $0.14	@ $0.20
Average Vehicle Operation Cost (cents/mile)	37.2	37.8	38.0
Fuel Cost (cents/mile)	4.8	5.4	5.6
Typical Fill-up Cost	11.40	12.80	13.40
Annual Fuel Cost	572	643	673
Total Annual Cost	4464	4536	4560

Source: American Automobile Association pamphlet entitled, "Your Driving Costs", 1990.

a/- Based on 12,000 mi/yr operation and $1.14/gal fuel price. The 12,000 mile average is derived from total miles traveled and total vehicle population from California Department of Transportation's report entitled, "California Motor Vehicles Stock, Travel and Fuel Forecast", November 1989. The $1.14/gal fuel price is average retail price of unleaded regular from 1st. quarter 1990 through 1st. quarter 1991, from the CEC Quarterly Oil Report, July 1991.

2. Toxic Air Contaminants

The cost-effectiveness of the Phase 2 gasoline specifications is expressed, for toxic air contaminants, in terms of cost per potential cancer case avoided. As explained in a previous chapter, the Phase 2 gasoline specifications are expected to result in a total of 35 potential lifetime cancer cases avoided per year over the 15-year period form 1996-2010. Attributing 50 percent of the total costs to the consumer for meeting Phase 2 gasoline specifications to toxic air contaminants results in a cost of 28 to 40 million dollars per cancer case avoided. These values are within the range of cost-effectiveness values for other air toxic air contaminant measures already adopted by the Board. For example, the recently adopted low emission vehicle/clean fuels program had a cost per cancer case avoided of 5 to 50 million dollars.

D. COMPARISON TO OTHER MEASURES

Table VI-5 shows a comparison of the cost-effectiveness of the Phase 2 reformulated gasoline specifications as a control measure to other measures that have been adopted in recent years. As shown in Table VI-5, the cost-effectiveness of the proposed regulation is within the range of other control measures adopted by the Board or the districts.

Table VI-5

Comparison of Cost-Effectiveness of the Proposed Phase 2 Reformulated Gasoline Specifications with Cost-Effectiveness of Other Control Measures for Criteria Pollutants

Source	Pollutant(s)	Capital Costs (million $)	Cost-Effectiveness ($/Ton of Pollutant Reduced)
Aromatics Content of Diesel Fuels	PM10, NOx	720	14,000
Low Emission Vehicles/Clean Fuels	NOx, VOC, CO	N/A	10,000-32,000
Light Duty Diesel Exhaust Standards	PM10	N/A	5,400-21,400
Light-Duty Gasoline Vehicle Standards	NOx	N/A	1,300
Heavy Duty Diesel Exhaust Standards	PM10	N/A	6,400
SCAQMD Rule 1135 Power Plants	NOx	532	7,000-24,000
SCAQMD Rule 1146 Industrial Boilers & Heaters	NOx	N/A	20,000
Phase 2 Gasoline	VOC, NOx CO, SOx	4,000-7,000	8,000-12,000

E. FURTHER ANALYSIS OF COSTS USING LINEAR PROGRAMMING MODELS

Staff intends to evaluate further the impacts of the fiscal impacts associated with Phase 2 regulations on the refining industry using linear programming (LP) refinery models. This approach will provide specific economic data for specific refineries operating within California. Results from modeled refineries will provide valuable information when evaluating the rest of the refineries with similar operating characteristics. At the present time, our LP models are not yet sufficiently developed to produce an accurate assessment of costs. Therefore, staff utilized data submitted from refiners, in addition to other sources of data, to estimate the fiscal impact on the refining industry. These results are considered to be preliminary.

F. COST ESTIMATES BASED ON BENZENE SURVEY DATA

1. Increase in Cost and Price of Gasoline

The staff received data from 19 California refineries in 1988 on their capital and operating costs for meeting limits of 1.2, 1.0, 0.8, and 0.6 percent by volume benzene in their typical gasolines. The data apply specifically to meeting a limit on the benzene in each respondent's typical or average gasoline in the absence of other refinery modifications. Since reducing benzene might be a natural result of a new refinery design adopted to meet other new regulations, or it might be provided by special equipment added onto a new refinery design, we believe that the costs represent an upper bound on the cost of meeting the benzene limits.

Table VI-6 shows the average refiner's after-tax cost expressed in cents per gallon for the basic benzene limit and the cap limit. For the proposed basic limit (0.80 percent by volume), the average cost among all gasoline is 1.6 cents (in 1991 $) per gallon. Among the refiners who responded to the survey, the cost ranges from 0.35 to 5.5 cents per gallon. In addition, there would be a cost to comply with the absolute limit of 1.20 percent by volume. The staff has assumed a need for some redundant equipment capable of meeting the absolute limit when the primary equipment (used to meet the basic limit) would be out of service for maintenance. The amortized capital for the redundant equipment expected to be needed for the 1.20 percent by volume cap is 0.42 cents per gallon. Therefore, the total estimated cost to refiners is about 2.0 cents per gallon.

Table VI-6

Estimated Refiner Cost for Reducing Benzene in Gasoline a/

Limit	Capital Cost (million $)	Annual Operating Cost (million $)	Average Cost b/ (cents/gallon) Average
Basic: 0.80 vol.%	1,100	280	1.6
Cap: 1.20 vol.%	740	---	0.4
Total	1,840	280	2.0

a/ After tax, 1991 $.
b/ Average overall cost per gallons assuming gasoline is the sole fuel for low emission vehicles.

The survey responses do not suggest that reducing benzene in gasoline would cost more per gallon for a small refiner than for a large one. However, the data do not address potential difficulty in financing capital expenses.

The effect of the refiners' extra costs on the price of gasoline (the consumer's cost) is difficult to predict. The price increase that is of particular interest is the price corresponding to the increased revenue needed to exactly offset the refiners' added costs, called the "revenue requirement". If a refiner's revenue requirement is attained, its net profit of operation would not be affected by the regulation. The revenue requirement is higher than the cost because a profitable business must pay income taxes--with funds that come from revenue.

The cost of the regulation per unit of benzene removed from gasoline is approximately constant down to 0.80 percent by volume, but increases at 0.60 percent by volume. It appears that 0.80 percent by volume is a break point in terms of technical feasibility and cost-effectiveness. As shown in Table VI-7, the estimated cost per gallon (derived from a 1988 ARB survey of refiners) gradually rises as the benzene limit becomes more stringent, but rises sharply between 0.80 percent by volume and 0.60 percent by volume.

The optional flat limit (1.00 percent by volume) could not be set much higher than the basic limit without a risk that the resulting average benzene content would be higher than what the staff believes is the reasonable target--0.80 percent by volume. Meeting 1.00 percent by volume for all gasoline may be impractical for some refiners, who might have to design for a typical benzene content considerably less than 0.80 percent by volume so as to never exceed 1.00 percent by volume. Such refiners would be expected to select the basic limit option instead.

Table VI-7

Gasoline Price Increases That Would Meet Aggregate Refiners' Revenue Requirements for Various Benzene Limits

Benzene a/ Limit (vol%)	Price increase (cents/gallon)
1.20	2.5
1.00	2.9
0.80	3.5
0.60	4.3

a/ Includes a cap limit of 1.20 percent by volume

Source: Price increase calculated based on 1988 ARB survey of refiners.

As shown in Table VI-8, the total aggregate refiners' revenue requirements of the proposed 0.80 percent by volume benzene limit (with a 1.20 percent by volume cap) is estimated to be about 560 million dollars per year, which would be equivalent to a gasoline price increase of 3.5 cents per gallon. The price increase would be 4.6 cents per gallon in the scenario where one-half of the low emission vehicles use gasoline. This is because there are fixed capital costs that must be amortized over the 15-year period, even if there are fewer gallons of gasoline sold.

Table VI-8

Price Increase Meeting Aggregate Refiners' Revenue Requirements

Limit		Revenue Required (million $/year)	Price Increase average
Basic:	0.80 vol.%	450	2.8
Cap:	1.20 vol.%	114	0.7
	Total	564	3.5

G. ECONOMIC IMPACTS ON SMALL REFINERS

The staff assessed the financial conditions of the small refiners (owners of gasoline-producing refineries with crude oil capacities less than 55,000 barrels per day) in California for which data are available. On average, the small refiners have higher-than-average debts relative to assets and lower returns on investment in comparison to the large refiners. Therefore, the small refiners would generally find it more expensive to raise funds for the new capital expenses. This is in part due to borrowing for other environmental projects such as those needed to meet the FCAA. (Note small refiners in Southern California must meet FCAA reformulated gasoline requirements in 1995. The FCAA has no provision to allow relief because of economic effects.) In some cases, obtaining capital at any cost may be a problem because of the financial status of the small refiners.

Some gasoline imported into California is imported by small marketers. Such a company may be unable to purchase gasoline meeting Phase 2 gasoline specifications. An alternative would be to process purchased gasoline to meet the Phase 2 gasoline specifications. Two companies who import gasoline to California have provided information on processing costs to meet the benzene limit alone. Their cost estimates were higher per gallon than the cost reported by California refiners. If importers' costs could not be sufficiently recovered by a price increase, they could choose to leave the gasoline business rather than install process equipment.

A number of small refiners that currently do not produce automotive gasoline would not be affected by the proposed Phase 2 regulation. Staff met with representatives of the small refineries that market gasoline in California to discuss the options available to them to comply with the requirements of the Phase 2 gasoline specifications. The options available to small refiners are limited; they must either install capital equipment to produce gasoline of the specified quality or to withdraw from the California gasoline market and target alternative markets.

The staff has requested cost information from the small refineries and has already received some cost data which have been included in the staff cost-effectiveness analysis. A preliminary analysis of the data provided by several small refiners indicates that the major obstacles that small refiners would be facing is their ability to raise the necessary capital and the uncertainty on their ability to pass the cost of compliance to the consumer in today's competitive fuel market. It also appears from this preliminary evaluation that their ability to meet the proposed standards vary from refinery-to-refinery. Some refiners might require large capital investments to meet the proposed sulfur standards but some others might require large capital to meet the aromatics hydrocarbons or the olefins standard. The staff expects to complete its evaluation of the impacts to the small refiners and if changes are warranted will propose them at the Board hearing.

H. ECONOMIC EFFECTS ON SMALL BUSINESSES

Government Code Section 11342 et seq. requires the ARB to discuss adverse effects on small businesses that would have to comply with a proposed regulation. The effects that must be discussed are the effects that are direct results of the need to comply.

The Code explicitly excludes all refiners from the definition of "small business". Also, the definition includes only businesses that are independently owned and, if in retail trade, that gross less than $2,000,000 per year. Thus, with respect to the proposed Phase 2 reformulated gasoline specifications, the Code requires a discussion of adverse effects of compliance for only some gasoline retailers and jobbers. (A jobber is a business that buys gasoline at wholesale and delivers and sells it to another party, usually a retailer or a user.)

If the wholesale price of gasoline would rise as refiners comply with the proposed Phase 2 reformulated gasoline specifications, retailers and jobbers would have to pay more for every unit of complying gasoline that they re-sell. Since they could legally sell only complying gasoline, this higher price of acquisition could be construed as an adverse effect upon them--but only if their profits would decrease. The profits could decrease either because retail prices might not increase as much as would wholesale prices or because the public's demand for gasoline might slacken at a higher retail price.

The magnitude of a reduction in profit would be difficult to estimate reliably for any particular wholesale price increase since large swings in price commonly occur without obvious major detriment to retailers. Therefore, the staff does not foresee any significant adverse effect upon small businesses as defined.

VII.

OTHER IMPACTS OF THE PROPOSED REGULATIONS

A. ENVIRONMENTAL IMPACTS

1. Construction

Emissions generated from refinery construction efforts are from the heavy-duty equipment and from disruption of the soil. Both sources are temporary and can, to some extent, be controlled. Emissions from construction vehicles can be mitigated by limiting the idling time of the vehicle when not in use and by tuning the engines to promote efficiency and to lower the emissions. Dust can be controlled by watering and enforcing speed limits on unpaved surfaces. Changes to topography, water absorption rates, and drainage patterns are minor environmental effects due to construction which may be permanent.

2. Transportation

Methyl-tertiary-butyl-ether (MTBE) may be produced on-site or moved to refineries by ships or, possibly, pipelines. Ethanol will most likely be moved by rail. Since the volume of MTBE and ethanol needed are likely to increase compared to current usage, the impacts on waterborne and rail traffic are expected. Because Phase 2 reformulated gasolines are likely to have a lower energy content than gasoline (about five percent less) more frequent delivery of the fuel to retail outlets may be required. This in turn could result in increased traffic hazards to motor vehicles, bicyclists, and pedestrians. In addition, noise increases associated with such additional transportation may result.

To the extent refiners choose to sell benzene extracted from gasoline, it may be shipped. However, we expect the majority of refiners will find other approaches to benzene control more economical.

3. Air Quality

In addition to emissions arising from construction efforts, there will be increases in refining emissions and emissions related to increased use of transportation systems. California emissions related to the transport of oxygenates to the west coast are estimated to be less than one ton per day for pollutants from this source.

Addition of new processing equipment, increased fuel consumption and increased storage of products could occur and may increase the emissions of oxides of sulfur, volatile organic compounds, carbon monoxide, oxides of nitrogen, and PM10. The magnitude of the possible emission increase cannot be estimated until the actual changes to refinery processes are identified. Although sulfur dioxide emissions are regulated regionally and permits will be required, a small increase in sulfur dioxide emissions at some refineries may occur. Increased volatile organic compound emissions may result due to increased fuel combustion at the refinery, production of MTBE, handling of volatile organic compounds to meet the RVP specifications, and storage of refinery products. Additional emissions of oxides of nitrogen, carbon monoxide, and PM10 may result from increased fuel consumption and increased gasoline processing at the refinery.

Increases in these pollutants can be minimized by using advanced pollution control equipment or low-emitting equipment, and by employing good operating practices and frequent maintenance. The pollutant increases at the refinery will be offset either by on-site emission reductions or by regional emission reductions due to the Phase 2 gasoline regulations.

Benzene is emitted from refineries as part of fugitive volatile organic compound emissions from process units and storage tanks. If the benzene content of gasoline is reduced by saturating benzene, there may be fugitive HC and benzene emissions from new hydrotreating units. If the benzene content is reduced by extracting and selling benzene, there would be new benzene emissions from the storage and shipping of the benzene. In either case, the gasoline storage tanks and shipping facilities would handle and emit less benzene than in the absence of the benzene limit, because of the lower benzene content of the gasoline. The possible net increase in benzene emissions at refineries would be much less than the decrease in benzene emissions from vehicles in the air basin.

Reducing the benzene content of gasoline could increase the cyclohexane content, through saturation with hydrogen of the benzene. There is some evidence that cyclohexane is a precursor to emissions of 1,3-butadiene in the exhaust. However, recent tests conducted using "refinery average" gasoline spiked with 2.5 percent cyclohexane showed a slight increase in 1,3-butadiene exhaust emissions in only one of six vehicles tested. The other five vehicles, including a vehicle with no catalyst, showed slight decreases in 1,3-butadiene exhaust emissions. Under these circumstances, the reduction in risk, provided by removing benzene from gasoline is greater than any risk from an occasional increase of 1,3-butadiene emissions from the added cyclohexane.

Increased incidence of objectionable odors from refineries are possible due to the increased volume of hydrogen sulfide produced and treated as part of the sulfur removal process. However, this would require that an upset condition occur.

4. Natural Resources, Energy and Utilities

Natural gas may be used as supplemental fuel for refineries. Natural gas may also be used to produce methanol, a component of MTBE. As refineries convert their processes to conform with Phase 2 gasoline regulations, their individual permits and environmental impact reports will clarify the impact that the need for natural gas would have on public utilities. The need for water for any additional water cooled towers will also be defined in the future. Refineries have the option of air-cooled towers at additional expense. Solid waste and disposal may be affected by catalyst disposal. MTBE catalysts are corrosive metals which can be neutralized prior to disposal.

5. Risk

Potential risk of accidental release of toxic materials or vapors may be increased as a result of the Phase 2 gasoline specifications due to increased creation of hydrogen sulfide during sulfur extraction and the additional transportation of oxygenates. The addition of new alkylation units may increase the risk of exposure to corrosive sulfuric acid emissions. The potential risk associated with oxygenate transport includes additional traffic and the risk of spill. Oxygenates are not very toxic, probably less so than gasoline, although they can be more difficult to remove from contaminated water than the hydrocarbon portion of gasoline. A small increase in risk of fire may result from broadening of the explosive range of gasoline due to the addition of oxygenates.

6. Human Health

The overall effect of Phase 2 reformulated gasoline specifications on human health will be positive. One of the primary environmental goals of reformulated gasoline is to reduce ozone-forming VOCs during the high ozone season. Well-documented health effects of ozone in nonattainment areas include acute respiratory impacts such as coughing, shortness of breath and chest tightness. Reduced ozone, NO2, sulfur, particulate matter and CO concentrations may reduce the incidence of chronic lung disease and provide human welfare benefits including improved agricultural yield, decreased material damage and improved visibility.

Reformulated gasoline will also decrease toxic emissions year-round. Since exposure to toxic compounds in ambient air may increase an individual's potential cancer risk, reformulated gasoline will reduce the number of potential cancer cases associated with exposure to the toxic compounds from gasoline.

7. Global Warming

The combustion of gasoline by passenger cars and light duty trucks generates carbon dioxide. Carbon dioxide is classified as a greenhouse gas. These gases contribute to global warming. Passenger cars and light-duty trucks account for nearly 20 percent of total carbon dioxide emissions in the United States.

Reformulated gasoline has a higher oxygenate and lower aromatics and olefin concentrations than regular gasoline. Oxygenates have lower heating values than aromatics and olefins. Reformulated gasoline is also less dense. These factors result in a five percent loss in fuel economy and a corresponding gain in carbon dioxide emissions. However, reformulated gasoline also has a lower carbon content because of the presence of oxygenates. The oxygen in oxygenates contributes to the total mass, thereby decreasing the proportion of carbon and the amount of carbon dioxide generated per gallon of gasoline. These opposing factors cancel each other, resulting in a ± one percent change in carbon dioxide as shown in the Auto Oil RVP/oxygenate test data on ARCO EC-X. Another factor which affects carbon dioxide production is the increase in combustion efficiency resulting in a 15-20 percent reduction in carbon monoxide. This decrease in carbon monoxide results in a negligible increase in carbon dioxide.

8. Flammability

The adoption of regulations by ARB, EPA, and other regulatory agencies to reduce the volatility of gasoline has raised certain concerns relating to the safety of low volatility gasoline. The concerns are that with low volatility gasoline, the vapors in a partially filled automobile gasoline tank will become flammable at lowered temperatures. Most of today's vehicles use in-tank fuel pumps that have capabilities of emptying essentially the entire liquid phase. The motors that drive the fuel pumps are often housed in the fuel tank. The presence of the these motor in the fuel tank provide potential ignition source internal to the vehicle's fuel tank. With past and current gasoline, the vapor space in a vehicle's tank was largely protected from ignition by being richer than fuel-rich flammability limits. Protection against fire and explosion was provided in part by the volatile gasoline components in equilibrium with the liquid phase. As the volatility of gasoline is reduce, the concentration of hydrocarbon vapor in the fuel tank can drop below the fuel-rich flammabilty limit. At this point, ignition can occur if an adequate ignition source is available.

To address the concern of increase vapor space flammability, the National Institute for Petroleum and Energy Research (NIPER) has conducted an investigation on the effect of gasoline volatility and ambient temperature on the flammability of fuel tank vapor space. Based on data from these tests, a model was developed to predict the temperature at Upper Flammability Limit (TUFL) as a function of gasoline RVP.

Because refiners may manufacture gasoline 0.5 psi below the regulated limit and a RVP loss of 0.5 psi may occur from weathering of the fuel, a 7.0

psi RVP limit may result in a gasoline RVP of 6.0 psi when empty. Using the NIPER model, the TUFL for gasoline with a RVP of 6.0 psi is estimated to be about 18°F. What this means is that the vapor space in a gasoline tank containing gasoline with 7.0 psi RVP (when empty) is protected from flammability conditions at temperatures above 18 °F. The RVP season runs from April through October, and California does not normally experience temperature excursions below 18°F during this period. Thus, the staff does not believe that lowering the limit of gasoline RVP to 7.0 psi will result in any adverse safety impacts.

B. OBTAINING PERMITS

Obtaining permits from the air quality districts for new equipment does not appear to be a major problem overall with respect to criteria pollutants. In general, the major concern of project proponents about permits for criteria pollutants is the need to provide emission offsets. However, the South Coast Air Quality Management District (AQMD) has adopted an exemption from the requirement to provide offsets if offsets are not available and if the increases resulted from complying with a district, state, or federal air pollution control regulation. The Bay Area AQMD does not have an analogous provision, but our discussion with the Bay Area AQMD staff indicate that refineries in the district have banked emission reductions that can offset considerable new emissions.

The current policies or rules of the districts where refineries are located would not allow permits for changes in a refinery if the net added potential risk calculated for new toxic emissions would exceed ten in a million at the nearest off-site receptor. The major toxic pollutant of concern with respect to this provision is probably benzene. Since benzene emissions at different locations in the refinery may increase or decrease depending on the particular changes made to comply with the Phase 2 reformulated gasoline specification, it is difficult to estimate whether or not the maximum risks to the nearest off-site receptor would exceed ten in a million.

Some districts (e.g. South Coast AQMD) have indicated that they will provide flexibility when on-site emission increases are a result of actions to significantly reduce area-wide emissions. We anticipate that the area-wide risk reduction due to the proposed Phase 2 reformulated gasoline regulations, will more than offset any near-source increases in risk. For example, the reduction in risk from the proposed limit on benzene in gasoline would be, on an average, 35 in a million (in 2000) and would apply to all persons in the state. South Coast AQMD Rule 1401 specifically allows increases in one toxic air contaminant to be offset by contemporaneous emission reductions of the same or other toxic air contaminants as long as the risk at all exposed receptors is less than before the changes.

APPENDIX A

PROPOSED REGULATION ORDER

PROPOSED REGULATION ORDER

(Phase 2 Reformulated Gasoline)

Note: In order to facilitate incorporation of new regulations pertaining to Phase 2 reformulated gasoline, the Air Resources Board has recently made editorial changes to the numbering and organization of its fuels and associated regulations. The proposed amendments and new regulations presented herein are shown in the context of the fuels regulations as reorganized.

Chapter 5 of Division 3, Title 13, California Code of Regulations, remains titled "Standards for Motor Vehicle Fuels." Within Chapter 5, Article 1 has been renamed "Article 1, Standards for Gasoline." Section 2252, which previously addressed the sulfur content of both unleaded gasoline and diesel fuel sold in the south coast, has been revised to eliminate all references to diesel fuel. Accordingly, section 2252 retains sections (a) and (b) without change, retains in a relettered section (c) the definition of "motor vehicle" that had been in (f), and retains as a relettered section (d) the variance provisions previously in (m), with references to sections pertaining to diesel fuel deleted. All other provisions in section 2252 have been deleted from that numbered section. The provisions in prior section 2252 pertaining to diesel fuel, and the other two sections pertaining to diesel fuel (sections 2255 (sulfur content) and 2256 (aromatics content)) have been moved to a new "Article 2. Standards for Diesel Fuel" and are renumbered as sections 2280, 2281, and 2282. Previous Article 2 of Chapter 5, "Sampling and Test Procedures," has been renumbered Article 4. The two sections in the article, 2261 and 2262, have been renumbered 2296 and 2297.

Copies of the recent editorial revisions are available from the Board's Public Information Office, 1102 Q Street, Sacramento, CA 95814, (916) 322-2990.

[NOTE: The proposed amendments on pages 1 - 6 are shown in *italics* for additions and ~~strikeout~~ for deletions. The text on pages 7 and following, proposed new subarticle 2 (sections 2260-2271), is all new. The fact that the text is all new is noted at the beginning of subarticle 2 and is not separately shown by italics.]

Amend Article 1, Chapter 5, Division 3, Title 13, California Code of Regulations, by adding the following subarticle heading immediately following the Article 1. heading:

Article 1. Standards for Gasoline

Subarticle 1. Standards for Gasoline Applicable Prior to January 1, 1996

Amend section 2250, Title 13, California Code of Regulations, to read as follows:

Section 2250. Degree of Unsaturation for Gasolines *Sold Before January 1, 1996*.

[No change to sections (a) or (b)]

* * * *

(c) This section shall not apply to gasoline sold or supplied on or after January 1, 1996.

NOTE: Authority cited: sections 39600, 39601, 43013, *43018*, 43101, and 43831, Health and Safety Code; *and* Western Oil and Gas Ass'n. *v.* Orange County Air Pollution Control District, *14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975)*. Reference: sections 39000, 39001, 39002, 39003, *39010*, 39500, *39515*, *39516*, 39606, *41511*, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Amend section 2251.5, Title 13, California Code of Regulations, to read as follows:

Section 2251.5. Reid Vapor Pressure of Gasoline Sold After January 1, 1992, *and Before January 1, 1996*

(a) **Regulatory Standards.**

(1) **Basic Regulatory Standard.**

(A) Starting January 1, 1992, within each of the air basins during the regulatory period set forth in section (a)(1)(B), no person shall sell, offer for sale, dispense, supply, offer for supply, or transport California gasoline which has a Reid vapor pressure exceeding 7.8*0* pounds per square inch.

(B) Basic Regulatory Control Periods.

(i) April 1 through October 31:
South Coast Air Basin *and Ventura County*
San Diego Air Basin
Southeast Desert Air Basin

(ii) May 1 through September 30:
Great Basin Valley Air Basin

(iii) May 1 through October 31:
San Francisco Bay Area Air Basin
San Joaquin Valley Air Basin
Sacramento Valley Air Basin
Mountain Counties Air Basin
Lake Tahoe Air Basin

(iv) June 1 through September 30:
North Coast Air Basin
Lake County Air Basin
Northeast Plateau Air Basin

(v) June 1 through October 31:
North Central Coast Air Basin
South Central Coast Air Basin *(Excluding Ventura County)*

(2) **Additional Regulatory Standards for Gasoline Sold, Supplied or Transferred from a Production or Import Facility.**

(A) Starting January 1, 1992, no producer or importer shall sell, offer for sale, supply, or offer to supply from its California production facility or California import facility in an air basin during the regulatory period specified in section (a)(2)(B), California gasoline which has a Reid vapor pressure exceeding 7.80 pounds per square inch. Starting January 1, 1992, no person shall transport directly from a California production facility or California import facility in an air basin during the regulatory period set forth in section (a)(2)(B), California gasoline which has a Reid vapor pressure exceeding 7.80 pounds per square inch.

(B) Additional Regulatory Control Periods.

(i) March 1 through March 31:
South Coast Air Basin *and Ventura County*
San Diego Air Basin
Southeast Desert Air Basin

(ii) April 1 through April 30:
San Francisco Bay Area Air Basin
San Joaquin Valley Air Basin
Sacramento Valley Air Basin
Great Basin Valley Air Basin
Mountain Counties Air Basin
Lake Tahoe Air Basin

(iii) May 1 through May 31:
North Central Coast Air Basin
South Central Coast Air Basin *(Excluding Ventura County)*
North Coast Air Basin
Lake County Air Basin
Northeast Plateau Air Basin

(3) **Special Provisions for Blends of Gasoline Containing Ethanol.**

(A) Any blend of gasoline containing at least 10 percent ethanol by volume shall not result in a violation of this section (a) unless the gasoline used in the blend exceeds the standards set forth in this

section (a).

(B) This section (a)(3) shall be effective only so long as Health and Safety Code section 43830 establishes special provisions for the volatility of gasoline blends containing at least 10 percent ethanol by volume.

(4) (A) Section (a)(1) shall not apply to a transaction occurring in an air basin during the basic regulatory control period where the person selling, supplying, or offering the gasoline demonstrates as an affirmative defense that, prior to the transaction, he or she has taken reasonably prudent precautions to assure that the gasoline will be delivered to a retail service station or bulk purchaser-consumer's fueling facility when the station or facility is not subject to a basic regulatory control period.

(B) Section (a)(2) shall not apply to a transaction occurring in an air basin during the additional regulatory control period for producers and importers where the person selling, supplying, offering or transporting the gasoline demonstrates as an affirmative defense that, prior to the transaction, he or she has taken reasonably prudent precautions to assure that the gasoline will be delivered to a retail service station or bulk purchaser-consumer's fueling facility located in an air basin not then subject to the basic regulatory control period or the additional control period for producers and importers.

(C) Section (a)(1) shall not apply to a transaction occurring in an air basin during the basic regulatory control period where the transaction involves the transfer of gasoline from a stationary storage tank to a motor vehicle fuel tank and the person selling, supplying, or offering the gasoline demonstrates as an affirmative defense that the last delivery of gasoline to the stationary storage tank occurred more than fourteen days before the start of the basic regulatory control period.

(5) For the purposes of section (a)(1), each sale of California gasoline at retail, and each dispensing of California gasoline into a motor vehicle fuel tank, shall also be deemed a sale or supply by any person who previously sold or supplied such gasoline in violation of section (a)(1).

[No changes to sections (b) - (e)]

* * * *

(f) This section shall not apply to gasoline sold or supplied on or after January 1, 1996.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, and 43101 of the Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Amend section 2252, Title 13, California Code of Regulations, to read as follows:

Section 2252. Sulfur Content of Gasoline Represented as Unleaded *Sold Before January 1, 1996*

[No change to section (a)]

* * * *

(b) The maximum sulfur content limitations specified in subsection (a) shall be determined by ASTM Test Method D2622-8287, or any other test method determined by the executive officer to give equivalent results.

[No changes to sections (c) and (d)]

* * * *

(p) This section shall not apply to gasoline sold or supplied after January 1, 1996.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39500, 39515, 39516,

39606, 41511, 43000, 43013, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Adopt new subarticle 2, sections 2260 - 2271, Title 13, California Code of Regulations, to read as follows:
[NOTE: The entire text of subarticle 2. is NEW TEXT to be added to the California Code of Regulations.]

Subarticle 2. Standards for Gasoline Sold Beginning January 1, 1996

Section 2260. Definitions

(a) For the purposes of this article, the following definitions apply:

(1) "Alternative gasoline formulation" means a blend of gasoline meeting all of the specifications identified in a certification issued by the Executive Officer pursuant to the "California Test Procedures for Evaluating Alternative Specifications for Gasoline", adopted [insert date of adoption], which is incorporated herein by reference.

(2) "ASTM" means the American Society of Testing and Materials.

(3) "Bulk purchaser-consumer" means a person that purchases or otherwise obtains gasoline in bulk and then dispenses it into the fuel tanks or motor vehicles owned or operated by the person.

(4) "California gasoline" means gasoline sold, intended for sale, or made available for sale as a motor vehicle fuel in California.

(5) "Designated alternative limit" means an alternative gasoline specification limit, expressed in the nearest part per million by weight for sulfur content, nearest hundreth percent by volume for benzene content, and nearest percent by volume for aromatic hydrocarbon content, which is assigned by a producer or importer to a final blend of California gasoline pursuant to section 2264.

(6) "Ethanol" means ethyl alcohol which meets any additional requirements for ethanol or ethyl alcohol in Health and Safety Code section 43830.

(7) "Executive Officer" means the executive officer of the Air Resources Board, or his or her designee.

(8) "Final blend" means a distinct quantity of gasoline which is introduced into commerce in California without further alteration which would tend to affect a regulated gasoline specification of the fuel.

(9) "Final distribution facility" means the stationary gasoline transfer point from which gasoline is transferred into the cargo tank truck, pipeline, or other delivery vessel from which the gasoline will be delivered to the facility at which the gasoline will be dispensed into motor vehicles.

(10) "Further process" means to perform any activity on gasoline, including distillation, treating with hydrogen, or blending, for the purpose of bringing the gasoline into compliance with the standards in this subarticle.

(11) "Gasoline" means any fuel that is commonly or commercially known, sold or represented as gasoline.

(12) "Import facility" means the facility at which imported California gasoline is first received in California, including, in the case of gasoline imported by cargo tank and delivered directly to a facility for dispensing gasoline into motor vehicles, the cargo tank in which the gasoline is imported.

(13) "Importer" means any person who first accepts delivery in California of California gasoline.

(14) "Motor vehicle" has the same meaning as defined in section 415 of the Vehicle Code.

(15) "Oxygenate" is any oxygen-containing, ashless, organic compound, such as an alcohol or ether, which, when added to gasoline increases the amount of oxygen in gasoline.

(16) (A) "Produce" means, except as otherwise provided in section (a)(16)(B) or (a)(16)(C), to convert liquid compounds which are not gasoline into gasoline. When a person blends volumes of blendstocks which are not gasoline with volumes of gasoline acquired from another person, and the resulting blend is gasoline, the person conducting such blending has produced only the portion of the blend which was not previously gasoline. When a person blends gasoline with other volumes of gasoline, without the

addition of blendstocks which are not gasoline, the person does not produce gasoline.

(B) Where a person supplies gasoline to a refiner who agrees in writing to further process the gasoline at the refiner's refinery and to be treated as the producer of the gasoline, the refiner shall be deemed for all purposes under this article to be the producer of the gasoline.

(C) Where a person blends oxygenates into gasoline which has already been supplied from a gasoline production facility or import facility, and does not alter the quality or quantity of the gasoline in any other way, the person does not produce gasoline.

(17) "Producer" means any person who owns, leases, operates, controls or supervises a California production facility.

(18) "Production facility" means a facility in California at which gasoline is produced. Upon request of a producer, the executive officer may designate, as part of the producer's production facility, a physically separate bulk storage facility which is owned and operated by the producer and which is not used to store or distribute gasoline that is not supplied from the production facility.

(19) "Refiner" means any person who owns, leases, operates, controls or supervises a refinery.

(20) "Refinery" means a facility that produces liquid fuels by distilling petroleum.

(21) "Supply" means to provide or transfer a product to a physically separate facility, vehicle, or transportation system.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 40000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2261. Applicability of Standards; Additional Standards

(a) Unless otherwise specifically provided, the standards contained in this subarticle shall apply to California gasoline sold or supplied on or after January 1, 1996.

(b) California gasoline sold or supplied on or after January 1, 1996, is also subject to section 2253.4 (Lead/Phosphorus in Gasoline), section 2254 (Manganese Additive Content), section 2257 (Required Additives in Gasoline), and section 2258 (Oxygen Content of Gasoline in the Wintertime).

(c) The standards contained in this subarticle shall not apply to a sale, offer for sale, or supply of California gasoline to a refiner if: (1) the refiner further processes the gasoline at the refiner's refinery prior to any subsequent sale, offer for sale, or supply of the gasoline, and (2) in the case of standards applicable only to producers or importers, the refiner to whom the gasoline is sold or supplied is the producer of the gasoline pursuant to section 2260(a)(17)(B).

(d) The prohibitions in sections 2262.2(b) and (c), 2262.3(b) and (c), 2262.4(b), 2262.5(c), 2262.6(b), and and 2262.7(b) and (c) shall not apply to gasoline which a producer or importer demonstrates was neither produced nor imported by the producer or importer.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2262.1. Standards for Reid Vapor Pressure

(a) Basic Regulatory Standard.

(1) Starting January 1, 1996, no person shall sell, offer for sale, supply, offer for supply, or transport California gasoline which has a Reid vapor pressure exceeding 7.00 pounds per square inch within each of the air basins during the regulatory period set forth in section (a)(2).

(2) Basic Regulatory Control Periods.

(A) April 1 through October 31:

South Coast Air Basin and Ventura County

San Diego Air Basin
Southeast Desert Air Basin

(B) May 1 through September 30:
Great Basin Valley Air Basin

(C) May 1 through October 31:
San Francisco Bay Area Air Basin
San Joaquin Valley Air Basin
Sacramento Valley Air Basin
Mountain Counties Air Basin
Lake Tahoe Air Basin

(D) June 1 through September 30:
North Coast Air Basin
Lake County Air Basin
Northeast Plateau Air Basin

(E) June 1 through October 31:
North Central Coast Air Basin
South Central Coast Air Basin (Excluding Ventura County)

(b) Additional Regulatory Standards for Gasoline Sold, Supplied or Transferred from a Production or Import Facility.

(1) Starting January 1, 1996, California gasoline sold, offered for sale, supplied or offered for supply by a producer or importer from its production facility or import facility in an air basin during the regulatory period specified in section (b)(2) shall have a Reid vapor pressure not exceeding 7.00 pounds per square inch. Starting January 1, 1996, California gasoline transported directly from a production facility or import facility in an air basin during the regulatory period set forth in section (b)(2) shall have a Reid vapor pressure not exceeding 7.00 pounds per square inch.

(2) Additional Regulatory Control Periods.

(A) March 1 through March 31:
South Coast Air Basin and Ventura County
San Diego Air Basin
Southeast Desert Air Basin

(B) April 1 through April 30:

San Francisco Bay Area Air Basin
San Joaquin Valley Air Basin
Sacramento Valley Air Basin
Great Basin Valley Air Basin
Mountain Counties Air Basin
Lake Tahoe Air Basin

(C) May 1 through May 31:
North Central Coast Air Basin
South Central Coast Air Basin (Excluding Ventura County)
North Coast Air Basin
Lake County Air Basin
Northeast Plateau Air Basin

(c) Applicability

(1) Section (a) shall not apply to a transaction occurring in an air basin during the basic regulatory control period where the person selling, supplying, or offering the gasoline demonstrates as an affirmative defense that, prior to the transaction, he or she has taken reasonably prudent precautions to assure that the gasoline will be delivered to a retail service station or bulk purchaser-consumer's fueling facility when the station or facility is not subject to a basic regulatory control period.

(2) Section (b) shall not apply to a transaction occurring in an air basin during the additional regulatory control period for producers and importers where the person selling, supplying, offering or transporting the gasoline demonstrates as an affirmative defense that, prior to the transaction, he or she has taken reasonably prudent precautions to assure that the gasoline will be delivered to a retail service station or bulk purchaser-consumer's fueling facility located in an air basin not then subject to the basic regulatory control period or the additional control period for producers and importers.

(3) Section (a)(1) shall not apply to a transaction occurring in an air basin during the basic regulatory control period where the transaction involves the transfer of gasoline from a stationary storage tank to a motor vehicle fuel tank and the person selling, supplying, or offering the gasoline demonstrates as an affirmative defense that the last delivery of

gasoline to the stationary storage tank occurred more than fourteen days before the start of the basic regulatory control period.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2262.2. Standards for Sulfur Content

(a) **Maximum sulfur standard for all California gasoline.** No person shall sell, offer for sale, supply, offer for supply, or transport California gasoline which has a sulfur content exceeding 80 parts per million by weight.

(b) **Additional flat sulfur standard for producers and importers.** No producer or importer shall sell, offer for sale, supply, or offer for supply from its production facility or import facility California gasoline which has a sulfur content exceeding 40 parts per million by weight, unless the transaction occurs during a period for which the producer or importer has elected to be subject to section (c), or unless the gasoline has been reported as an alternative gasoline formulation pursuant to section 2266(c).

(c) **"Designated alternative limit" option for producers and importers.** No producer or importer shall, during a period for which the producer or importer has elected to be subject to this section (c), sell, offer for sale, supply, or offer for supply from its production facility or import facility California gasoline which has a sulfur content exceeding 30 parts per million by weight, unless the gasoline has been reported as an alternative gasoline formulation pursuant to section 2266(c), or unless:

(A) A designated alternative limit has been established for the gasoline in accordance with the requirements of section 2264(a), and

(B) The sulfur content of the gasoline does not exceed the designated alternative limit, and

(C) Where the designated alternative limit exceeds 30 parts per million, the excess sulfur content is fully offset in accordance with section 2264(c).

(d) **Election of sulfur content standard by producers and importers.** On or before September 1, 1995, each producer or importer shall notify the executive officer of the party's election to be subject to section (b) or to section (c). All elections shall apply for a minimum of one calendar year and shall be effective in calendar year increments until changed by the producer or importer. A producer or importer may change or make an election for any calendar year after 1996 only by notifying the executive officer no later than October 1 of the preceding calendar year.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2262.3. Standards for Benzene Content

(a) **Maximum benzene standard for all California gasoline.** No person shall sell, offer for sale, supply, offer for supply, or transport California gasoline which has a benzene content exceeding 1.20 percent by volume.

(b) **Additional flat benzene standard for producers and importers.** No producer or importer shall sell, offer for sale, supply, or offer for supply from its production facility or import facility California gasoline which has a benzene content exceeding 1.00 percent by volume, unless the transaction occurs during a period for which the producer or importer has elected to be subject to section (c), or unless the gasoline has been reported as an alternative gasoline formulation pursuant to section 2266(c).

(c) **"Designated alternative limit" option for producers and importers.** No producer or importer shall, during a period for which the producer or importer has elected to be subject to this section (c), sell, offer for

sale, supply, or offer for supply from its production facility or import facility California gasoline which has a benzene content exceeding 0.80 percent by volume, unless the gasoline has been reported as an alternative gasoline formulation pursuant to section 2266(c), or unless:

(A) A designated alternative limit has been established for the gasoline in accordance with the requirements of section 2264(a), and

(B) The benzene content of the gasoline does not exceed the designated alternative limit, and

(C) Where the designated alternative limit exceeds 0.80 percent by volume, the excess benzene content is fully offset in accordance with section 2264(e).

(d) **Election of benzene content standard by producers and importers.** On or before September 1, 1995, each producer or importer shall notify the executive officer of the party's election to be subject to section (b) or to section (c). All elections shall apply for a minimum of one calendar year and shall be effective in calendar year increments until changed by the producer or importer. A producer or importer may change or make an election for any calendar year after 1996 only by notifying the executive officer no later than October 1 of the preceding calendar year.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2262.4. Standards for Olefin Content

(a) **Olefin cap on all California gasoline.** No person shall sell, offer for sale, supply, offer for supply, or transport California gasoline which has an olefin content exceeding 10.0 percent by volume.

(b) **Additional olefin standard for producers and importers.** No producer or importer shall sell, offer for sale, supply, or offer for supply from its production facility or import facility California gasoline which has an olefin content exceeding 5.0 percent by volume, unless the

gasoline has been reported as an alternative gasoline formulation pursuant to section 2266(c).

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2262.5. Standards for Oxygen Content

(a) **Minimum wintertime oxygen content standard for all California gasoline.** (1) Within each of the air basins during the regulatory control period set forth in section (a)(2), no person shall sell, offer for sale, supply, offer for supply, or transport California gasoline unless it has an oxygen content of not less than 1.8 percent by weight.

(2) **Regulatory Control Periods.**

(A) September 1 through February 29
South Coast Air Basin and Ventura County

(B) October 1 through January 31
Sacramento Valley Air Basin
San Joaquin Valley Air Basin
San Francisco Bay Area Air Basin
Lake Tahoe Air Basin
Great Basin Valley Air Basin
Mountain Counties Air Basin
North Coast Air Basin
Lake County Air Basin
Northeast Plateau Air Basin
North Central Coast Air Basin

(C) November 1 through February 29
San Diego Air Basin
South Central Coast Air Basin (Excluding Ventura County)
Southeast Desert Air Basin

(b) **Maximum oxygen content standard for all California gasoline.** No person shall sell, offer for sale, supply, or transport California gasoline which has an oxygen content exceeding 2.7 percent by weight.

(c) **Additional oxygen content standards for producers and importers.** No producer or importer shall sell, offer for sale, supply, or offer for supply from its production or import facility California gasoline which has an oxygen content less than 1.8 percent by weight or more than 2.2 percent by weight, unless the gasoline has been reported as an alternative gasoline formulation pursuant to section 2266(c) and complies with the standards contained in sections (a) and (b).

(d) **Restrictions on adding oxygenates to gasoline produced or imported by others.** No person may add oxygenates to California gasoline produced or imported by another person where the resulting oxygenated gasoline blend has an oxygen content exceeding 2.2 percent by weight, except where the person adding the oxygenates demonstrates that: (i) the gasoline to which the oxygenates are added has been reported pursuant to section 2266(c) as an alternative gasoline formulation and has not been commingled with other gasoline, and (ii) the person adding the oxygenates is doing so at the express request of the producer or importer of the gasoline, and (iii) the resulting oxygenated gasoline blend has an oxygen content not more than the maximum oxygen content specification in the certification for the reported alternative gasoline formulation.

(e) **Application of prohibitions.**

(1) Sections (a) and (c) shall not apply to transactions involving gasoline not meeting the minimum oxygen content standard where the person selling, supplying, or offering the gasoline demonstrates by affirmative defense that: [i] the gasoline has not yet been supplied from the final distribution facility, and [ii] the documents accompanying such gasoline clearly state that it does not comply with the minimum oxygen content standard in sections (a) and (c), and either [iii] the person has taken reasonably prudent precautions to assure that he or she will bring the gasoline within the standards in sections (a) and (c) before it is supplied from the final distribution facility, or [iv] at or before the time of the transaction the person has obtained a written statement from the purchaser,

recipient, or offeree of the gasoline stating that the party will cause the gasoline to come within the standards of section (a) and (c) before it is supplied from the final distribution facility.

(2) Section (a) shall not apply to a transaction occurring in an air basin during the regulatory control period where the person selling, supplying, or offering the gasoline demonstrates as an affirmative defense that, prior to the transaction, he or she has taken reasonably prudent precautions to assure that the gasoline will be delivered to a retail service station or bulk purchaser-consumer's fueling facility when the station or facility is not subject to a regulatory control period.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2262.6. Standards for Distillation Temperatures

(a) **Distillation temperature caps on all California gasoline.** No person shall sell, offer for sale, supply, offer for supply, or transport California gasoline which has a T90 (90 percent distillation temperature) exceeding 330 degrees Fahrenheit, or which has a T50 (50 percent distillation temperature) exceeding 220 degrees Fahrenheit.

(b) **Additional distillation temperature standards for producers and importers.** No producer or importer shall sell, offer for sale, supply, or offer for supply from its production facility or import facility California gasoline which has a T90 (90 percent distillation temperature) exceeding 300 degrees Fahrenheit, or which has a T50 (50 percent distillation temperature) exceeding 210 degrees Fahrenheit, unless the gasoline has been reported as an alternative gasoline formulation pursuant to section 2266(c).

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515,

39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2262.7. Standards for Aromatic Hydrocarbon Content

(a) **Maximum aromatic hydrocarbon standard for all California gasoline.** No person shall sell, offer for sale, supply, offer for supply, or transport California gasoline which has a aromatic hydrocarbon content exceeding 30 percent by volume.

(b) **Additional flat aromatic hydrocarbon standard for producers and importers.** No producer or importer shall sell, offer for sale, supply, or offer for supply from its production facility or import facility California gasoline which has a aromatic hydrocarbon content exceeding 25 percent by volume, unless the transaction occurs during a period for which the producer or importer has elected to be subject to section (c), or unless the gasoline has been reported as an alternative gasoline formulation pursuant to section 2266(c).

(c) **"Designated alternative limit" option for producers and importers.** No producer or importer shall, during a period for which the producer or importer has elected to be subject to this section (c), sell, offer for sale, supply, or offer for supply from its production facility or import facility California gasoline which has a aromatic hydrocarbon content exceeding 20 percent by volume, unless the gasoline has been reported as an alternative gasoline formulation pursuant to section 2266(c), or unless:

(A) A designated alternative limit has been established for the gasoline in accordance with the requirements of section 2264 (a), and

(B) The aromatic hydrocarbon content of the gasoline does not exceed the designated alternative limit, and

(C) Where the designated alternative limit exceeds 20 percent by volume, the excess aromatic hydrocarbon content is fully offset in accordance with section 2264(d).

(d) **Election of aromatic hydrocarbon content standard by producers and importers.** On or before September 1, 1995, each producer or importer shall notify the executive officer of the party's election to be subject to section (b) or to section (c). All elections shall apply for a minimum of

one calendar year and shall be effective in calendar year increments until changed by the producer or importer. A producer or importer may change or make an election for any calendar year after 1996 only by notifying the executive officer no later than October 1 of the preceding calendar year.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2263. Sampling Procedures and Test Methods

(a) Sampling Procedures.

(1) In determining compliance with the standards for Reid vapor pressure, T90, and T50 set forth in this subarticle 2, an applicable sampling methodology set forth in 13 Cal. Code Regs. section 2296 shall be used. In determining compliance with the standards set forth in this subarticle 2 other than Reid vapor pressure, T90, and T50, an applicable sampling methodology set forth in 13 Cal. Code Regs. section 2296 shall be used, deleting all references in section 2296 to the required use of a cooling bath.

(b) Test Methods.

(1) In determining compliance with the standards set forth in this subarticle 2, the test methods presented in Table 1 shall be used. All identified test methods are incorporated herein by reference.

Table 1

Section	Gasoline Specification	Test Method
2262.1.	Reid Vapor Pressure	ASTM D 323-58 a/ or 13 CCR Section 2297
2262.2.	Sulfur Content	ASTM D 2622-87
2262.3.	Benzene Content	ASTM 3606-87 or ARB MLD 116 b/
2262.4.	Olefin Content	ASTM D 1319-88
2262.5.	Oxygen Content	ASTM D 4815-88
2262.6.	T90 and T50	ASTM D 86-82
2262.7.	Aromatic Hydrocarbon Content	ARB MLD 116 b/

a/ Delete paragraph 4(b) concerning sampling.
b/ Air Resources Board, Monitoring and Laboratory Division, "Procedure for the Analysis of Benzene and Other Aromatic Components of Gasoline," dated August 1991. This method is to be used instead of ASTM 3606-87 to determine benzene content if ethanol is present.

(c) Equivalent Test Methods.

(1) Whenever this section provides for the use of a specified test method, another test method may be used following a determination by the executive officer that the other method produces results equivalent to the results with the specified method.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2264. Designated Alternative Limits

(a) Assignment of a designated alternative limit

(1) A producer or importer that has elected to be subject to sections 2262.2(c), 2262.3(c) or 2262.7(c) may assign a designated alternative limit to a final blend of California gasoline produced or imported by the

producer or importer by satisfying the notification requirements in this section (a). In no case shall a designated alternative limit be less than the sulfur, benzene, or aromatic hydrocarbon content of the final blend shown by the sample and test conducted pursuant to section 2270. If a producer or importer intends to assign designated alternative limits for more than one gasoline specification to a given quantity of gasoline, the party shall identify the same final blend for all designated alternative limits for the gasoline.

(2) (A) The producer or importer shall notify the executive officer of the volume (in gallons), the designated alternative limit, the blend identity, and the location of each final blend receiving a designated alternative limit. This notification shall be received by the executive officer before the start of physical transfer of the gasoline from the production or import facility, and in no case less than 12 hours before the producer or importer either completes physical transfer or commingles the final blend.

(B) For each final blend receiving a designated alternative limit exceeding 0.80 percent by volume benzene content, 30 parts per million by weight sulfur content, or 20 percent by weight aromatic hydrocarbon content, the producer or importer shall notify the executive officer of the date and time of the start of physical transfer from the production or import facility, within 24 hours after the start of such physical transfer. For each final blend receiving a designated alternative limit less than 0.80 percent by volume benzene content, 30 parts per million by weight sulfur content, or 20 percent by weight aromatic hydrocarbon content, the producer or shall notify the executive officer of the date and time of the completion of physical transfer from the production or import facility, within 24 hours after the completion of such physical transfer.

(3) If, through no intentional or negligent conduct, a producer or importer cannot report within the time period specified in (2) above, the producer or importer may notify the executive officer of the required data as soon as reasonably possible and may provide a written explanation of the cause of the delay in reporting. If, based on the written explanation and the surrounding circumstances, the executive officer determines that the

conditions of this section (a)(3) have been met, timely notification shall be deemed to have occurred.

(4) The executive officer may enter into a written protocol with any individual producer or importer for the purposes of specifying how the requirements in section (a)(2) shall be applied to the producer's or importer's particular operations, as long as the executive officer reasonably determines that application of the regulatory requirements under the protocol is not less stringent or enforceable than application of the express terms of section (a)(2). Any such protocol shall include the producer's or importer's agreement to be bound by the terms of the protocol.

(5) Whenever the final blend of a producer or importer includes volumes of gasoline the party has produced or imported and volumes the party has neither produced nor imported, the producer or importer's designated alternative limit shall be assigned and applied only to the volume of gasoline the party has produced or imported. In such a case, the producer or importer shall report to the executive officer in accordance with section (a) both the volume of gasoline produced and imported by the party, and the total volume of the final blend. The party shall also additionally report the sulfur content, benzene content, and aromatic hydrocarbon content, as applicable, of the portion of the final blend neither produced nor imported by the party, determined as set forth in section 2270(b).

(b) **Additional prohibitions regarding gasoline to which a designated alternative limit has been assigned.** (1) No producer or importer shall sell, offer for sale, or supply California gasoline in a final blend to which the producer or importer has assigned a designated alternative limit exceeding 0.80 percent by volume benzene content, 30 parts per million by weight sulfur content, or 20 percent by weight aromatic hydrocarbon content, where the total volume of the final blend sold, offered for sale, or supplied exceeds the volume reported to the executive officer pursuant to section (a).

(2) No producer or importer shall sell, offer for sale or supply California gasoline in a final blend to which the producer or importer has

assigned a designated alternative limit less than 0.80 percent by volume benzene content, 30 parts per million by weight sulfur content, or 20 percent by weight aromatic hydrocarbon content, where the total volume of the final blend sold, offered for sale, or supplied is less than the volume reported to the executive officer pursuant to section (a).

(c) **Offsetting excess sulfur.** Within 90 days before or after the start of physical transfer from a production or import facility of any final blend of California gasoline to which a producer has assigned a designated alternative limit for sulfur content exceeding 30 parts per million, the producer or importer shall complete physical transfer from the same production or import facility of California gasoline in sufficient quantity and with a designated alternative limit sufficiently below 30 parts per million to offset the mass of sulfur in excess of a limit of 30 parts per million.

(d) **Offsetting excess aromatic hydrocarbons.** Within 90 days before or after the start of physical transfer from a production or import facility of any final blend of California gasoline to which a producer has assigned a designated alternative limit for aromatic hydrocarbon content exceeding 20 percent, the producer or importer shall complete physical transfer from the same production or import facility of California gasoline in sufficient quantity and with a designated alternative limit sufficiently below 20 percent to offset the volume of sulfur in excess of a limit of 20 percent.

(e) **Generation and use of benzene credits**

(1) In the case of each producer or importer that has elected to be subject to section 2262.3(c), the executive officer shall establish a benzene credit account for each location at which the producer or importer produces or imports California gasoline. At the request of the producer or importer, credit shall be deposited in the producer's or importer's account according to the provisions of this section (e). Credit shall be withdrawn from the account to offset the benzene in any of the producer's or importer's blends of gasoline with designated alternative limits exceeding 0.80 volume percent.

(2) Benzene credits may only be generated by California gasoline produced or imported at the facility into whose account the credit will be

deposited. Credit from an account may only be withdrawn to offset excess benzene in gasoline blends that have designated alternative limits and that have been produced or imported at the location corresponding to the account.

(3) The amount of benzene credit deposited for a blend with a designated alternative limit less than 0.80 volume percent shall be:

$$\frac{0.80\% - \text{designated alternative limit}}{100} \times \text{volume of blend (gallons)}$$

Credits from a final blend with a designated alternative limit less than 0.80 volume percent shall be deposited as of the date and time that physical transfer of the final blend from the production or import facility is completed.

(4) The maximum allowable balance of benzene credit in any account at any time shall be:

.012 x one-half the volume of gasoline produced or imported at the location during the most recent calendar year for which such volume has been reported to the California Energy Commission pursuant to the Petroleum Industry Information Reporting Act.

Benzene credit shall not be generated by any gasoline at a location when the account for that location contains the maximum allowed balance.

(5) For each blend with an alternative limit exceeding 0.80 percent by volume, the executive officer shall withdraw, as of the date and time that physical transfer of the final blend from the production or import facility is commenced, any available benzene credits from the producer's or importer's account equal to:

$$\frac{\text{designated alternative limit} - 0.80\%}{100} \times \text{volume of blend (gallons)}$$

If the credit balance in the account is insufficient allow the withdrawal amount of credits identified above, then the excess benzene in the final blend has not been offset.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2265. [Reserved for Certified Gasoline Formulations Resulting in Equivalent Emission Reductions Based on a Predictive Model]

Section 2266. Certified Gasoline Formulations Resulting in Equivalent Emission Reductions Based on Motor Vehicle Emission Testing.

(a) **Certification of alternative gasoline formulations.** Following application by a producer or importer, the executive officer may certify, and identify alternative specifications for, an alternative gasoline formulation pursuant to the Air Resources Board's "California Test Procedures for Alternative Specifications for Gasoline," as adopted **[Insert date of adoption]**, which is incorporated herein by reference.

(b) **Prohibited activities regarding alternative gasoline formulations.**

(1) No producer or importer shall sell, offer for sale, supply, or offer for supply from its production facility or import facility California gasoline which has been reported pursuant to section (c) as an alternative gasoline formulation, if it fails to conform with any of the alternative specifications identified in the certification order for the formulation, as determined in accordance with the test methods identified in the certification order.

(2) A producer or importer who has reported a final blend of gasoline as an alternative gasoline formulation shall not be subject to section 2262.2(b) or (c), section 2262.3(b) or (c), section 2262.4(b), section 2262.5(c), section 2262.6(b), or section 2262.7(b) or (c).

(c) **Notification regarding sales and supplies of alternative gasoline formulations.** A producer or importer of intending to sell or supply a

final blend of California gasoline from its production facility or import facility as an alternative gasoline formulation shall notify the executive officer in accordance with this section (c). The notification shall identify the final blend and the identification name of the certified alternative gasoline formulation. The notification shall be received by the executive officer at least 12 hours before start of physical transfer of the final blend from the production or import facility. A producer or importer intending to have a series of its final blends be a specific certified alternative gasoline formulation may enter into a protocol with the executive officer for reporting such blends as long as the executive officer reasonably determines the reporting under the protocol would provide at least as much notice to the executive officer as notification pursuant to the express terms of this section (c).

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2267. Exemptions

(a) Exemption for Gasoline Used in Research Programs.

(1) The executive officer may approve a written application from any person seeking to sell, supply or transport not more than 5000 gallons of gasoline having specifications exceeding any of the standards specified in this subarticle as part of a test program investigating the effect of various gasoline characteristics on vehicle emissions, vehicle performance, or related research objectives. Upon approval of the application, the sale, supply or transport of the gasoline described in the application shall not be subject to the standards in this subarticle.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and

Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2268. Liability of Persons Who Commit Violations Involving Gasoline That Has Not Yet Been Sold or Supplied to a Motor Vehicle.

(a) For the purposes of this subarticle, each sale of California gasoline at retail, and each dispensing of California gasoline into a motor vehicle fuel tank, shall also be deemed a sale or supply by any person who previously sold or supplied such gasoline in violation of any applicable section of this subarticle.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, and 43101 of the Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2269. Submittal of Compliance Plans

(a) Each producer shall, by January 1, 1993, submit to the executive officer a plan showing the producer's schedule for achieving compliance with the standards set forth in this subarticle. Each producer shall, by January 1, 1994, and January 1, 1995, submit an update of the plan.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, and 43101 of the Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: Sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2270. Testing and Recordkeeping.

(a) (1) The requirements of this section (a) shall apply to each producer and importer that that has elected to be subject to sections 2262.2(c), 2262.3(c) or 2262.7(c). The references to sulfur content shall apply to each producer or importer that has elected to be subject to section 2262.2(c). The references to benzene content shall apply to each

producer or importer that has elected to be subject to section 2262.3(c). The references to aromatic hydrocarbon shall apply to each producer or importer that has elected to be subject to section 2262.7(c).

(2) Each producer shall sample and test for the sulfur, aromatic hydrocarbon, and benzene content in each final blend of California gasoline which the producer has produced, in accordance with an applicable test method identified in section 2263. If a producer blends gasoline components directly to pipelines, tankships, railway tankcars or trucks and trailers, the loading(s) shall be sampled and tested for the sulfur, aromatic hydrocarbon, and benzene content by the producer or authorized contractor. The producer shall maintain, for two years from the date of each sampling, records showing the sample date, identity of blend sampled, container or other vessel sampled, final blend volume, sulfur content, aromatic hydrocarbon content, and benzene content. In the event a producer sells, offers for sale, or supplies gasoline which the producer claims is not California gasoline and which has a sulfur, aromatic hydrocarbon, or benzene content exceeding the standards specified in sections 2262.2(c), 2262.3(c), and 2262.7(c), such producer shall maintain, for two years from the date of any sale or supply of the gasoline, records demonstrating that the gasoline was not California gasoline when it was sold or supplied by the producer. All gasoline produced by the producer and not tested as California gasoline by the producer pursuant to this section shall be deemed to have a sulfur, aromatic hydrocarbon, and benzene content exceeding the standards specified in sections 2262.2(c), 2262.3(c), and 2262.7(c), unless the producer demonstrates that the gasoline meets those standards.

(3) Each importer shall sample and test for the sulfur, aromatic hydrocarbon, and benzene content in each shipment of California gasoline which the importer has imported by tankship, pipeline, railway tankcars, trucks and trailers, or other means, in accordance with an applicable test method identified in section 2263. The importer shall maintain, for two years from the date of each sampling, records showing the sample date, product sampled, container or other vessel sampled, the volume of the shipment, sulfur content, aromatic hydrocarbon content, and benzene

content. All gasoline imported by the importer and not tested as California gasoline by the importer pursuant to this section shall be deemed to have a sulfur, aromatic hydrocarbon, and benzene content exceeding the standards specified in sections 2262.2(c), 2262.3(c), and 2262.7(c), unless the importer demonstrates that the gasoline meets those standards.

(4) A producer or importer shall provide to the executive officer any records required to be maintained by the producer or importer pursuant to this section within 20 days of a written request from the executive officer if the request is received before expiration of the period during which the records are required to be maintained. Whenever a producer or importer fails to provide records regarding a final blend of California gasoline in accordance with the requirements of this section, the final blend of gasoline shall be presumed to have been sold by the producer or importer of the standards in sections 2262.2(c), 2263.3(c), and 2262.7 to which the producer or importer has elected to be subject.

(4) The executive officer may enter into a protocol with any producer or importer for the purpose of specifying alternative sampling, testing, recordkeeping, or reporting requirements which shall satisfy the provisions of sections (a)(2) or (a)(3). The executive officer may only enter into such a protocol if s/he reasonably determines that application of the regulatory requirements under the protocol will be consistent with the state board's ability effectively to enforce the provisions of sections 2262.2(c), 2262.3(c), and 2262.7(c). Any such protocol shall include the producer's or importer's agreement to be bound by the terms of the protocol.

(b) (1) For each final blend which is sold or supplied by a producer or importer from the party's production facility or import facility, and which contains volumes of gasoline that party has produced and imported and volumes that the party neither produced nor imported, the producer or importer shall establish, maintain and retain adequately organized records containing the following information:

(A) The volume of gasoline in the final blend that was not produced or imported by the producer or importer, the identity of the persons(s) from

whom such gasoline was acquired, the date(s) on which it was acquired, and the invoice representing the acquisition(s).

(B) The sulfur content, benzene content, and aromatic hydrocarbon content of the volume of gasoline in the final blend that was not produced or imported by the producer or importer, determined either by (A) sampling and testing, by the producer or importer, of the acquired gasoline represented in the final blend, or (B) written results of sampling and test of the gasoline supplied by the person(s) from whom the gasoline was acquired.

(2) A producer or importer subject to this section (b) shall establish such records by the time the final blend triggering the requirements is sold or supplied from the production or import facility, and shall retain such records for two years from such date. During the period of required retention, the producer or importer shall make any of the records available to the executive officer upon request.

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

Section 2271. Variances

(a) Any person who cannot comply with the standards set forth in sections 2262.1 through 2261.7 because of reasons beyond the person's reasonable control may apply to the executive officer for a variance. The application shall set forth:

(1) The applicable section(s) in which the variance is sought;

(2) the specific grounds upon which the variance is sought;

(3) the proposed date(s) by which compliance with the provisions of the applicable section(s) will be achieved; and

(4) a plan reasonably detailing the method by which compliance will be achieved.

(b) Upon receipt of an application for a variance containing the information required in section (a), the executive officer shall hold a

hearing to determine whether, or under what conditions and to what extent, a variance from the requirements of the applicable section(s) is necessary and will be permitted. Notice of the time and place of the hearing shall be sent to the applicant by certified mail not less than 20 days prior to the hearing. Notice of the hearing shall also be submitted for publication in the California Regulatory Notice Register and sent to every person who requests such notice, not less than 20 days prior to the hearing.

(c) At least 20 days prior to the hearing, the application for the variance shall be made available to the public for inspection. Interested members of the public shall be allowed a reasonable opportunity to testify at the hearing and their testimony shall be considered.

(d) No variance shall be granted unless all of the following findings are made:

(1) that, because of reasons beyond the reasonable control of the applicant, requiring compliance with the applicable section(s) would result in an extraordinary economic hardship;

(2) that the public interest in mitigating the extraordinary hardship to the applicant by issuing the variance outweighs the public interest in avoiding any increased emissions of air contaminants which would result from issuing the variance; and

(3) that the compliance plan proposed by the applicant can reasonably be implemented and will achieve compliance as expeditiously as possible.

(e) Any variance order shall specify a final compliance date by which the requirements of the applicable section(s) will be achieved. Any variance order shall also contain a condition that specified increments of progress necessary to assure timely compliance be achieved, and such other conditions, such as limitations on the gasoline specifications, that the executive officer, as a result of the testimony received at the hearing, finds necessary to carry out the purposes of Division 26 of the Health and Safety Code. Any variance order granting a variance from section 2262.1 shall impose a substitute gasoline Reid vapor pressure limit as stringent as feasible under the circumstances, in no case to exceed 9.0 pounds per square inch.

(f) The executive officer may require, as a condition of granting a variance, that a cash bond, or a bond executed by two or more good and sufficient sureties or by a corporate surety, be posted by the party to whom the variance was granted to assure performance of any construction, alteration, repair, or other work required by the terms and conditions of the variance. Such bond may provide that, if the party granted the variance fails to perform such work by the agreed date, the cash bond shall be forfeited to the state board, or the corporate surety or sureties shall have the option of promptly remedying the variance default or paying to the state board an amount, up to the amount specified in the bond, that is necessary to accomplish the work specified as a condition of the variance.

(g) No variance which is issued due to conditions of breakdown, repair, or malfunction of equipment shall have a duration, including extensions, of more than six months.

(h) The executive officer may, after holding a hearing without complying with the provisions of sections (b) and (c), issue an emergency variance to a person from the requirements of the applicable section(s) upon a showing of reasonably unforeseeable extraordinary hardship and good cause that a variance is necessary. In connection with the issuance of an emergency variance, the executive officer may waive the requirements of section (f). No emergency variance may extend for a period of more than 45 days. If the applicant for an emergency variance does not demonstrate that he or she can comply with the provisions of the applicable section(s) within such 45-day period, an emergency variance shall not be granted unless the applicant makes a prima facie demonstration that the findings set forth in section (d) should be made. The executive officer shall maintain a list of persons who have informed the executive officer in writing of their desire to be notified by telephone in advance of any hearing held pursuant to section (h), and shall provide advance telephone notice to any such person.

(i) A variance shall cease to be effective upon failure of the party to whom the variance was granted substantially to comply with any condition.

(j) Upon the application of any person, the executive officer may review and for good cause modify or revoke a variance from the requirements the applicable section(s) after holding a hearing in accordance with the provisions of sections (b) and (c).

NOTE: Authority cited: sections 39600, 39601, 43013, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975). Reference: sections 39000, 39001, 39002, 39003, 39010, 39500, 39515, 39516, 41511, 40000, 43000, 43016, 43018, and 43101, Health and Safety Code; and Western Oil and Gas Ass'n. v. Orange County Air Pollution Control District, 14 Cal. 3d 411, 121 Cal. Rptr. 249 (1975).

APPENDIX B

CALIFORNIA TEST PROCEDURES FOR EVALUATING ALTERNATIVE SPECIFICATIONS FOR GASOLINE

Adopted: [ ]

STATE OF CALIFORNIA
AIR RESOURCES BOARD

10/01/91

California Test Procedures for Evaluating
Alternative Specifications for Gasoline
Adopted: [ ]

I. INTRODUCTION

A. Purpose and Applicability

1. The test procedures and analyses prescribed in this document ("test protocol") may be used to evaluate gasoline specifications proposed as alternatives to the gasoline specifications set forth in Chapter 5, Article 1, subarticle 2, sections 2260 et. seq., Title 13, California Code of Regulations (referred to herein as "adopted gasoline specifications")

2. Gasoline properties for which alternative specifications may be set by this protocol include all properties having adopted gasoline specifications, except Reid vapor pressure (RVP). Any other properties not regulated by the code stated in I.A.1. also may receive specifications by this protocol.

3. Limits on the values allowable for certain specifications are as follows:

benzene	--	not to exceed 1.20 volume percent
olefin (total)	--	not to exceed 10 volume percent
olefin (C3 to C5)	--	not to exceed 1 volume percent
sulfur	--	not to exceed 80 ppm
aromatic hydrocarbon	--	not to exceed 30 volume percent
oxygen	--	not to exceed 2.7 wt. percent
distillation temp.		
T90	--	not to exceed 300 degrees F
T50	--	not to exceed 210 degrees F

4. The pollutant measures addressed by this protocol are carbon monoxide emissions (CO, gm/mile), oxides of nitrogen emissions (NOx, gm/mile), exhaust emissions of non-methane organic gases (NMOG, gm/mile), the combined ozone forming potential of exhaust NMOG emissions (gm. ozone/mile), and the combined potency-weighted emissions of toxic air contaminants in exhaust (mg/mile).

B. Synopsis of Protocol

The difference in emissions between the test fuel and the reference fuel (test fuel emissions minus reference fuel emissions, in grams/mile) is computed for tests in each test vehicle and then averaged over all vehicles within each of several vehicle categories in a test fleet. These average differences by category are combined

into a mileage-weighted mean that serves as an estimate of the difference in average emissions per mile between the test and reference fuels in the relevant on-road vehicle fleet. A statistical upper bound for this mileage-weighted estimate is computed. A mileage-weighted estimate of average emissions per mile from the reference fuel among the on-road vehicle fleet is also computed, using the same weights.

For each pollutant, the statistical upper bound for the average difference in emissions is compared to one percent of the average emissions of that pollutant from the reference fuel. If the statistical upper bound is the greater of these two numbers for any pollutant, the candidate fuel cannot be approved.

C. Definitions

1. "Applicant" means the party seeking approval of alternative gasoline specifications and responsible for the demonstration described in Section II.

2. "Reference fuel" means a gasoline meeting the following specifications:

ASTM Property	Test Method	Specification
Research Octane, min.	D2699	93
Sensitivity, min.		7.5
Lead (organic), max., g/US gal	D3237	0.050
Distillation Range		
10 pct. point, degrees F	D86-82	130-140
50 pct. point, degrees F	D86-82	190-210
90 pct. point, degrees F	D86-82	280-300
Sulfur, max. ppm wt.	D2622-87	40
Phosphorous, max., g/US gal		0.005
RVP, psi	D323-58 or 13 CCR sec. 2297	6.7-7.2
Hydrocarbon composition		
Olefins, maximum pct.	1319-88	5.0
Aromatics, maximum pct.	ARB MLD 116	25.0
Saturates		remainder
Oxygen, wt pct.	4815-88	1.8-2.2
Benzene, max. vol. pct.	3606-87	1.00

3. "Candidate fuel" means any gasoline that would meet specifications proposed as alternatives to the specifications cited in I.A.1. All candidate fuels under a particular set of proposed specifications are represented in the emission demonstration by the test fuel.

4. "Duplicate test" means an emission test run on a particular vehicle and a particular fuel as a repetition of the preceding test on the same vehicle and fuel, without draining and re-filling the fuel tank and conducting pre-test dynomometer cycles, as described in VII.D., between the tests.

5. "LDV" means light-duty vehicle. "MDV" means medium-duty vehicle. "TLEV" means transitional low-emission vehicle. "LEV" means low-emission vehicle. "ULEV" means ultra-low emission vehicle, all as defined in Title 13, California Code of Regulations, section 1960.1. "Low-emission vehicle" includes LEVs, TLEVs, and ULEVs. For the purpose of this protocol, only vehicles capable of using gasoline are included among low-emission vehicles.

6. "Replicate test" means an emission test or a set of duplicate tests run on a particular vehicle and a particular fuel as a repetition of another test or set of tests on the same vehicle and fuel, with draining and re-filling the fuel tank and the pre-test dynomometer cycles, as described in VII.D., between the tests or sets of tests.

7. "Test fuel" means the particular batch of gasoline representing candidate fuels in the emission demonstration required for approval of alternative gasoline specifications.

8. "Toxic air contaminants" means exhaust emissions of benzene, 1,3-butadiene, formaldehyde, and acetaldehyde.

II. DEMONSTRATION REQUIRED FOR CANDIDATE FUELS

The demonstration of approvability of alternative specifications shall consist of emission tests on a test fuel whose properties identified per the test plan in Section VI. have been accurately measured. The values of those properties shall correspond, as described in Section VI, with the proposed specifications. Comparisons of the results of these tests with the results of tests on the reference fuel must satisfy the criterion in section IV.

III. EMISSION TESTS AND COMPARISONS REQUIRED FOR CANDIDATE FUELS

A. Emission tests and comparisons shall be done on a fleet of on-road vehicles which exist at the time of the testing. The vehicle categories appropriate for inclusion in these fleets are defined in subsection V.A.

B. Within each fleet in subsection III.A., comparisons using the criterion in section IV. shall be made between emissions measured in tests using a test fuel representing the candidate fuel and emissions measured in tests using reference fuel.

C. The criterion in section IV. shall be applied separately to CO emissions, NOx emissions, the exhaust NMOG emissions, the combined ozone-forming potential of exhaust NMOG emissions, and the combined potency-weighted emissions of toxic air contaminants. If the test fuel fails to meet the criterion in section IV. for any of these pollutants, the candidate fuel shall have failed the required demonstration.

IV. CRITERION FOR DEMONSTRATION OF ACCEPTABLE EMISSIONS

For each comparison required in section III., the upper confidence limit (UCL) for the estimated mean difference in emissions between fuels (test fuel vs. reference fuel) among all on-road vehicles in the tested categories, computed at the significance level 0.15 for the one-sided t-statistic, shall be less than or equal to one percent of the average emissions (E_c, in grams/mile) estimated for those on-road vehicles using the reference fuel. The estimate of emission difference shall be based on the emission measurements in the test fleet. In terms of parameters calculated per section IX., the criterion is expressed as:

$$UCL = D + t_{.15,\ nu} * S.E. \leq 0.01 * E_c$$

where D is the estimate of the mean difference in emissions between the fuels, and S.E. is the standard error for that estimate, calculated for *nu* degrees of freedom.

V. TEST VEHICLES

A. Vehicle Categories for Testing

1. For the purpose of this protocol, eight categories of light-duty vehicles (passenger cars and trucks) are defined by the following model years, catalyst types, and/or emission standards. Only vehicles meeting all defining descriptors for a category are included in that category.

Model Year	Catalyst Type	Emission Standard
Pre-1975	No catalyst	
1975 - 1980	Open-loop oxidizing	
1981 - 1985	Closed-loop three-way	
1986 - 1990	Closed-loop three-way	
Post-1990	(any)	not low-emission
"	(any)	TLEV
"	(any)	LEV
"	(any)	ULEV

2. The executive officer shall maintain estimates of the total emissions from, and total annual miles travelled by, vehicles in the state in each of the categories listed above. These estimates shall be for the same time as, consistent with, and updated on the same schedule as the estimates of miles travelled that the executive officer uses to determine the required numbers of new retail outlets for clean fuels under section 2305 (d)(2) and section 2307 (e)(2), Title 13, California Code of Regulations.

3. Over all emissions categories in subsection V.A.1., the executive officer shall sum all exhaust NMOG emissions and all miles travelled in the state for the time corresponding to the estimates described in subsection V.A.2., assuming that all the vehicles receive the reference fuel all the time.

4. The test fleet required by subsection III.A.1. shall consist of each vehicle category contributing at least 3 percent of the sum of NMOG emissions (described in subsection III.A.3. over all categories for the fleet or at least 5 percent of the sum of miles traveled over all categories.

B. Number, Descriptions, and Preparation of Vehicles

1. Within each vehicle category to be tested per subsection V.A.4., the emission comparisons described in subsection III. shall be conducted in at least five vehicles. Over all categories tested, the total number of vehicles shall be at least 20.

2. Except in the case described in subsection V.B.6., the group of vehicles within each test category shall meet these restrictions:

   (a) no two vehicles shall be the same model and model year.

   (b) not more than 20 percent shall have the same owner or the same manufacturer.

3. Except as provided in subsection V.B.6., within each vehicle category, the test vehicles shall have distributions of engine displacement, types of fuel/air metering, catalyst technology, emission control system, and California vs. U.S. (49-state) certification that the executive officer deems are sufficiently representative of California's on-road fleet to make significant bias of the overall test results unlikely.

4. Except as provided in subsection V.B.6, each vehicle used under this protocol shall have accumulated at least the following miles travelled:

Age of vehicle, as determined by model year	Minimum miles travelled
0 to 1	4,000
2 to 5	18,000
6 to 10	41,000
11 to 15	61,000
> 15	76,000

5. Each vehicle shall be tested in its as-received condition; except, any routine maintenance scheduled to occur per the manufacturer's recommendation may be performed.

6. If the applicant demonstrates to the executive officer that the requirements in subsection V.B. are unreasonably difficult to meet for a vehicle category and unnecessary to provide a group of vehicles that reasonably represents the vehicle category, the executive officer may relax the requirements for that vehicle category.

7. Instead of following paragraphs 2 through 5 of this subsection B., the applicant may compose each category of test vehicles required by subsection V.A.4. through random sampling of on-road vehicles. This option may be followed only after approval by the executive officer of the proposed sampling method as part of the plan described in section VI.

VI. TEST PLAN

A. The applicant shall submit to the executive officer a test plan including the following information:

1. identification of properties of the fuel that affect exhaust emissions and would require specification in commercially available fuel; these shall include (but are not limited to) all properties with adopted gasoline specifications.

2. identification of the appropriate form of specification for each property identified in VI.A.1.; each specification shall be of one of the following forms, as necessary to ensure that all candidate fuels made to the specification would not cause greater emissions of the pollutants addressed by the protocol than would the test gasoline:

   (a) allowable value of property < [specified value]
   (b) allowable value of property > [specified value]
   (c) [specified value] < property < [specified value]

3. the engine families, model years, California or U.S. certification, and sources of vehicles with which the applicant proposes to satisfy subsection V.B. (if the option in subsection V.B.7 is not exercised);

4. if the option in subsection V.B.7 is exercised, the method by which random sampling will be accomplished;

5. the identities of any contractors who will conduct emission tests or analyses of samples;

6. quality control provisions consistent with good laboratory procedures in testing for the emission levels expected to be encountered in the tests,

7. the number of emission tests (duplicates and replicates) to be run on each vehicle within each vehicle category,

8. an approximate description of the test fuel, including all properties in subsection VI.A.1.,

9. a test procedure for determining the value of each property in VI.A.1 that does not have an adopted gasoline specification, and

10. a description of any statistical test by which the applicant would analyze individual test data to identify and discard statistical outliers.

B. Items 1. and 2. below apply to each proposed specification that would alter an adopted gasoline specification or that pertains to a gasoline property that does not have an adopted gasoline specification.

1. If a specification is of the kind in subsection VI.A.2.(a) or (b), the value of [specified value] shall be the value measured for that property in the test fuel, as described in subsection VI.E.

2. If a specification is of the kind in subsection VI.A.2.(c), the values of [specified value] shall be stated in the test plan.

C. For each adopted gasoline specification that would not be changed by the proposed alternative specifications, the value of the associated property in the test fuel shall satisfy that specification and be typical of values in current retail gasoline.

D. Unless the option in subsection V.B.7 is exercised, upon the executive officer's approval of the plan, the applicant shall specify to the executive officer the vehicle identification numbers of the vehicles to be tested. These numbers shall become part of the approved plan.

E. Upon the executive officer's approval of the plan, the applicant shall supply measurements of the properties of the test fuel, including all properties in subsection VI.A.1.

F. No datum shall be considered valid for the purpose of a demonstration controlled by this protocol unless that datum has been produced according to a plan approved by the executive officer before the datum has been taken.

G. Except as provided by section VIII., no demonstration shall be valid unless all data corresponding to an approved plan have been taken and included in the calculations prescribed in section IX.

H. Except as provided by section VIII., deviations from an approved plan shall not be permitted except by the prior permission of the executive officer.

I. No more than 20 days after receiving a proposed test plan, the executive officer shall either inform the applicant that the plan is complete or advise the applicant of necessary additions or changes. No more than 15 working days after receiving requested additions or changes, the executive officer shall advise the applicant that the amended plan is complete or further advise the applicant of necessary additions or changes. No more than 20 working days after advising the applicant that a plan is complete, the executive officer shall either approve or reject the plan. A rejection shall be accompanied by specifications of deficiencies.

J. The executive officer shall not approve a test plan unless he or she finds that it would produce a valid emission demonstration, as required by section III, by the procedures described in this protocol.

K. If requested by the executive officer, the applicant shall supply a sample of the test fuel to the ARB.

VII. EMISSION TEST PROCEDURES

A. All emission tests shall be done according to "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 Title 13, California Code of Regulations, section 1960.1.

B. Within any vehicle category, the same number of replicate tests and the same number of duplicate tests within each replicate test shall be run on each test vehicle on both the reference fuel and the test fuel. The number of replicate tests and the number of duplicate tests shall be determined by the applicant (subject to approval as part of the test plan) and may vary among the vehicle categories.

C. The first fuel to be tested in any vehicle shall be chosen randomly.

D. Whenever the fuel to be tested in a vehicle differs from the existing fuel in the vehicle, and whenever a replicate test is to be run, the test vehicle's fuel tank and fuel delivery system shall be drained of fuel to the extent that is practicable. The fuel tank shall then receive a 40 percent fill of the fuel to be tested. The vehicle shall then be run though one Highway Fuel Economy Driving Cycle (HFEDC) (40 Code of Federal Regulations, Part 600, Subpart B). The fuel tank and fuel delivery system shall again be drained, and the tank shall receive a 40 percent fill of the test fuel. Finally, the vehicle shall undergo another HFEDC and two consecutive LA4 cycles. The test vehicle shall not be operated again before the back-to-back FTP tests required in A. above.

E. Pre-testing procedures alternative to subsection VII.D. may be used if they are part of the approved plan described in section VI. Such alternatives may be approved only if found to be equivalent or superior in achieving a valid FTP test of the fuel under test.

F. In each FTP test run, the NMOG emissions shall be speciated for determining the ozone-forming potential of the vehicle's exhaust. Species in the NMOG emissions shall be identified and quantified by the procedures in the "California Non-Methane Organic Gas Test Procedures". Exhaust emissions of benzene, 1-3 butadiene, formaldehyde, and acetaldehyde shall be identified and quantified using the procedures in the same document.

VIII. EXCLUSION OF DATA OR VEHICLES

A. Any datum from an individual FTP run may be excluded as an outlier relative to its duplicate data (or to its replicate data if replicates do not contain duplicate tests) if so indicated by a statistical test approved by the executive officer as part of the test plan. If an analysis is used to exclude one or more datum for a pollutant, the same analysis shall be applied to all data for that pollutant.

B. Any vehicle may be excluded from the test program if it cannot be tested safely. In such a case, a similar vehicle shall be tested.

C. No datum shall be used in an emission demonstration under this protocol if:

1. test procedures during the generation of the datum differed from the procedures in the FTP, or

2. the datum was taken without adherence to the quality control requirements in the test plan, or

3. the vehicle used to generate the datum can be shown to have operated in a way different from the way it operated during other tests, and such a difference can reasonably be expected to affect emissions, or

4. either the testing equipment or the chemical analytical equipment can be shown to have functioned differently during the generation of the datum than during other tests, and such difference in function can reasonably be expected to affect emissions.

D. A datum deleted according to one of the disqualifying conditions in VIII.C. shall be replaced by a new test unless the vehicle used to generate the datum is no longer in the possession of the applicant or the applicant's contractor or unless the vehicle has been used in ordinary service since testing was completed. However, if the original vehicle cannot be tested and the deletion of a datum leaves no data for a particular vehicle/fuel combination, a similar vehicle shall be obtained and all tests on the original vehicle shall be repeated with the replacement vehicle.

IX. CALCULATIONS

A. Summary and Explanation of Calculations

This procedure calculates a statistical upper bound on the difference in average emissions per mile from the test fuel and from the reference fuel for the relevant on-road vehicle fleet. The emissions of all the pollutants measured during testing are expressed in units of mass per mile. The calculation procedure is the same for all pollutants.

From the data on each vehicle, the difference in average emissions per mile is calculated as:

average emissions per mile from the test fuel
minus
average emissions per mile from the reference fuel

where the average is over all data, whether duplicate test data or replicate test data.

Within each vehicle category, the difference in emissions between the two fuels is the mean value of the difference values among vehicles. Within each vehicle category, the standard deviation of the difference among vehicles is also calculated.

The expectation value of the relevant on-road vehicle fleet's average difference in emissions per mile is the weighted average of the differences in emissions among the vehicle categories. The weights used in the averaging are the estimates of total miles travelled by vehicles in the various categories.

Estimates of the standard error and degrees of freedom corresponding to the fleet-average difference in emissions are calculated from the weights, the numbers of test vehicles in the categories, and the standard deviations within categories.

The upper bound on the average difference in emissions for the on-road fleet is calculated from the expectation value, the standard error, and the one-sided student-t value for the 0.15 significance level and the calculated degrees of freedom.

The tolerance value for the upper bound is 0.01 times the weighted average value of the average emissions measured within vehicle categories on the reference fuel.

The type of statistical upper bound computed by this procedure is called an "upper confidence limit" in the statistical literature. Upper confidence limits for a statistical result have a high probability of exceeding the unknown true value of the quantity being measured. The probability is approximately 85 percent that the (unknown) true value of the mileage-weighted average difference of emissions per mile is less than its corresponding upper confidence limit. Consequently, if the true value of the difference in average emissions per mile is greater than the 1 percent tolerance, approximately 85 percent, or more, of all possible upper confidence limits will exceed this true value and therefore exceed the 1 percent tolerance. It follows that a candidate fuel with a true difference of emissions of a certain pollutant greater than the 1 percent tolerance will satisfy the criterion, and be accepted (with respect to that pollutant, only) as causing no increase in emissions, only about 15 percent of the time.

The upper confidence limits computed by this procedure are 85 percent one-sided upper confidence limits for a weighted average of normally distributed random variables. They are based on an approximate t-distribution. The degrees-of-freedom parameter of this distribution is calculated by Welch's approximation.

B. Test Run Results

1. Emission rates of CO, NOx, and NMOG, expressed as "g/mile", and the emission rate of each toxic pollutant, expressed as "mg/mile", shall be determined in each test by the procedure described in the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles".

2. Values of ozone-forming potential, in "g ozone per mile", shall be determined for exhaust emissions in each test according to Appendix VIII of the regulation stated in subsection IX.A.

3. In each test, the emission rate of each toxic pollutant shall be multiplied by its relative potency, as shown in the following table, and the four products shall be summed.

	Relative Potency
1,3-butadiene	1.0
benzene	0.21
formaldehyde	0.17
acetaldehyde	0.016

C. Upper Confidence Limit for Inferred Mean Emission Difference

1. The procedures in this section shall be followed for the test fleet in subsection III.A.1. The procedures shall be followed separately for CO, NOx, NMOG, the combined ozone-forming potential of exhaust NMOG, and the combined potency-weighted toxic emissions.

2. For each vehicle, the results (g/mile for CO, NOx, and NMOG, g ozone/mile, or mg/mile for combined potency-weighted toxic emissions) from all tests (whether duplicates or replicates) on the test fuel shall be averaged, as shall the results from all tests on the reference fuel. The average result when the vehicle is tested on the reference fuel shall be subtracted from the average when the vehicle is tested on the test fuel. The result of the subtraction is a difference value for the vehicle, d_v for the pollutant measure.

3. Within each vehicle category, the mean value and squared standard deviation of mean difference values shall be calculated over all vehicles:

   $m_{d,i}$ = mean value of d_v over all (n_i) vehicles in category i

   $s^2_{d,i}$ = square of standard deviation corresponding to $m_{d,i}$

   = sum over vehicles of $\{(d_v - m_{d,i})^2 / (n_i - 1)\}$

4. The population-weighted mean value of m_d shall be calculated over all tested vehicle categories:

   D = Sum over all categories (i) of $\{m_{d,i} * p_i\}$

   where p_i is total miles travelled by on-road vehicles in vehicle category i divided by the sum of total miles travelled by on-road vehicles in all categories that have been tested within the fleet. The values of "p" shall be determined for the same time as the sums of NMOG emissions and the sums of miles travelled described in subsections V.A.3.

5. The standard error of the weighted mean emission difference shall be calculated from the standard deviations within emission categories:

$$S.E.^2 = \text{Sum over all categories (i) of } \{p_i^2 * s_{d,i}^2 / n_i\}$$

where n_i is the number of test vehicles in category_i.

6. The number of degrees of freedom associated with D shall be calculated as:

$$nu = \frac{(S.E.^2)^2}{\text{Sum over all categories of } \{p_i^4 * s_{d,i}^4 / [n_i^2 * (n_i - 1)]\}}$$

7. The upper confidence limit for the population mean emission difference shall be calculated as:

$$UCL = D + t_{.15,\ nu} * S.E.$$

where t is the one-tailed "student's t" value for significance level (alpha) = .15 and degrees of freedom *nu*.

8. "t" shall be calculated as:

$$t_{.15,\ nu} = U + (U^3 + U)/(4 * nu) + (5 * U^5 + 16 * U^3 + 3 * U)/(96 * nu)$$

where U = 1.036

D. Emissions from the Use of Reference fuel

1. Within each test vehicle category, the average of all emission results (mass/mile) when the reference fuel is used, as described in IX.B.2, shall be averaged over all vehicles. The result, $e_{c,i}$, is the emission rate for category i.

2. The estimate of the on-road fleet emissions from the use reference fuel shall be the weighted sum over categories of $e_{c,i}$, using the same weights, p_i, as in the calculation of D.

$$E_c = \text{sum over all categories (i) of } \{p_i * e_{c,i}\}$$

X. SUBMISSION OF RESULTS

By means agreed upon by the executive officer and the applicant, the applicant shall submit documentation of adherence to the plan described in section VI. and to the procedures specified in section VII., the calculations required in section IX., any outlier analyses conducted per paragraph VIII.A., the output from all FTP runs and all speciations of NMOG.

XI. CERTIFICATION OF CANDIDATE FUELS

A. No more than 20 working days after receiving the information described in section X., the executive officer shall either inform the applicant that the information is complete or advise the applicant of necessary additions or changes. No more than 15 working days after receiving requested additions or changes, the executive officer shall advise the applicant that the amended information is complete or further advise the applicant of necessary additions or changes. No more than 20 working days after advising the applicant that the information is complete, the executive officer shall deem the demonstration required by subsection II.A., concerning emission comparisons, to be either accomplished or not accomplished. A rejection shall be accompanied by specifications of deficiencies.

B. If the executive officer determines that an applicant has accomplished the demonstration concerning emission comparisons in subsection II.A., the executive officer shall certify the candidate fuel as a certified alternative gasoline formulation. The executive officer shall include in the certification order specifications for properties of the certified fuel in accordance with subsections VI.A.1., VI.B., and VI.C. The executive officer shall notify interested parties of the certification order within 10 days of issuance.

C. A certification shall be in force for five years, at which time the reapproval process in section XII. shall be followed.

XII. PERIODIC REAPPROVAL

A. Every five years after the initial certification of alternative specifications, test data shall be provided for any vehicle category previously exempted from testing pursuant to section V.A.6. if the exempting criteria (less than 3 percent of emissions and less than 5 percent of miles travelled) are no longer met. Test data shall also be provided for any previously tested vehicle category for which the executive officer determines that the vehicles tested no longer provide a reasonable representation of the on-road vehicles in that category.

B. Every five years, the upper confidence limit specified in subsection IX.B. and the emissions from the use of reference fuel specified in subsection IX.C. shall be re-calculated for the test fleets identified in subsections V.A.1. and subsection V.A.2. The calculations shall use the original test data, any new test data provided pursuant to subsection XII.A. or XIII.A., and the current statistical weights (p) as described in subsection IX.B.4. If the upper confidence level exceeds the criterion in section IV. for any pollutant, the certification of the fuel shall be rescinded, effective two years following the date of the order rescinding the certification.

XIII. AUGMENTATION OF ORIGINAL TEST DATA

A. An applicant who made the petition that led to the approval may augment any portion of the information in the original test plan or the submission required in section X. All new information shall be developed according to this test protocol.

B. If new information or proposed changes are submitted, the executive officer shall evaluate and either accept or reject them by standards consistent with the requirements in this procedure for the original approval.