State of California

California Environmental Protection Agency

AIR RESOURCES BOARD

STAFF REPORT: Initial Statement of Reasons

PUBLIC HEARING TO CONSIDER AMENDING THE TEST METHODS DESIGNATED TO MEASURE THE CONCENTRATIONS OF TOTAL AROMATIC HYDROCARBONS, POLYNUCLEAR AROMATIC HYDROCARBONS, NITROGEN AND SULFUR CONTENT IN, AND DISTILLATION OF, CALIFORNIA COMMERCIAL AND CERTIFICATION DIESEL FUELS

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State of California
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Air Resources Board

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

PUBLIC HEARING TO CONSIDER AMENDING THE TEST METHODS DESIGNATED TO MEASURE THE CONCENTRATIONS OF TOTAL AROMATIC HYDROCARBONS, POLYNUCLEAR AROMATIC HYDROCARBONS, NITROGEN AND SULFUR CONTENT IN, AND DISTILLATION OF, CALIFORNIA COMMERCIAL AND CERTIFICATION DIESEL FUELS

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I. INTRODUCTION

The staff of the Air Resources Board (ARB or Board) is proposing that the ARB amend its designations of the test methods used to measure the amount of total aromatic hydrocarbons, polynuclear aromatic (PNA) hydrocarbons, nitrogen, and sulfur in diesel fuels and the test method for distillation of petroleum products. The updated test methods will be used to determine if motor vehicle diesel fuels comply with the ARB's clean diesel fuel regulations.

In 1988 the Board adopted regulations establishing statewide standards for the sulfur content and aromatic hydrocarbon content of diesel fuel for use in motor vehicles in California, starting October 1, 1993. The regulations were renumbered in 1991 as Title 13, California Code of Regulations, sections 2281 (sulfur content) and 2282 (aromatic hydrocarbon content). The maximum sulfur content limit is 500 parts per million by weight (ppmw). The maximum total aromatic hydrocarbon content limit is 10 volume percent for large refiners and 20 volume percent for qualifying small refiners. The regulation on aromatic hydrocarbon content allows refiners to comply by selling a certified alternative diesel fuel formulation that has an aromatic hydrocarbon content greater than the basic aromatic hydrocarbon limit, if the alternative formulation has been shown to result in equivalent emissions. Along with meeting a substitute total aromatic hydrocarbon limit, the certified alternative diesel fuel formulation must also meet formulation-specific limits for maximum PNA hydrocarbons, nitrogen and sulfur contents.

The diesel fuel test methods to be amended are designated in Title 13, CCR, sections 12281(c) and 2282(g)(3) for sulfur, and in sections 2282(c) and (g)(3) for total aromatic hydrocarbons, PNA hydrocarbons, nitrogen, and distillation of petroleum products. Most of the methods used in these regulations are approved and published by the American Society of Testing and Materials

(ASTM). We are also proposing that the newly designated test methods be identified for determining the pertinent properties of the 10 percent aromatic hydrocarbon diesel "certification" fuel designated in the ARB's test procedures for determining whether new motor vehicles and engines qualify to be certified as meeting the California motor vehicle emission standards.

Although the currently applicable test methods for total aromatic hydrocarbons and PNA hydrocarbons were the best procedures available when the clean diesel fuel regulations were adopted, both the ARB and the affected industry recognized that they had shortcomings. Accordingly, after adoption of the regulations, the staff began to work with industry to identify improved test procedures as they became available.

To this end, we have participated in ASTM-sponsored interlaboratory studies of the precision of test methods for total aromatic hydrocarbons, PNA hydrocarbons, and sulfur content in diesel fuel. We also met regularly with members of the Western States Petroleum Association (WSPA) to discuss the development of new or improved test methods. We held three public workshops which were attended by members of the oil industry, instrument manufacturers, and other interested parties. Through these efforts, we have identified new and updated test methods for measuring the total aromatic hydrocarbons, PNA hydrocarbons, and sulfur contents in diesel fuels.

The test methods we are proposing are identified in Table 1. They reflect the consensus of the participants (e.g., WSPA, ASTM, ARB) in the search for improved test methods.

TABLE 1. PROPOSED TEST METHOD CHANGES

Regulated Component	Currently Adopted Method	Proposed Method
Total Aromatic Hydrocarbons	ASTM D1319-84	ASTM D5186-9x (2/2/95 draft)
Polycyclic (or polynuclear) Aromatic Hydrocarbons	ASTM D2425-83	ASTM D5186-9x (2/2/95 draft)
Nitrogen	ASTM D4629-86	ASTM D4629-91
Sulfur	ASTM D2622-82	ASTM D2622-94
Distillation	ASTM D86-82	ASTM D86-96

II. BACKGROUND

A. The California Diesel Fuel Regulations

The clean diesel fuel regulations adopted by the Board in 1988 established a statewide maximum sulfur content limit of 500 ppmw or 0.05 percent by weight, and maximum total aromatic hydrocarbon content limits of 10 volume percent for large refiners and 20 volume percent for qualifying small refiners. These standards became applicable to California motor vehicle diesel fuel sold on and after October 1, 1993.

The regulation on aromatic hydrocarbon content allows refiners to comply by selling a certified alternative diesel fuel formulation that has an aromatic hydrocarbon content greater than the basic aromatic hydrocarbon limit. An alternative formulation will be certified if it has been found in an engine test program to result in emissions equivalent to the emissions resulting from diesel fuel meeting the 10 percent aromatic hydrocarbon limit (20 percent in the case of qualifying small refiners). In the engine test program, the emissions using a refiner's "Candidate fuel" are compared to the emissions using a 10 (or 20) percent aromatic hydrocarbon content "Reference fuel." The regulation identifies the specifications of the Reference fuel used in the comparative testing. It is to be produced from straight-run California diesel fuel by a hydrodearomatization process, and must have the characteristics set forth in Table 2 under "General Reference Fuel Specifications."

When certifying an alternative fuel formulation that has satisfied the engine test requirements, the Executive Officer specifies the total aromatic hydrocarbons, PNA hydrocarbons, nitrogen and sulfur contents and the cetane number of the Candidate fuel. A batch of commercial diesel fuel identified by the producer or importer as a certified diesel fuel formulation will comply with the regulation only if the batch does not exceed the specified total aromatic hydrocarbons, PNA hydrocarbons, nitrogen and sulfur contents of the Candidate fuel. In addition, the cetane number of the batch of commercial diesel fuel cannot be less than that of the Candidate fuel, and the diesel fuel generally must contain all additives that were in the Candidate fuel. Most of the motor vehicle diesel fuel now being sold in California has been identified by the producer or importer as meeting one of various certified alternative diesel fuel formulations.

The regulation on aromatic hydrocarbon content also requires producers and importers of California motor vehicle diesel fuel to sample and test each final blend for aromatic hydrocarbon content, using a designated test method.

The ARB's test procedures for certifying new motor vehicles and engines to the California emission standards identify the specifications of the certification fuel to be used in emissions testing. The specifications for certification diesel fuel are identified in the following test procedures, which are incorporated by reference in Title 13, CCR, 1956.8(b) and 1960.1(k) respectively:

TABLE 2. REFERENCE FUEL SPECIFICATIONS

Regulated Components of Diesel Fuel	Adopted Method	Reference Fuel Specifications	Small Refiner Reference Fuel Specifications
Aromatic Hydrocarbon Content, Vol%	D1319-84	10 vol% max	20 vol% max
Polycyclic Aromatic Hydrocarbon Content, wt%	D2425-83	1.4 Wt% max	4 Wt% max
Nitrogen Content	D4629-86	10 ppm max	90 ppm max
Sulfur Content	D2622-82	500 ppm max	500 ppm max
Natural Cetane No.	D613-84	48 minimum	47 minimum
Gravity, API	D287-82	33 - 39	33 - 39
Viscosity at 40^{O}F, cSt*	D445-83	2.0 - 4.1	2.0 - 4.1
Flash point, ^{O}F, (min)	D93-80	130	130
Distillation			
^{O}F	D86-82		
IBP**		340 - 420	340 - 420
10% REC***		400 - 490	400 490
50% REC		470 - 560	470 - 560
90% REC		550 - 610	550 - 610
EP****		580 - 660	580 - 660

* Centistokes (a unit of viscosity)
** Initial Boiling Point
*** Recovery
**** Endpoint

A. California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles.

B. California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles.

The ARB's various emission standards and test procedures for off-road vehicles and engines incorporate the certification fuel provisions in these two test procedures.

The two test procedures listed above allow manufacturers the option of using either of two certification diesel fuels -- the low-sulfur certification fuel specified in the federal test procedures, or a low-sulfur and low-aromatics certification fuel meeting specifications set by the ARB. The proposed amendments will affect only the low-sulfur and low-aromatics certification diesel fuel specifications.

B. Test Methods Development

The diesel fuel regulations designate the test methods to be used in measuring the fuel components. After the Board adopted the regulations, staff continued to be actively involved in identifying, developing, and refining test methods to measure total aromatic hydrocarbons, PNA hydrocarbons, and sulfur. The ARB staff worked with WSPA to form the ARB/WSPA Working Group on Fuels Test Methods as a forum for discussing progress in test methods development. Staff also took an active role in the activities of ASTM Subcommittee D2 on Hydrocarbon Analysis, participating in an interlaboratory (round robin) study of test methods ASTM D5186-9x and ASTM D2622.

In addition, staff held three separate public workshops on April 5, 1995, September 21, 1995, and March 19, 1996. Attendees included members of the oil industry, instrument manufacturers and other interested parties. Comments and questions raised at the workshops have been addressed in the development of the proposed methods and the supporting documentation. One major industry concern was whether or not methods deemed equivalent to the currently adopted methods would retain their equivalency after adoption of the new test methods. Staff indicated that the equivalent test methods would have to be repetitioned and measured against the proposed test methods if adopted by the Board. However, this review could be done prior to the hearing and the equivalencies could be determined and granted concurrent with the Board's adoption of the new methods. This would provide the refiners uninterrupted analysis through the equivalency process.

In evaluating test methods for adoption, a primary consideration is the precision of the test method. One measure of precision, reproducibility, is particularly applicable to interlaboratory comparisons. The ASTM uses the following language to define reproducibility:

> The difference between two single and independent results obtained by different operators working in different laboratories on identical test material would, in the long run, exceed the values only in one case in 20.

In addition to precision, we also considered factors such as cost, practicality, reliability, the underlying technology, and the United States Environmental Protection Agency (U.S. EPA) methods. We placed greater emphasis on methods based on proven technology.

The ARB often uses ASTM test methods as the means to determine compliance with its standards for motor vehicle diesel fuels. The ASTM is a well-known not-for-profit organization that provides a forum for manufacturers and users of products and instruments, as well as academicians and government representatives, with the intent of preparing standards based on a consensus approach. Test methods are one of the standards adopted by the ASTM. These test methods are given an identification number with the year of approval indicated by the last two numbers following the hyphen, e.g., ASTM D5186-91 is a method approved in 1991. Draft test methods, i.e., those that have not yet been approved through ASTM's formal balloting process, are indicated by the last two numbers' notation of "-9x", e.g., ASTM 5186-9x.

We expect that ASTM will complete the formal balloting process on ASTM D5186-9x by December, 1996. Upon approval by ASTM we will substitute the appropriate numbers representing the year of approval.

C. Equivalent Methods

The ARB's diesel fuel regulations permit the use of test methods other than those adopted by rulemaking, if it is shown that they produce results that are equivalent to the adopted method (see Title 13, CCR, Sections 2281(c) and 2282(k)). In determining if a candidate method is equivalent, ARB staff review the level of agreement in results between the candidate and adopted method as well as the precision of the candidate method relative to the adopted method.

The ASTM D5186-9x method being proposed in place of adopted method ASTM D1319-84 was approved in May 1992 as an equivalent method for total aromatic hydrocarbons (see Attachment A, Executive Order G-719-002 approving ASTM D5186-91), and in October 1993 as an equivalent method for PNA hydrocarbons (see Attachment B, letter to Douglas Henderson from William V. Loscutoff, Chief of the ARB's Monitoring and Laboratory Division approving Draft #3 dated September 2, 1993). The 1995 round robin results showed that ASTM D5186-9x has a much better precision than ASTM D1319-84. Therefore, we are proposing that ASTM D1319-84 be replaced with ASTM D5186-9x as the method of analysis for total aromatic hydrocarbons. We are also proposing that ASTM D2425-83 be replaced with ASTM D5186-9x as the method of analysis for PNA hydrocarbons.

Two methods have been approved by ARB as equivalent for sulfur: ASTM D5453-93 (approved September 2, 1993), and Method S121, designated by the Canadian General Standards Board as CAN/CGSB-3.0, No. 16.0-95 (approved November 15, 1995).

D. Federal Regulations

A U.S. EPA regulation, applicable beginning October 1, 1993, requires that on-road motor vehicle diesel fuel must have a sulfur content not exceeding 500 ppm, and must either meet a maximum total aromatic hydrocarbon content limit of 35 volume percent or have a cetane index of at least 40 (40 CFR section 80.29(a)(1)). The test methods and regulatory limits required by the U.S. EPA are summarized in Table 3. Given the advantages of the methods being proposed in this rulemaking, we expect that refiners and distributors verifying compliance with the federal requirements will be willing to rely on the results using the proposed California test methods.

TABLE 3. REQUIRED EPA METHODOLOGIES

Components	Test Method	Regulatory Limit
Total Aromatic Hydrocarbon	ASTM D1319-88[a]	35 volume %
Sulfur	ASTM D2622-87[b]	0.05 weight % (500 ppmw)

a,b (40 C.F.R. Sections 80.29 and 80.30)

III. RECOMMENDATION

We recommend that the Board amend the sections in Title 13, CCR, and the test procedures incorporated by reference, as indicated in Attachment C. The amendments would update the methods designated for determining the total aromatic hydrocarbons, PNA hydrocarbons, nitrogen, and sulfur contents in, as well as the distillation procedure of, California commercial and certification diesel fuels.

IV. PROPOSED ACTIONS, RATIONALE, AND ALTERNATIVES

In this section, we will evaluate the currently adopted, proposed, and alternative (if any) test methods for measuring total aromatic hydrocarbons, PNA hydrocarbons, nitrogen, and sulfur in diesel fuels, and the distillation procedure of petroleum products.

A. Replace ASTM D1319-84 with ASTM D5186-9x for the Measurement of Total Aromatic Hydrocarbons in Diesel Fuels

ASTM Method D1319-84 is the method currently required for the measurement of total aromatic hydrocarbons in diesel fuels. We recommend that the Board adopt ASTM D5186-9x to replace the current method for the following reasons:

First, ASTM did not verify applicability of D1319-84 to diesel fuels with a boiling point greater than 315 degrees Centigrade (599 degrees Fahrenheit). Diesel fuel No. 2 has a boiling point up to 338 degrees Centigrade (640 degrees Fahrenheit) and the proposed method, ASTM D5186-9x, is applicable to diesel fuels with a boiling point range of 338 degrees Centigrade. The second reason is that dark colored samples interfere in the analysis when using ASTM D1319-84, while colored samples do not interfere in the analysis when using ASTM D5186-9x. The third and most important reason why ASTM D5186-9x is proposed is because it has a better reproducibility than the currently adopted method.

1. Comparison of Adopted and Proposed Methods for Total Aromatic Hydrocarbons

The proposed method, ASTM D5186-9x, uses the supercritical fluid chromatographic (SFC) technique to separate and the flame ionization detector to quantify total aromatic hydrocarbons and PNA hydrocarbons from non-aromatic hydrocarbons. The detector response during the elution of the components of interest is recorded as an integrated peak. The mass percent monoaromatic hydrocarbon and PNA hydrocarbon contents of the diesel fuel is calculated by the integrator. The sum of these two groups of aromatic hydrocarbons gives the total aromatic hydrocarbons (in mass percent) present in the diesel sample.

ASTM D1319-84 is a fluorescent indicator adsorption (FIA) method based on elution chromatography and measures total aromatic hydrocarbons. The method does not separate polynuclear aromatic fractions from the total aromatic fractions. In this method, the diesel fuel sample is pumped down a highly polar silica gel column impregnated with indicator dyes. As the diesel sample separates into individual fractions, the indicator dyes interact with each hydrocarbon type (aromatic, olefinic, paraffinic) to give a unique fluorescent color band which is visible under ultraviolet (UV) light. The length of the colored band due to aromatic hydrocarbons, compared to the total length of the band of the diesel sample, is a measure of the volumetric concentration (or volume percent) of the total aromatic hydrocarbon fraction in the diesel sample.

When ASTM D5186-91 was approved by ARB as an equivalent test method to ASTM D1319-84, a correlation equation developed by WSPA (based on an interlaboratory round robin study) was used to correlate ASTM D5186-91 results in percent by weight to ASTM D1319-84 results in percent by volume. We are proposing that this equation be used to determine compliance with the volume percent limits.

volume % = 0.916 x mass % + 1.33

The advantage of the adopted method, ASTM D1319-84 is that the initial cost of instrumentation is low compared to the proposed method.

The following are the disadvantages of the adopted method, ASTM D1319-84:

a. Applicability of this method to diesel fuels with a boiling point greater than 315 degrees Centigrade (599 degrees Fahrenheit) has not been verified. Diesel fuels have boiling points up to 338 degrees Centigrade or 640 degrees Fahrenheit (ASTM D975-93).

b. Dark colored samples interfere in the analysis when using ASTM D1319-84.

c. The analysis is time consuming, therefore increasing cost in personnel time.

d. The precision of ASTM D1319-84 is poor compared to ASTM D5186-9x (see Table 4).

TABLE 4. RELATIVE REPRODUCIBILITIES BETWEEN ASTM D1319-84 AND ASTM D5186-9X (AT 10 VOL% TOTAL AROMATIC HYDROCARBONS)

ASTM Method	Relative Reproducibility (%)
D1319-84	69
D5186-9x	13

There are several advantages of the proposed method, ASTM D5186-9x, over the adopted method, ASTM D1319-84:

a. Although the initial cost of the SFC instrumentation used in the ASTM D5186-9x is higher than that of ASTM D1319-84, it is offset by other factors such as ASTM D5186-9x is less labor intensive than ASTM D1319-84. This will result in lower labor costs.

b. Test method ASTM D5186-9x provides results for PNA hydrocarbons, and therefore the cost for a separate analysis is eliminated. This will result in savings in manpower as well as instrumentation costs.

c. The most important advantage of ASTM D5186-9x over ASTM D1319-84 is that ASTM D5186-9x has a much better precision than ASTM D1319-84 (see Table 4 for comparison of relative reproducibilities between the two methods).

The following are the disadvantages of the proposed method, ASTM D5186-9x:

a. High initial cost of instrumentation used by this method.

b. The cutoff point between the monoaromatic and PNA compounds is not clearcut. Instead, it is based on the start of the naphthalene peak (a standard used for PNAs).

2. Alternative Method for Total Aromatic Hydrocarbons

The oil industry and instrument manufacturers are working on another method titled "Determination of Aromatic Hydrocarbon Types in Diesel Fuels and Distillates - High Performance Liquid Chromatography Refractive Index Detection Method" for the determination of monoaromatic, diaromatic, triaromatic, and total aromatic hydrocarbons (Method IP391/90, backflush modified). This method is still undergoing evaluation and testing.

The advantage of this method is that there is a well defined separation between the monoaromatic and PNA hydrocarbon peaks while the disadvantage of the method is the instability of the baseline.

B. Replace ASTM D2425-83 with ASTM D5186-9x for the Measurement of PNA Hydrocarbons in Diesel Fuels

We recommend replacing ASTM D2425-83 with ASTM D5186-9x to measure the PNA hydrocarbon content of diesel fuels because ASTM D5186-9x is more practical and cost-effective than ASTM D2425-83.

1. Comparison of Proposed and Adopted Methods for PNA

The currently adopted method, ASTM D2425-83, consists of two separate analytical procedures. The first procedure, ASTM D2549, separates the saturate and the aromatic fractions before the mass spectrometer (ASTM D2425-83) can be used to analyze the separated fractions.

The advantage of the adopted method, ASTM D2425-83 is its good accuracy.

The following are the disadvantages of the adopted method, ASTM D2425-83:

a. The adopted method is made up of two separate analytical procedures. This is time consuming, and it can add more errors to the analytical result.

b. ASTM D2425-83 uses an outmoded instrument which may no longer be commercially available. A version of ASTM D2425-83 using modern instrumentation is currently in the early stages of development and will require further development and interlaboratory testing.

c. A highly skilled analyst is required to operate the mass spectrometer, thus increasing the cost of analysis.

The following are the advantages of the proposed method for PNAs, ASTM D5186-9x:

a. The instrument and analytical procedure used in this method are the same as those used in the analysis for total aromatic hydrocarbons resulting in cost savings in labor and instrumentation.

b. The proposed method of analysis is less time consuming, is more practical, and does not require a highly skilled analyst.

c. The proposed method is for diesel samples with a boiling point range of around 338 degrees Centigrade (640 degrees Fahrenheit).

d. ASTM D5186-9x is the method currently used by industry to analyze for PNA hydrocarbons.

The disadvantage of the proposed method, ASTM D5186-9x, is that there is no clearcut separation between the mononuclear and PNA hydrocarbons; therefore, the cutoff point between these two groups of aromatic hydrocarbons is based on the time when the naphthalene (a PNA standard) peak begins. However, some PNAs are known to elute prior to the naphthalene peak and using the naphthalene cutoff can result in a lower value for PNAs. ARB and WSPA staff are reviewing method modifications which could improve the accuracy of this method for PNAs. Further ASTM-sponsored testing is anticipated.

2. Alternative Method for PNA

The oil industry and instrument manufacturers are working on a method, IP391/90 (backflush modified), using high performance liquid chromatography with a refractive index detector for the determination of PNA hydrocarbons. This method is still undergoing evaluation and testing.

The advantage of this method is the well-defined separation between the monoaromatic and PNA hydrocarbons while the disadvantage of this method is the unstable baseline.

C. Replace ASTM D4629-86 with ASTM D4629-91 for the Measurement of Nitrogen in Diesel Fuels

ASTM D4629 is used in the determination of total nitrogen found in diesel fuels. The bound nitrogen in diesel fuel is made to react with oxygen forming nitric oxide which in turn reacts with ozone to form excited nitrogen oxide (NO). The light emitted as the excited NO decays is measured, and this in turn gives the amount of total nitrogen found in the sample.

1. Comparison of Proposed and Adopted Methods for Nitrogen

The adopted method, ASTM D4629-86, is very similar to the proposed method, ASTM D4629-91, in terms of instrumentation and precision. However, ASTM D4629-91 contains some editorial changes.

2. Alternative Method for Nitrogen

At present, there is no known alternative method for nitrogen in diesel fuels.

D. Replace ASTM D2622-82 with ASTM D2622-94 for measuring sulfur in diesel fuel.

ASTM D2622 is an x-ray spectrometric technique used for the measurement of sulfur in diesel fuel. The sample is placed in the x-ray beam, and the intensity of the sulfur line is measured.

1. Comparison of Proposed and Adopted Methods for Sulfur

The proposed and adopted methods for sulfur are identical in terms of instrumentation and precision. However, ASTM D2622-94 contains editorial changes and improvements in some of the parts used in the instrument, and it recommends matrix matching between samples and standards.

We did not recommend any of the alternative methods for adoption (see below) because ASTM D2622 has been shown by recent interlaboratory testing to be the most precise method for the measurement of sulfur in diesel fuel, and because ASTM D2622 is a proven, reliable, and practical method for sulfur measurement. Furthermore, ASTM D2622-94 is the test method specified in California Phase 2 regulations as well as in the U.S. EPA's regulations.

2. Alternative Methods Considered for Sulfur

In addition to the proposed method ASTM D2622-94, we evaluated several alternative methods used to measure the sulfur content of diesel fuel including ASTM D5453-93, ASTM D4294-90, and Method S121 (CAN/CGSB-3.0, No. 16.0-95.

a. ASTM D5453-93

This method utilizes a pyrolysis technique which converts the sulfur to sulfur dioxide. The sulfur dioxide is made to fluoresce using ultraviolet radiation. The amount of fluorescence emitted is proportional to the concentration of sulfur in diesel.

We did not recommend this method for adoption because ASTM D5453-93 is not as well established as the proposed method.

b. ASTM D4294-90

ASTM D4294 utilizes energy-dispersive x-ray fluorescence spectroscopy for the direct measurement of total sulfur content. The sample is placed in the beam emitted from an x-ray source, and the resulting characteristic radiation is measured.

We did not recommend adoption of ASTM D4294 because the reproducibility of the method is poor compared to ASTM D2622-94.

c. Method S121 (CAN/CGSB-3.0, No. 16.0-95)

This method is similar to ASTM D4294 in instrumentation, but Method S121 uses a different calibration procedure specific for diesel fuel. It has good relative reproducibility (14%) at the 10 volume percent level. It was approved as an equivalent method for sulfur analysis in diesel based on the currently adopted method. However, ASTM has not adopted this method; therefore, it was not considered as a potential adopted method.

E. Replace ASTM D86-82 with ASTM D86-96 for the Distillation Procedure of Petroleum Products

ASTM D86 is a standard test method for the distillation of petroleum products using either a manual or automated method. The sample is distilled under prescribed conditions that are appropriate to its nature. Systematic observations of thermometer readings and volumes of condensate are made, and from these data the results of the test are calculated and reported.

1. Comparison of Proposed and Adopted Methods for the Distillation Procedure

The two procedures are similar to each other; however, ASTM D86-96 is better written, thus it is easier to follow the procedures given in ASTM D86-96 than in ASTM D86-82. ASTM D86-96 separates the different groups of boiling points during the discussions of the sampling and test procedures, and there is more explanation given to some of the procedures mentioned. There is also a device added to center the temperature sensor in the neck of the flask used in the automated distillation procedure of ASTM D86-96.

In the manual distillation procedure for ASTM D86-96, there is a difference of 0.01 in pressure (see Table 5, Approximate Thermometer Reading Corrections, under degree Fahrenheit in the correction per 1.3 kPa, 10 mm) beginning at the 130 to 150 degree Centigrade level. However, this difference is negligible.

These two methods have equivalent precision and accuracy.

V. AIR QUALITY, ENVIRONMENTAL, AND ECONOMIC IMPACTS

A. Air Quality and Environmental Impacts

The proposed changes in the test methods will not result in any air quality impacts because the standards for diesel fuel will remain the same. The staff has not identified any adverse non-air quality environmental impacts that would result from these proposals.

B. Economic Impacts

This section evaluates the potential economic impact of the proposed changes in the test methods on business enterprises in California. Government Code Section 11346.3(a) requires that in proposing to adopt or amend an administrative regulation, state agencies shall assess the potential for adverse economic impact on California business enterprises and individuals. The assessment shall also include the impact of the proposed or amended regulation on the ability of California businesses to compete with businesses in other states. In addition, Government Code Section 11346.3(b) requires state agencies to assess the potential impact of their regulations on the creation or elimination of jobs in California, the creation of new businesses or its elimination, and the expansion of businesses in California.

The proposed changes in the test methods are intended to increase the precision and accuracy of the test methods currently used to measure the total aromatic hydrocarbon and PNA hydrocarbon contents of diesel fuel. The proposed sulfur method is an update of the adopted method with an improvement in some parts of the instrument used. The revisions in the nitrogen test method are mostly editorial changes for clarification purposes, and the distillation procedure has a centering device added for the temperature sensor used in the automated

procedure as well as editorial changes for clarification purposes. There is also a negligible change in the correction for the pressure used for the manual procedure (see Table 5 of ASTM D86-96).

The test methods update may actually result in cost savings to some affected businesses due to the combination of the analysis for total aromatic hydrocarbons and PNA hydrocarbons, using one instrument and one analytical procedure instead of two different instruments and two different analytical procedures. Besides, most of the refiners are using this method already; therefore, they do not have to purchase an SFC instrument.

The proposed methods, ASTM D2622-94 for sulfur, ASTM D4629-91 for nitrogen, and ASTM D86-96 for distillation procedure, impose no additional costs on affected businesses because they use the same instrumentation as the adopted method.

Most of the refiners or diesel fuel producers need only one of each of the instruments to comply with the regulations. For those who do not own an SFC, the costs associated with purchasing an SFC instrument include an initial investment of around $85,000 for the instrument, around $4,000 for training the operator, $7,000 for the cost of annual maintenance, and around $4,000 for the cost of the gases (depending on the number of analyses done) or a total of $100,000 for the first year initial operation excluding personnel costs. After the first year, an annual maintenance cost of around $7,000 plus the cost of the gases used (around $4,000) is incurred. Assuming the useful life of the instrument is eight years, the annualized capital cost of the SFC instrument is estimated to be around $16,000. The total annualized cost including the costs of maintaining the instrument and the purchase price of the gases is around $27,000. This cost increase is not expected to have a significant impact on the profitability of California refiners or fuel producers since this analysis can be automated resulting in savings in labor and time and the majority of the refiners in California currently have SFCs.

Refiners are not considered small businesses, and most refiners in California that produce vehicular diesel fuel have a supercritical fluid chromatograph, the instrument used in the proposed ASTM Method D5186-9x for both total aromatic hydrocarbons and PNA hydrocarbons. Therefore, the method changes in ASTM D5186-9X are not expected to impose significant additional costs on California business enterprises.

For the proposed PNA hydrocarbons method (ASTM D5186-9x also), there are savings to industry since it will not be necessary to purchase another expensive instrument (a mass spectrometer which cost around $200,000), and this method does not need a highly skilled instrument operator (higher salary) to operate the complex mass spectrometer instrument which is used in the current method, ASTM D2425-83.

The table below summarizes the ASTM method changes and total annualized costs for the proposed and alternative methods.

TABLE 5. TOTAL ANNUALIZED COSTS OF THE CURRENT, PROPOSED AND ALTERNATIVE METHODS

Parameter	Current Method	Current TAC[a]	Proposed Method	Proposed TAC[a]	Alter-native method	Alter-native TAC[a]
TAHC[b]	D1319-84	None	D5186-9x	$27,000	IP391/90	$15,000
PNAs	D2425-83	$50,000	D5186-9x	None[c]	IP391/90	None[c]
Nitrogen	D4629-86	None[d]	D4629-91	None[d]	No alternative method	
Sulfur	D2622-82	None[d]	D2622-94	None[d]	D5453-93 S121	$19,000 $5,800
Distil-lation	D86-82	None[d]	D86-96	None[d]	No alternative method	

a Total Annualized Cost
b Total Aromatic Hydrocarbon
c No instrument cost because the same instrument is used for PNAs as for total aromatic hydrocarbons above.
d No cost because the same instrument is used by the current and proposed methods.

In light of the above considerations, we expect no significant change in employment, business competitiveness, and the status of businesses in California due to the change of the five diesel test methods. However, to the extent that refiners or fuel producers purchase new instruments from California businesses, some jobs may be created in the manufacture, distribution, and sales of these instruments.

REFERENCES

1. ASTM D1319-84, "Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption." Annual Book of ASTM Standards.

2. Executive Order G-719-002 signed on May 29, 1992.

3. ASTM D5186-9X, "Standard Method for Determination of Aromatic Content of Diesel Fuels by Supercritical Fluid Chromatography." Draft Method. Annual Book of ASTM Standards.

4. ASTM D5186-91, "Standard Method for Determination of Aromatic Content of Diesel Fuels by Supercritical Fluid Chromatography." Annual Book of ASTM Standards.

5. ASTM D2425-83, "Standard Test Method for Hydrocarbon Types in Middle Distillates by Mass Spectrometry." Annual Book of ASTM Standards.

6. ASTM D2622-94, "Standard Test Method for Sulfur in Petroleum Products by X- Ray Spectrometry." Annual Book of ASTM Standards.

7. ASTM D2622-82, "Standard Test Method for Sulfur in Petroleum Products by X- Ray Spectrometry." Annual Book of ASTM Standards.

8. ASTM D2549-91, "Standard Test Method for Separation of Representative Aromatics and Nonaromatics Fractions of High-Boiling Oils by Elution Chromatography." Annual Book of ASTM Standards.

9. ASTM D4629-86, "Standard Test Method for Organically Bound Trace Nitrogen in Liquid Petroleum Hydrocarbons By Oxidative Combustion and Chemiluminescence Detection." Annual Book of ASTM Standards.

10. ASTM D4629-91, "Standard Test Method for Trace Nitrogen in Liquid Petroleum Hydrocarbons by Syringe/Inlet Oxidative Combustion and Chemiluminescence Detection." Annual Book of ASTM Standards.

11. ASTM D4294-90, "Standard Test Method for Sulfur in Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectroscopy." Annual Book of ASTM Standards.

12. ASTM D770-95, "Specification for Isopropyl Alcohol." Annual Book of ASTM Standards.

13. ASTM D1655-93, "Specification for Aviation Turbine Fuels." Annual Book of ASTM Standards.

14. ASTM D2001-92, "Test Method for the Depentanization of Gasoline and Naphthas." Annual Book of ASTM Standards.

15. ASTM D4057, "Practice for Manual Sampling of Petroleum and Petroleum Products." Annual Book of ASTM Standards.

16. E 11, "Specification for Wire-Cloth Sieves for Testing Purposes." Annual Book of ASTM Standards.

17. ASTM D86-96, "Test Method for Distillation of Petroleum Products." Annual Book of ASTM Standards.

18. ASTM D2007, "Test Method for Characteristic Groups in Rubber Extender and Processing Oils and other Petroleum Derived Oils by the Clay-Gel Adsorption Chromatographic Method." Annual Book of ASTM Standards.

19. ASTM D2786, "Test Method for Hydrocarbon Types of Gas-Oil Saturate Fractions by High Ionizing Voltage Mass Spectrometry." Annual Book of ASTM Standards.

20. ASTM D2887, "Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography." Annual Book of ASTM Standards.

21. ASTM D3239, "Test Method for Aromatic Types Analysis of Gas-Oil Aromatic Fractions by High Ionizing Voltage Mass Spectrometry." Annual Book of ASTM Standards.

22. IP391/90, "Aromatic Hydrocarbon Types in Diesel Fuels and Petroleum Distillates by High Performance Liquid Chromatography with Refractive Index Detection." Institute of Petroleum, Method Number 391, pages 391.1 to 391.5.

23. ASTM D5453-93, "Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels, and Oils by Ultraviolet Fluorescence." Annual Book of ASTM Standards.

24. Method S121, "Standard Test Method for Sulfur in Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectroscopy." CAN/CGSB 3.0 No. 16.0- 94.

25. ASTM D4177, "Practice for Automatic Sampling of Petroleum and Petroleum Products." Annual Book of ASTM Standards.

26. Letter signed by W. V. Loscutoff, Chief of the ARB Monitoring and Laboratory Division dated November 15, 1995 approving CAN/CGSB-3.0, No. 16.0-95 as an equivalent test method to the ARB's adopted method for the determination of sulfur, ASTM D2622-82.

27. Letter signed by William V. Loscutoff, Chief of the ARB Monitoring and Laboratory Division dated October 1, 1993 approving WSPA Draft #3 (September 2, 1993) as an equivalent method to ASTM D2425-83 for the determination of PNA hydrocarbon content of diesel fuels.

28. Letter signed by William V. Loscutoff, Chief of the ARB Monitoring and Laboratory Division dated September 2, 1993, approving the UV fluorescence method, ASTM D5453, as an equivalent method to ASTM D2622-82, the adopted method for the determination of sulfur.

29. ASTM D323, "Test Method for Vapor Pressure of Petroleum Products (Reid Method)." Annual Book of ASTM Standards.

30. ASTM D396, "Specification for Fuel Oils." Annual Book of ASTM Standards.

31. ASTM D850, "Test Method for Distillation of Industrial Aromatic Hydrocarbons and Related Materials." Annual Book of ASTM Standards.

32. ASTM D1078, "Test Method for Distillation Range of Volatile Organic Liquids." Annual Book of ASTM Standards.

33. ASTM D2892, "Test Method for Distillation of Crude Petroleum (15 Theoretical Plate Column." Annual Book of ASTM Standards.

34. E 1, "Specification of ASTM Thermometers." Annual Book of ASTM Standards.

35. E 77, "Test Methods of Verification and Calibration of Liquid-in-Glass Thermometers." Annual Book of ASTM Standards.

36. E 133, "Specification for Distillation Equipment." Annual Book of ASTM Standards.

37. E 220, "Method for Calibration of Thermocouples by Comparison Techniques." Annual Book of ASTM Standards.

38. ASTM D936, "Test Method for Aromatic Hydrocarbons in Olefin-Free Gasolines by Silica Gel Adsorption." Annual Book of ASTM Standards.

39. ASTM E137, "Practice for Evaluation of Mass Spectrometers for Quantitative Analysis from a Batch Inlet." Annual Book of ASTM Standards.

40. ASTM D975, "Specification for Diesel Fuel Oils." Annual Book of ASTM Standards.

41. ASTM D4953, "Test Method for Vapor Pressure of Gasoline and Gasoline Oxygenate Blends (Dry Method)." Annual Book of ASTM Standards.

42. ASTM D5190, "Test Method for Vapor Pressure of Petroleum Products (Automatic Method). " Annual Book of ASTM Standards.

43. ASTM 5191, "Test Method for Vapor Pressure of Petroleum Products (Mini Method)." Annual Book of ASTM Standards.

44. ASTM D5482, "Test Method for Vapor Pressure of Petroleum Products (Mini Method-Atmospheric)." Annual Book of ASTM Standards.

45. IP 69, "Determination of Vapour Pressure - Reid Method." Institute of Petroleum, Method Number 69, pages 69.1 to 69.19.

46. IP 171, "Vapour Pressure Micro Method." Institute of Petroleum, Method Number 171, pages 171.1 to 171.7.

47. ASTM D86-82, "Test Method for Distillation of Petroleum Products." Annual Book of ASTM Standards.

ATTACHMENT A

Executive Order G-719-002

ATTACHMENT B

Letter of Equivalency for Polynuclear Aromatic hydrocarbons

ATTACHMENT C

Proposed Amendments to Sections 2281(c), 2282(b), (c), and (g), 1956.8(b) and 1960.1(k) of Title 13, California Code of Regulations

PROPOSED REGULATION ORDER

Note: The proposed new language is shown in underline, and the proposed deletions are shown in ~~strikeout~~.

The symbol * * * * * means that the remainder of the text in the section is not shown in this document and is not proposed to be amended.

Amend Title 13, California Code of Regulations, section 2281(c) to read as follows:

§ 2281. Sulfur Content of Diesel Fuel.

(a) ***Regulatory Standard.***

* * * * *

(c) ***Test Method.***

The sulfur content of diesel fuel limitation specified in subsection (a)(1) shall be determined by ASTM Test Method D 2622-~~82~~94, which is incorporated herein by reference, or any other test method determined by the executive officer to give equivalent results.

* * * * *

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

Amend Title 13, California Code of Regulations, section 2282 to read as follows:

§ 2282. Aromatic Hydrocarbon Content of Diesel Fuel

* * * * *

(b) ***Definitions.***

* * * * *

(0.5) "Aromatic hydrocarbon" has the same meaning as “total aromatic hydrocarbons.”

* * * * *

(14) "Polycyclic aromatic" ~~means the sum of the concentrations of the compound types defined in paragraphs 3.8 through 3.12 of ASTM D 2425-83, which is incorporated herein by reference.~~ (also referred to as “polynuclear aromatic hydrocarbons”) means an organic compound containing two or more aromatic rings.

* * * * *

(c) ***Test Method.***

(1) Compliance with ~~The~~ the aromatic hydrocarbon content limitations specified in ~~subsection (a)~~ this section 2282 shall be determined by ASTM D~~ 1319-84~~ 5186-9x, which is incorporated herein by reference ~~modified as set forth in Subsection (c)(2)~~. The following correlation equation shall be used to convert the SFC results in mass percent to volume percent:

Correlation Equation: Aromatic Hydrocarbons expressed in % by volume = 0.916 x (Aromatic Hydrocarbons expressed in % by weight) + 1.33

~~(2) For the purposes of this Section 2282, the text of Section 1.1 of ASTM Method D 1319-84 shall be modified to read: "1.1 This test method covers the determination of hydrocarbon types over the concentration ranges from 5 to 99 volume % aromatics, 0.3 to 55 volume % olefins, and 1 to 95 volume % saturates in No. 1-D and No. 2-D diesel fuel."~~

* * * * *

(g) ***Certified Diesel Fuel Formulations Resulting in Equivalent Emissions Reductions.***

* * * * *

(2) The applicant shall supply the candidate fuel to be used in the comparative testing pursuant to Subsection (g)(4). The candidate fuel shall meet the specifications for No. 1-D or 2-D diesel fuel set forth in ASTM D975-81, which is incorporated herein by reference. The following characteristics of the candidate fuel shall be determined as the average of three tests conducted in accordance with the referenced test method (the ASTM methods are incorporated herein by reference):

(A) Sulfur content (not to exceed 500 ppm) by ASTM D2622-~~82~~94;
(B) Total aromatic hydrocarbon content, by ASTM D~~1319-84~~5186-9x;
(C) Polycyclic aromatic hydrocarbon content, by ASTM D~~2425-83~~5186-9x;
(D) Nitrogen content, by ASTM D4629-~~86~~91;

* * * * *

(3) The reference fuel used in the comparative testing described in Subsection (g)(4) shall be produced from straight-run California diesel fuel by a hydrodearomatization process and shall have the characteristics set forth below under "General Reference Fuel Specifications" (the listed ASTM methods are incorporated herein by reference):

Reference Fuel Specifications

Property	ASTM Test Method	General Reference Fuel Specifications	Small Refiner Reference Fuel Specifications
Sulfur Content	D2622-~~82~~94	500 ppm max	500 ppm max
Aromatic Hydrocarbon Content, vol %	D~~1319-84~~ 5186-9x	10 % max	20 % max
Polycyclic Aromatic Hydrocarbon Content, Wt%	D~~2425-83~~ 5186-9x	1.4% max	4% max
Nitrogen Content	D4629-~~86~~91	10 ppm max	90 ppm max
Natural Cetane Number	D613-84	~~4~~8 minimum	47 minimum
Gravity, API	D287-82	33 - 39	33 - 39
Viscosity at 40°F, cSt	D445-83	2.0 - 4.1	2.0 - 4.1
Flash point, °F, (min)	D93-80	130	130
Distillation, °F	D86-~~82~~96		
IBP		340 - 420	340 - 420
10 % REC		400 - 490	400 - 490
50 % REC		470 - 560	470 - 560
90 % REC		550 - 610	550 - 610
EP		580 - 660	580 - 660

* * * * *

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

Amend Title 13, California Code of Reguations, section 1956.8(b) to read as follows:

§ 1956.8 Exhaust Emissions Standards and Test Procedures - 1985 and Subsequent Model Heavy-duty Engines and Vehicles.

* * * * *

(b) The test procedures for determining compliance with standards applicable to 1985 and subsequent heavy-duty diesel engines and vehicles are set forth in the "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" adopted April 8, 1985, as last amended ~~September 22, 1994~~ [insert new date], which is incorporated herein by reference.

* * * * *

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

Amend Title 13, California Code of Regulations, section 1960.1(k) to read as follows:

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

* * * * *

(k) The procedures for determining compliance with these standards are set forth in "California Exhaust Emission Standards and Test Procedures for 1981 through 1987 Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," adopted by the state board on November 23, 1976, as last amended May 20, 1987, and in "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles," adopted by the state board on May 20, 1987, as last amended ~~May 31, 1996~~ [insert new date], both of which are incorporated herein by reference.

* * * * *

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

ATTACHMENT D

Proposed Amendments to the "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles"

Proposed

STATE OF CALIFORNIA
AIR RESOURCES BOARD

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

Adopted: April 8, 1995
Amended: July 29, 1986
Amended: January 22, 1990
Amended: May 15, 1990
Amended: December 26, 1990
Amended: July 12, 1991
Amended: October 23, 1992
Amended: October 22, 1993
Amended: March 24, 1994
Amended: September 22, 1994
Amended: June 29, 1995
Amended: _____

NOTE: This document is printed in a style to indicate amendments to the existing California Standards and Test Procedures. The proposed new language is shown in underline, and the proposed deletions are shown in ~~strikeout~~.

The symbols "# # # # #" mean that the remainder of the text of these procedures is not shown in this document and is not proposed to be amended.

This document incorporates by reference various sections of the Code of Federal Regulations, some with modifications. California provisions which replace specific federal provisions are denoted by the words "DELETE" for the federal language and "REPLACE WITH" for the new California language. California provisions adding new paragraphs are denoted by "ADD." The symbols "*****" and "..." mean that the remainder of the federal test for a specific section, which is not shown in these procedures, has been included by reference, with only the printed text changed. Federal regulations which are not listed are not part of the procedures.

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

# # # # #

86.1313-90 Fuel Specifications. April 11, 1989.

* * * * *

(b)(2) Except as noted below, petroleum fuel for diesel engines ... shall be used. For 1993 and subsequent model-year diesel-fueled engines, the petroleum fuel used in exhaust emissions testing may meet the specifications in Table N94-2 of 40 Code of Federal Regulations section 86.1313-94(b)(2), as adopted August 21, 1990, or substantially equivalent specifications approved by the Executive Officer as an option to the specifications in Table N90-2. For 1995 and subsequent model-year medium-duty diesel-fueled engines, and for 1996 and 1997 model-year urban bus engines only, the petroleum fuel used in exhaust emissions testing may meet the specifications listed below, or substantially equivalent specifications approved by the Executive Officer as an option to the specifications in Table N90-2. Where a manufacturer elects pursuant to this subparagraph to conduct exhaust emission testing using the specifications in Table N94-2,

or the specifications listed below, the Executive Officer shall conduct exhaust emission testing with the diesel fuel meeting the specifications elected by the manufacturer.

Fuel Property	Limit	Test Method a/	
Natural Cetane Number	47 - 55	D613-86	
Distillation Range, °F		~~D86-82~~	Title 13 CCR, §2282(g)(3)
IBP	340 - 420		
10 % point	400 - 490		
50 % point	470 - 560		
90 % point	550 - 610		
EP	580 - 660		
API Gravity, degrees	33 - 39	D287-82	
Total Sulfur, wt%	0.01-0.05	~~D2622-82~~	Title 13 CCR, §2282(g)(3)
Nitrogen Content, ppmw	100 - 500	~~D4629-86~~	Title 13 CCR, §2282(g)(3)
Total Aromatic Hydrocarbons, vol%	8 - 12	~~D1313-83~~	~~D5186-91~~ Title 13 CCR, §2282(g)(3)
Polycyclic Aromatic Hydrocarbons, wt.% (max)	1.4	~~D2425-88~~	Title 13 CCR, §2282(g)(3)
Flashpoint, degrees F (max)	130	D93-80	
Viscosity @ 40 degrees F, centistokes	2.0 - 4.1	D445-83	

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

# # # # #

ATTACHMENT E

Proposed Amendments to the "California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles"

Proposed

State of California
AIR RESOURCES BOARD

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

Adopted: May 20, 1987
Amended: December 20, 1989
Amended: January 22, 1990
Amended: December 26, 1990
Amended: July 12, 1991
Amended: August 12, 1992
Amended: October 23, 1992
Amended: May 28, 1993
Amended: September 17, 1993
Amended: September 22, 1993
Amended: September 22, 1994
Amended: June 24, 1996
Amended: _____

NOTE: This document is printed in a style to indicate amendments to the existing California Standards and Test Procedures. The proposed new language is shown in underline, and the proposed deletions are shown in ~~strikeout~~.

The symbols "# # # # #" mean that the remainder of the text of these procedures is not shown in this document and is not proposed to be amended.

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

California Exhaust Emission Standards and Test Procedures for 1988 and Subsequent Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles

# # # # #

9. **Test Requirements**

a. Fuel Specifications

In paragraph 86.113-90, 86.113-91, and 86.113-94:

# # # # #

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

(2) Except as noted below, petroleum fuel for diesel vehicles meeting the specifications referenced in 86.113-90(b)(2), or substantially equivalent specifications approved by the Executive Officer, shall be used in exhaust emission testing. The grade of petroleum fuel recommended by the engine manufacturer, commercially designated as "Type 2-D" grade diesel, shall be used. For 1993 and subsequent model-year diesel vehicles, petroleum fuel meeting the specifications of 86.113-94(b)(2) may be used in exhaust emission testing as an option to the specifications in 86.113-90(b)(2). For 1995 and subsequent model-year diesel-fueled vehicles, the petroleum fuel used in exhaust emission testing may meet the specifications listed below, or substantially equivalent specifications approved by the

Executive Officer, as an option to the specifications in 86.113-90(b)(2) or 86.113-94(b)(2). Where a manufacturer elects pursuant to this subparagraph to conduct exhaust emission testing using the specifications of 86.113-94(b)(2), or the specifications listed below, the Executive Officer shall conduct exhaust emission testing with the diesel fuel meeting the specifications elected by the manufacturer.

Fuel Property	Limit	Test Method a/	
Natural Cetane Number	47 - 55	D613-86	
Distillation Range, °F		~~D86-82~~	Title 13, CCR, §2282(g)(3)
IBP	340 - 420		
10% point	400 - 490		
50% point	470 - 560		
90% point	550 - 610		
EP	580 - 660		
API Gravity, degrees	33 - 39	D287-82	
Total Sulfur, wt%	0.01-0.05	~~D2622-82~~	Title 13, CCR, §2282(g)(3)
Nitrogen Content, ppmw	100 - 500	~~D4629-86~~	Title 13, CCR, §2282(g)(3)
Total Aromatic Hydrocarbons, vol%	8 - 12	~~D1313-83 D5186-91~~	Title 13, CCR, §2282(g)(3)
Polycyclic Aromatic Hydrocarbons, wt% (max)	1.4	~~D2425-88~~	Title 13, CCR, §2282(g)(3)
Flashpoint, degrees F (max)	130	D93-80	
Viscosity @ 40 degrees F, centistokes	2.0 - 4.1	D445-83	

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

# # # # #