State of California
AIR RESOURCES BOARD

Resolution 95-47

November 16, 1995

Agenda Item No.: 95-12-2

WHEREAS, sections 39600 and 39601 of the Health and Safety Code authorize the Air Resources Board (the "Board") to adopt standards, rules and regulations and to do such acts as may be necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law;

WHEREAS, Health and Safety Code section 43018(a), enacted by the California Clean Air Act of 1988, directs the Board to endeavor to achieve the maximum degree of emission reduction possible from vehicular and other mobile sources in order to accomplish the attainment of the state ambient air quality standards at the earliest practicable date;

WHEREAS, Health and Safety Code section 43018(c) provides that in carrying out section 43018, the Board shall adopt standards and regulations which will result in the most cost-effective combination of control measures on all classes of motor vehicles and motor vehicle fuel, including but not limited to specification of vehicular fuel composition;

WHEREAS, Health and Safety Code section 43013 authorizes the Board to adopt and implement motor vehicle fuel specifications for the control of air contaminants and sources of air pollution, which requirements the Board has found to be necessary, cost-effective, and technologically feasible to carry out the purposes of division 26 of the Health and Safety Code;

WHEREAS, on September 28, 1990, by Resolution 90-59, the Board approved adoption of section 2257, title 13, California Code of Regulations, prohibiting the sale or distribution of motor vehicle gasoline except gasoline certified to contain adequate levels of deposit control additives;

WHEREAS, the ARB staff has administered the deposit control additive regulation for nearly four years and has approved over 200 applications for certification;

WHEREAS, the staff conducted a public workshop on July 20, 1995, regarding proposed amendments to the deposit control additive requirement;

WHEREAS, based on this experience and industry input provided at a July 20, 1995 workshop, staff has proposed various amendments to section 2257, title 13, California Code of Regulations, to clarify the regulation, to create additional flexibility in the program, and to provide consistency with anticipated future federal vehicle testing requirements for deposit control additives;

WHEREAS, the California Environmental Quality Act and Board regulations require that no project that may have significant adverse environmental impacts be adopted as originally proposed if feasible alternatives or mitigation measures are available to reduce or eliminate such impacts;

WHEREAS, a public hearing and other administrative proceedings have been held in accordance with provisions of chapter 3.5 (commencing with section 11340), part 1, division 3, title 2 of the Government Code;

WHEREAS, the Board has considered the effect of the proposed amendments on the economy of the state;

WHEREAS, the Board finds that:

Requiring certification test fuels to represent the maximum requested properties will provide regulatory clarity and uniformity;

It is reasonable to provide a blending tolerance to provide flexibility for production of certification test fuels;

Adoption of ASTM Method D 5598-94 for port fuel injector (PFI) keep-clean performance will provide improved quality assurance and accuracy compared to the current PFI keep-clean test method;

It is appropriate to revise ARB's current PFI clean-up test method to incorporate the quality control procedures of ASTM Method D 5598-94 for consistency and to provide improved accuracy compared to the current PFI clean-up test method;

Adoption of ASTM Method D 5500-94 for intake valve keep-clean performance provides improved quality assurance and accuracy compared to the current intake valve keep- clean test method;

The amendment of the PFI and intake valve test procedures to specify the use of ASTM test procedures is consistent with the anticipated future federal vehicle testing requirements for deposit control additives;

Adoption of a provision to allow manual additive blending after gasoline loads have left the final distribution facility will provide flexibility without reducing the effectiveness of the additization requirement;

The other clarifying amendments to section 2257, title 13, California Code of Regulations, will simplify the regulation, resolve ambiguity and provide more specificity, and enhance the enforcement of the regulation;

WHEREAS, the Board further finds that:

The approved amendments do not affect the current emissions reductions associated with the regulation;

The amendments will not result in any adverse environmental impact;

All previously approved gasoline additive certifications will continue to be effective after the approved amendments have been implemented;

NOW THEREFORE BE IT RESOLVED that the Board hereby approves amendments to title 13, California Code of Regulations, section 2257, and the incorporated test procedures, as set forth in Attachments A and B hereto.

BE IT FURTHER RESOLVED that the Board directs the Executive Officer to adopt the regulations with modifications as set forth in Attachments A and B, after making the regulations as modified available to the public for a period of 15 days, provided that the Executive Officer shall consider such written comments regarding the modifications as may be submitted during this period, shall make modifications as may be appropriate in light of the comments received, and shall present the regulations to the Board for further consideration if he determines that this is warranted.

BE IT FURTHER RESOLVED that, following approval by the Office of Administrative Law of the amendments adopted under this resolution, the Executive Officer is directed, as appropriate, to adopt the amendments as part of the California State Implementation Plan and to submit them to the U.S. Environmental Protection Agency as a revision to the California State Implementation Plan.

BE IT FURTHER RESOLVED that the Board directs the staff to review the recordkeeping and other requirements of section 2257, title 13, California Code of Regulations, when the U.S. Environmental Protection Agency adopts the final federal gasoline deposit control additive regulations and to propose additional modifications to the section 2257 if warranted.

I hereby certify that the above is a true and correct copy of Resolution 95-47, as adopted by the Air Resources Board.

Pat Hutchens

Pat Hutchens, Board Secretary

Resolution 95-47

November 16, 1995

Identification of Attachments in the Resolution

Attachment A: Staff's proposed modifications to the original proposed regulation order

Attachment B: Staff's proposed modifications to the Test Method for Evaluating Port Fuel Injector (PFI) Deposits in Vehicle Engines

APPENDIX A
COMMENTS & RESPONSES FROM JULY 20, 1995 WORKSHOP

Appendix A

Summary of Comments and Responses Made at the July 20, 1995 Workshop

1) If a large refiner trades with a small refiner when CaRFG is required in March 1996, does the large refiner need to certify a gasoline that meets the more severe deposit forming properties of a small refiner fuel?

Response: Yes. All gasoline that is marketed in California must be certified to contain effective deposit control additives for which certification has been granted. This means that if a large refiner intends to trade gasoline with a small refiner, the refiner must ensure that the gasoline is certified and properly additized. After April 1, 1998, all small refiners will need to conform to all the gasoline specifications for CaRFG, therefore, large and small refiners will certify their gasolines to similar specifications.

2) Is it necessary to require disclosure of the additive chemical composition for the gasoline certification?

Response: Chemical disclosure of additives is necessary and is an important aspect in evaluating a gasoline additive certification. The chemical composition allows staff to correlate new additive packages to previous certifications. Also, it allows staff to identify toxic compounds which may be part of the additive package. All proprietary information is used internally by the ARB and is kept confidential

3) The ARB should follow the EPA approach by requiring the disclosure of the minimum additive treatment rate in terms of gallons of additive per thousand gallons of gasoline instead of pounds per thousand gallons.

Response: We agree with this comment. We are proposing to amend the regulation to specify the disclosure of the minimum additive treatment rate on a volume basis.

4) Even though it was not the subject of this rulemaking, we encourage the ARB to drop the cleanup testing requirement. Cleanup is redundant and is not necessary.

Response: The cleanup portion of the ARB's vehicle testing requirements are an important part of the demonstration to show an additive's effectiveness in severe gasoline formulations. At this time, we do not have the necessary technical data to conclusively justify the elimination of the cleanup requirement. We will continue to work with industry to evaluate the need for this requirement.

5) In the blending of certification test fuels, it may not be possible to exactly meet the properties requested for certification. Therefore, it would be appropriate to provide some blending flexibility. One suggestion is to provide the test method reproducibility as the blending margin or tolerance.

Response: We agree that meeting multiple properties would be difficult when blending certification test fuels. However, we do not agree that the test reproducibility should be the tolerance. The test reproducibility could be very large and can lead to certification test fuels that do not adequately represent gasoline formulations for which certification is being requested. As an alternative, we propose a 20 percent tolerance based on our certification procedures we have used in the past. This means that certification test fuels must be within 20 percent of all maximum gasoline specifications requested for certification.

6) The dirty-up fuel specification referenced in the cleanup test should not be proposed as a specification, but rather as a guideline for fuel blenders in order to provide a minimal measure of dirty-up performance.

Response: We agree. The current available literature does not support the specification of exact minimum properties to achieve adequate dirty-up performance. Therefore, we propose to change the current dirty-up fuel properties of the cleanup test method to be a guideline. The dirty-up fuel will still need to achieve 10 percent PFI plugging within 10,000 miles as specified in the cleanup test method.

7) Since the regulation specifically states that recordkeeping is to be done on a monthly basis, the ARB's daily recordkeeping requirement is more onerous and could lead to a cost impact.

Response: The regulation requires monthly "compilations" of records. We have interpreted this to mean that daily records must be compiled on a monthly basis to ensure that each gallon of gasoline is properly additized. We understand that all facilities are adequately equipped to provide daily recordkeeping to meet the intent of this requirement and most facilities already maintain daily records. We believe the cost to meet this requirement will be minimal.

8) What is the environmental benefit of daily recordkeeping?

Response: The environmental benefit of daily records comes from the air quality benefit of properly additized gasolines (see ARB Staff Report dated August 13, 1990). The current regulation already requires daily recordkeeping and ARB enforcement efforts impose this requirement. The amendment to the recordkeeping requirements is merely a clarification of the existing requirements and will not have an environmental impact.

9) Santa Fe Pacific Pipeline requested that the regulation provide a daily tolerance of 5 percent in the additive treatment level if daily recordkeeping is required.

Response: Currently, the ARB Compliance Division enforcement policy allows a 5 percent additization tolerance for daily records.

10) Why doesn't the ARB adopt the EPA's recordkeeping approach of the interim regulation instead of proposing the need for daily records?

Response: We believe that at this time, the technical data available clearly supports a per gallon standard. While it may appear from some technical data that occasional underadditization will not have adverse air quality impacts, no comprehensive studies have been done on this subject. Some technical data suggests that just one tankful of unadditized gasoline could result in severe fuel system deposits, which in turn could lead to emission increases.

The EPA's interim regulation recordkeeping requirements are specifically designed to enforce a monthly average additive concentration level. However, gross underadditization is still a concern. In fact, under the latest EPA proposal for the final rule, EPA suggests requiring weekly recordkeeping to better assure that all gasoline is properly additized. We believe that the EPA approach will not provide enough assurance that the per gallon standard could be met. Furthermore, EPA's recordkeeping requirements reflect the national norm of additive monitoring technology, which may not always be adequate to monitor additive use on a daily basis. In California, our evaluations show that all facilities can currently monitor additive use daily.

11) Will previously approved gasoline certifications be valid once the proposed amendments go into effect?

Response: Yes. All currently approved gasoline certifications will be valid.

APPENDIX B
PROPOSED REGULATION ORDER

PROPOSED REGULATION ORDER

Amend title 13, California Code of Regulations, section 2257 to read as follows:

§ 2257. Required Additives in Gasoline.

(a) Regulatory Standard.

(1) On or after January 1, 1992, no person shall sell, offer for sale, supply, or offer for supply any California gasoline unless at the time of the transaction:

[i] the producer, importer, or distributor of the gasoline has been issued a currently effective certification pursuant to subsection (c), and

[ii] the gasoline contains at least the minimum concentration of the additive or additives identified in *the* final application for certification.

(2) Subsection (a)(1) shall not apply to transactions where the person selling, supplying, or offering the gasoline demonstrates that:

[i] the gasoline has not yet been sold, offered, or supplied from the final distribution facility, and either

[ii] the person has taken reasonably prudent precautions to assure that he or she will bring the gasoline into satisfaction with the requirements of subsection (a)(1) before it is sold, supplied or offered from the final distribution facility, or

[iii] 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 he or she is a distributor who has been issued a currently effective certification pursuant to subsection (c), and will cause the gasoline to satisfy the requirements of subsection (a)(1) before it is sold, supplied or offered from the final distribution facility.

(3) Subsection (a)(1)[ii] shall not apply to the sale, supply, or offer of gasoline from a final distribution facility where the person selling, supplying, or offering the gasoline demonstrates that the gasoline will be corrected to comply with section (a)(1)[ii] prior to or at the time of delivery to the facility at which the gasoline will be dispensed into motor vehicles. If such corrective action is taken, the producer, importer, or distributor of the gasoline must notify the Compliance Division of the Air Resources Board by telephone or in writing within 2 business days of the correction and must maintain records to document each occurrence in accordance with subsection (d).

(~~3~~4) For the purposes of subsection (a)(1), each sale of gasoline at retail for use in a motor vehicle, and each supply of 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 subsection (a)(1).

(b) Definitions.

For the purposes of this section:

(1) "Additive" means any substance or mixture of substances that is intentionally added to gasoline for the purpose of reducing or preventing fuel injection system or intake valve deposits, and that is not intentionally removed prior to the gasoline's sale or use.

(2) "Bulk purchaser-consumer" means a person who purchases or otherwise obtains

gasoline in bulk and then dispenses it into the fuel tanks of motor vehicles owned or operated by the person.

(3) "California gasoline" means gasoline sold or intended for sale ~~as~~ as a motor vehicle fuel in California.

(4) "Chemical composition" means the name, percentage by weight, and chemical identification of each compound in an additive.

(5) "Distributor" means any person who transports or stores or causes the transportation or storage of gasoline, produced or imported by another person, at any point between any producer's or importer's facility and any retail outlet or wholesale purchaser-consumer's facility.

(6) "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.

(7) "Gasoline" means any fuel which is *sold or intended for sale as a California motor vehicle fuel and is either: (a)* commonly or commercially known or sold as gasoline, or *(b) any fuel blend* ~~which is a mixture of~~ *gasoline as defined in (a) and alcohol in which the portion of gasoline is* more than 50 percent *of the total blend* ~~fuel commonly known or sold as gasoline and alcohol and which is sold or intended for sale as a motor vehicle fuel in California~~.

(8) "Gasoline production facility" means a facility in California at which gasoline is produced; it does not include a facility whose sole operation is to transfer gasoline or to blend additives into gasoline.

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

(10) "Import facility" means the facility at which imported 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.

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

(12) "Produce" means to convert liquid compounds which are not gasoline into gasoline.

(13) "Producer" means any person who produces California gasoline in California.

(14) "Retail outlet" means any establishment at which gasoline is sold or offered for sale for use in motor vehicles.

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

(c) Certification Requirements.

(1)(A) No gasoline formulation shall be certified under this subsection (c) unless the applicant for certification demonstrates each of the following to the executive officer's satisfaction:

(i) The gasoline formulation meets the unlimited mileage standard of ~~an average of~~ a maximum of 100 milligrams ~~per~~ *averaged over all* intake valves when tested in accordance with *ASTM D 5500-94* ~~the Stationary Source Division's BMW 10,000 Mile Intake Valve Test~~

~~Procedure, dated March 1, 1991~~, which is incorporated herein by reference.

(ii) The gasoline formulation does not result in a flow loss of more than five percent *for any fuel injector* when tested in accordance with *ASTM D 5598-94* ~~the Stationary Source Division's Test Method for evaluating Port Fuel Injector Deposits in Vehicle Engines, dated March 1, 1991~~, which is incorporated herein by reference.

(iii) The gasoline formulation is capable of reducing fuel injector deposits so that no fuel injector suffers a flow loss of more than five percent when tested in accordance with the Stationary Source Division's Test Method for Evaluating Port Fuel Injector Deposits in Vehicle Engines, dated ~~March 1, 1991~~ *[insert date of adoption]*, which is incorporated herein by reference.

(B) The executive officer may approve alternative test procedures for demonstrating satisfaction with any of the performance criteria set forth in subsection (c)(1)(A) if an applicant or potential applicant demonstrates to the executive officer's satisfaction that a gasoline formulation which meets the performance criteria of the alternative test procedure would also meet the performance criteria specified in subsection (c)(1)(A).

(2) Any producer, importer, or distributor may apply to the executive officer for certification of a gasoline formulation in accordance with this subsection (c). The application shall be in writing and shall include, at a minimum, the following:

(A) The name and chemical composition of the additive or additives in the gasoline formulation, except that if the chemical composition is not known to either the applicant or to the manufacturer of the additive (if other than the applicant), the applicant may provide a full disclosure of the chemical process of manufacture of the additive in lieu of its chemical composition.

(B) The minimum concentration of each additive in the gasoline formulation *in terms of gallons of additive per thousand gallons of gasoline.*

(C) The results of tests conducted on the gasoline formulation pursuant to the test procedures set forth in subsection (c)(1), all data generated by the tests, the identity of the entity which conducted each test, and a description of the quality assurance and quality control procedures used during the testing.

(D) Data demonstrating that the ~~gasoline formulation used in the tests is representative of the gasoline produced, imported, or distributed by the applicant~~ *fuel used for certification testing ("certification test fuel") is representative of the gasoline formulation for which certification is requested. Properties of the certification test fuel must be at least 80 percent of the maximum properties of the gasoline formulation to be certified for the following: aromatic hydrocarbon content, olefin content, sulfur content, oxygen content, and T90 distillation temperature.*

(E) Data demonstrating that the certification test fuel is representative of typical commercial gasoline and will be produced from typical refinery blend stocks.

(~~E~~*F*) The theoretical mechanism of action (if known) of the additive in meeting any of the performance criteria set forth in subsection (c)(1)(A).

(~~F~~*G*) Copies of all material pertaining to the additive or additives in the gasoline formulation, submitted by the applicant to the U.S. Environmental Protection Agency pursuant to 40 CFR sections 79.6, 79.10 and 79.11. If the applicant has submitted no such material,

copies of all material pertaining to the additive or additives in the gasoline formulation, submitted by the additive manufacturer to the U. S. Environmental Protection Agency pursuant to 40 CFR sections 79.6, 79.20 and 79.21.

(~~H~~*G*) A test method reasonably adequate for determining the presence and concentration of each additive in the gasoline, *including test method reproducibility*. The test method may involve identification of the presence of a surrogate marker substance if the applicant demonstrates that such test method will adequately demonstrate the presence and concentration of the additive.

(3) Within 30 days of receipt of an application, the executive officer shall advise the applicant in writing either that it is complete or that specified additional information is required to make it complete. Within 30 days of submittal of additional information, the executive officer shall advise the applicant in writing either that the application is complete, or that specified additional information or testing is still required before it can be deemed complete.

(4) If the executive officer finds that an application meets the requirements of this section and determines that the applicant has satisfactorily made the demonstrations identified in subsection (c)(1), then he or she shall issue an Executive Order certifying the gasoline fuel formulation. The executive officer shall act on a complete application within 30 days after the application is deemed complete.

(5) If the executive officer determines that the gasoline sold by a producer, importer or distributor contains the minimum concentration of additives identified in an applicable certification, but substantially fails to meet the performance criteria set forth in subsection (c)(1), the executive officer shall evoke or modify the prior certification as is necessary to assure that gasoline sold by the producer, importer or distributor meets the performance criteria set forth in subsection (c)(1). The executive officer shall not revoke or modify a prior certification order without first affording the applicant for the certification an opportunity for a hearing in accordance with title 17, California Code of Regulations, part III, chapter 1, subchapter 1, article 4 (commencing with section 60040). If the executive officer determines that a producer, importer or distributor would be unable to comply with this regulation as a direct result of a certification revocation or modification pursuant to this subsection, the executive officer may delay the effective date of such revocation or modification for such period of time as is necessary to permit the person to come into compliance in the exercise of all reasonable diligence.

(d) Recordkeeping.

(1) Each producer, importer, and distributor who has been issued a certification pursuant to subsection (c) ~~shall~~ *must* maintain records ~~identifying~~ *for* each facility at which he or she adds an additive to California gasoline in order to comply with subsection (a)(1). For each such facility, ~~commencing January 1, 1992,~~ the producer, importer or distributor ~~shall~~ *must* ~~compile~~ *maintain daily* records *for each business day and compile those records monthly,* showing ~~on a monthly basis~~ for each grade of gasoline:

[i] the volume of California gasoline supplied from the facility by the producer, importer or distributor,

[ii] the volume of California gasoline to which the producer, importer or distributor added the additive to comply with subsection (a)(1), ~~and~~

[iii] the name and volume of each additive (or additive package) ~~used~~ added to the California gasoline fuel, *and*

[iv] the actual additive usage rate achieved.

(2) For purposes of demonstrating compliance with the standard in subsection (a)(1) based on the records required under this subsection (d)(1)

[i] Monthly records must demonstrate that for each month the gasoline on average contains at least the minimum concentration of the additive or additives identified in the final application for certification.

[ii] Daily records must demonstrate that for each 24 hour period the gasoline on average contains at least 95 percent of the minimum concentration of the additive or additives identified in the final application for certification.

(3) Daily records and the monthly compilations covering a calendar month must be available for inspection 15 days after the end of the month. The daily records and monthly compilation of ~~R~~records ~~covering a month shall~~ *must* be ~~compiled no later than 30 days after the end of the month, and shall be~~ retained for at least two years ~~after the end of the month~~.

(~~4~~2) Any person required by subsection (d)(1) to *maintain and* compile ~~and retain~~ records ~~shall provide to the executive officer any such records within 20 days of a~~ *must make those records available for inspection and copying immediately upon request by the executive officer or his/her designee. Upon a* written request ~~received~~ from the executive officer or her/her designee, *a copy of the daily records must be provided to the executive officer within 20 days of the request* ~~before expiration of the period during which the records are required to be retained~~. Whenever such a person fails to provide records regarding a volume of California gasoline in accordance with this subsection (d)(*~~4~~2), the volume of California gasoline ~~shall~~ *will* be presumed to have been sold by the person in violation of subsection (a)(1).

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).

APPENDIX C
PLAIN ENGLISH SUMMARY OF PROPOSED AMENDMENTS

APPENDIX C

This appendix provides a noncontrolling plain English summary of the proposed amendments to the gasoline deposit control additive regulation, section 2257, title 13, California Code of Regulations, as required by Government Code section 11346.2(a)(1). These amendments will be considered by the Air Resources Board at its November 16-17, 1995 public hearing:

Add new subsection (a)(3). The existing regulation requires that all commercial gasoline be properly additized before it leaves prior to reaching a retail or wholesale facility such as service station. The regulation does not allow for correction of gasoline that does not have the required minimum concentration of additive ("underadditized gasoline") after it leaves the final distribution facility headed for the retail or wholesale facility where it will be dispensed into motor vehicles, for example, a service station. This new provision allows manual correction of underadditized gasoline at the retail or wholesale facility if the following requirements are met: (1) the person who received the certification for the gasoline demonstrates that it was correctly additized before it was dispensed at the retail or wholesale facility, (2) that person notifies the Compliance Division of the ARB that underadditized gasoline was manually corrected within 2 business days, and (3) that person maintains a record of the occurrence.

Amend subsection (b)(7). This amendment clarifies that to qualify as gasoline for purposes of this regulation, a gasoline/alcohol blend must contain more than 50 percent gasoline.

Amend subsection (c)(1)(A)(i). This section as amended incorporates the American Society of Testing and Materials (ASTM) D 5500-94 test method for evaluating the ability of an additive to prevent gasoline deposits on intake valves. ASTM D 5500-94 is a replacement for the ARB test method currently referenced in the regulation. The new test method includes more detailed instructions for conducting the test and better quality assurance/quality control procedures.

This section as amended clarifies that the unlimited mileage standard of 100 milligrams is measured as a average over all of the intake valves.

Amend subsection (c)(1)(A)(ii). This section as amended incorporates the ASTM D 5598-94 test method for evaluating the ability of an additive to prevent gasoline deposits on port fuel injectors. ASTM D 5500-94 is a replacement for the ARB test method currently referenced in the regulation. The new test method includes more detailed instructions for conducting the test and better quality assurance/quality control procedures.

Amend subsection (c)(1)(A)(iii). The amendment to this section incorporates a revision of the ARB test method for evaluating the ability of an additive to clean up port fuel injector deposits.

The test method has been modified to be consistent with ASTM D 5598-94. The revised test method includes more detailed instructions for conducting the test and better quality assurance/quality control procedures.

Amend subsection (c)(2)(B). This amendment specifies that the minimum additive concentration that must be reported in the certification application in terms of gallons of additive per thousand gallons of gasoline.

Amend subsection (c)(2)(D) and add subsection (c)(2)(E). These amendments establish new criteria for the fuel used for certification testing ("certification test fuel"). The amendments provide that the certification test fuel must be produced from typical refinery blend stocks, and must be representative of both typical commercial gasoline and the gasoline formulation for which certification has been requested. The amendments provide that the certification test fuel is representative of the gasoline formulation if its aromatic hydrocarbon, olefin, sulfur and oxygen content and T90 distillation temperature are within 80 percent of the gasoline formula's maximum values for these properties.

Amend subsection (d). Subsection (d) as amended clarifies and modifies the recordkeeping requirements. The amendments clarify that a person who has received certification for a gasoline formulation must maintain daily records for each business day containing specified information, including information about the actual additive usage rate. The existing regulation requires monthly compilation of records, but the amendments shorten the time for completing the compilation from 30 to 15 days after the end of the month.

The amendments provide that when enforcement of the regulations is based on these records, the monthly average additive dose rate must comply with the minimum dosage rate specified in the gasoline certification and that the daily average dose must be at least 95 percent of the minimum dosage rate.

APPENDIX D
REVISED ARB CLEAN UP VEHICLE TEST PROCEDURE FOR PORT FUEL INJECTORS

Test Method for Evaluating Port Fuel Injector (PFI)

Deposits in Vehicle Engines

NOTE: This document is printed in a style to show both the proposed amendments to the existing Air Resources Board (ARB) test procedure dated March 1, 1991, and ARB's revisions to ASTM D 5598-94, which is incorporated by reference in the ARB test procedure. Proposed amendments to the ARB test procedure appear in *italics* to indicate additions to and ~~strikeout~~ to indicate deletions from the existing test procedure. ARB's revisions to ASTM D 5598-94 are shown in underline to denote additions to and [~~bracketed strikeout~~] to denote deletions from the ASTM test method.

STATE OF CALIFORNIA
AIR RESOURCES BOARD
STATIONARY SOURCE DIVISION

~~March 1, 1991~~ *[insert date of adoption]*

TEST METHOD FOR EVALUATING PORT FUEL INJECTOR (PFI) DEPOSITS IN VEHICLE ENGINES

A. PURPOSE

The purpose of this test procedure is to evaluate the port fuel injector keep-clean characteristics of gasoline formulations and the effectiveness of gasoline formulations in cleaning up injector deposits. This test procedure closely follows ~~the CRC test procedure described in CRC Report No. 565, "A Program to Evaluate a Vehicle Test Method for Port Fuel Injector Deposit-Forming Tendencies of Unleaded Base Gasolines", February 1989~~ *ASTM D 5598, with some modifications to test for clean-up ability.*

B. TEST PROCEDURE OUTLINE

1. Keep-Clean Procedure

The keep-clean test procedure shall start with a vehicle/engine equipped with new fuel injectors. To avoid variability due to engine break-in effects, testing should begin only after 4,000 miles equivalent have accumulated. At the beginning of the test, the flow capacities of the injectors are measured. The *vehicle*/engine is operated on the applicant's additized gasoline fuel for the prescribed test cycle and the fuel injectors ~~are~~ *may be* flow-tested *not more than* every 1000 miles equivalent ~~to determine their flow capacities~~. After the *vehicle*/engine~~/vehicle~~ is operated for 10,000 miles equivalent on the prescribed test cycle, the fuel injectors are tested again to determine their flow capacities. *If the fuel injector No. 3 maximum skin temperature does not exceed 90° C (194° F) for more than 95% (685) of the hot soak cycles, then the test will be declared invalid unless a minimum of 685 total hot soak cycles with PFI No. 3 exceeding 90° C are met within an additional 2500 miles.*

2. Clean-Up Procedure

The clean-up test procedure shall start with a vehicle/engine equipped with new fuel injectors. To avoid variability due to engine break-in effects, testing should begin only

after 4,000 miles equivalent have accumulated. At the beginning of the test, the flow capacities of the injectors are measured. The vehicle/engine is operated for the prescribed test cycle on the ~~base~~ *dirty-up* fuel ~~(as described in section C.4) for 10,000 miles equivalent or for~~ as long as needed so that at least one of the injectors is at the 10% flow restriction level. ~~Fuel injectors are flow tested every 1000 miles equivalent. Then t~~ The vehicle/engine ~~shall~~ *must then* be operated on the applicant's additized gasoline formulation for ~~a maximum of an additional 10,000 miles equivalent and fuel injectors shall be tested to determine their flow capacities~~ *the prescribed test cycle up to 10,000 miles equivalent or until the fuel injectors all drop to less than a 5% flow restriction level. The fuel injectors may be flow-tested not more than every 1000 miles. After the test is completed, the fuel injectors are tested again to determine their flow capacities. If the fuel injector No. 3 maximum skin temperature does not exceed 90° C (194° F) for more than 95% of the hot soak cycles, then the test will be declared invalid.*

C. TEST PROGRAM

~~1. Test Vehicle/Engine~~

~~The test vehicle/engine used for this test program shall be a Chrysler vehicle equipped with a 2.2L., I-4, turbocharged engine.~~

~~2. Vehicle/Engine Preparation~~

~~The vehicle/engine shall be tuned to perform according to the manufacturer's specifications.~~

~~3. Test Cycle~~

~~The operating cycle for both keep-clean and clean-up test procedures shall consist of 15 minutes of operation at 55 mph road load followed by 45 minutes hot soak with the engine shut off.~~

~~The test cycle is repeated for 10,000 miles equivalent. Vehicle running conditions may be accomlished on a test track, road simulator or chassis dynamometer. It is important that the test vehicle be rapidly brought to 55 mph, as well as back to zero at the end. For open road operations, it is desirable to minimize the travel distance to reach the operating speed of 55 mph.~~

~~For hot soak, no special options are needed, (e.g., blankets, engine shrouds, etc). The intent is to run the vehicle in a realistic way "simulating" customer driving experiences.~~

NOTE: ALL TESTS, INCLUDING REPEAT RUNS, ARE TO START WITH NEW, FLOW-RATED INJECTORS.

4. Test Fuels

The base gasoline shall be a full boiling, commercial-types unleaded base gasoline with properties approximating those in Attachment A. Another base fuel may be substituted for the fuel prescribed in Attachment A after approval by the Executive Officer. The substitute fuel must be successful in causing enough deposits to plug at least one of the injectors to the 10% flow restriction level before 10,000 miles equivalent of vehicle/engine operation.

The gasoline formulation tested shall be typical of the product sold or intended to be sold in California.

Typical properties and analyses (from tests such as listed in Attachment A) for each fuel shall be provided when the fuel batches are made available. As a check on fuel uniformity, the following tests shall be run for each fuel at the beginning and at the end of the test program:

- ASTM - D381 (gum)
- ASTM - D525 (stability)
- R.V.P.
- ASTM distillation

5. Engine Oil

The same crankcase engine oil, an SAE 10W-30 viscosity grade of API SE or higher quality, shall be used throughout the test program. Prior to each test run, the engine shall be flushed with fresh oil following an oil filter change. Drain the oil, change filter, and put in a fresh charge of the same oil for the test.

6. Fuel Injectors

OEM part number pintle-style injectors with solid plastic cap ONLY, as manufactured by Bosch, are to be used.

D. MEASUREMENTS

1. Fuel Rail Pressure

The injector fuel rail pressure in the vehicle must be at the manufacturer's specified level during engine operation and remain at about the same level during the 45-minute shutdown period. A malfunctioning pressure regulator will allow the rail pressure to

~~decrease during the shutdown period, which can decrease PFI deposit formation rates. Fuel rail pressure shall be checked once per day during the operation period and within 10 minutes after shutdown.~~

~~2. Injector Flow-Rate Measurement~~

~~a. The laboratory flow apparatus shall control fuel pressure at about the same level as the fuel rail pressure of the vehicle/engine during operation.~~

~~b. A light hydrocarbon (isooctane, mineral spirit, or stoddard solvent) shall be used for flow-rate tests.~~

~~c. The injector shall be flowed statically (wide-open) for ten seconds +- one second. Longer time intervals may risk overheating the injector solenoid. The timing interval shall be reported to hundredths of a second. Bosch indicates injectors open fully at 8 volts DC without risk of overheating, which allows longer flow times to improve measurement accuracy.~~

~~d. A minimum of three repeat flow rate tests per injector are considered necessary. If necessary, additional tests must be run until repeat results have less than 1% variability (1% variability is reasonable expectation of new injectors). The average (to two decimal places) shall be reported as the flow rate for that injector measurement.~~

~~e. Injector flow-rates shall be measured as soon as possible, and in no case greater than 24 hours, after removal from the vehicle to avoid drying out and possible effects on deposit stability.~~

~~f. For clean injectors at the start of each test, run the Injector Leak Rate Test to check for leading, dribbling, etc. (See Attachment B). As injectors become fouled, the probability of pintle leakage increases. Deposit formation may cause an improper seal between pintle and injector opening, thus causing leakage. The upper production limit of leakage with air is 2cc per min. (at approx. 50 psi). Injectors leaking above this rate shall be rejected for the test. To avoid unnecessary rejection of new injectors due to dirt particles, the injectors shall be first flowed with liquid. This will serve to flush the critical internal areas before lead testing with air.~~

~~g. Rate injectors every 1000 miles.~~

~~h. For new injectors, flow rates within a test set for an engine shall fall within +- 2% of each other.~~

~~3. Temperature Measurement~~

~~The following temperature measurements shall be recorded:~~

~~a. Ambient at test site (maximum and minimum for every 24 hour time period).~~

~~b. Inlet air, coolant, oil and fuel tank (typical maximum for each day).~~

~~c. Bulk or individual-cylinder exhaust gas during operation.~~

~~4. Fuel Consumption~~

~~For each test, the fuel consumed per odometer miles traveled should be recorded with reasonable accuracy. Use of a standard gasoline dispensing pump is satisfactory. One average per test program is a representative measurement.~~

~~E. PRESENTATION OF DATA~~

~~The testing laboratory is required to provide the following in their final report:~~

~~1. Total number of soak cycles for the complete test and number of soaks per 1,000 miles equivalent.~~

~~2. Tabulation of raw flow rates for each injector by cylinder position as a function of miles or cycles.~~

~~3. Graphs of injector flow rates versus vehicle/engine miles equivalent, per fuel.~~

~~4. Graph typical exhaust gas temperature during stabilized road load operation for each cycle.~~

1. *Keep-Clean Procedure*

   The following procedure must be used: ASTM D 5598-94, Standard Test Method for Evaluating Unleaded Automotive Spark-Ignition Engine Fuel for Electronic Port Fuel Injector Fouling.

2. *Clean-Up Procedure*

   The following procedure must be used: ASTM D 5598-94, Standard Test Method for Evaluating Unleaded Automotive Spark-Ignition Engine Fuel for Electronic Port Fuel Injector Fouling, with the following modifications:

a. *Section 7. Reagents and Materials, add the following:*

7.7 Dirty-Up Fuel -- The dirty-up fuel must be a full boiling, unleaded gasoline that is capable of causing enough deposits to plug at least one of the injectors to the 10% flow restriction level before 10,000 miles of vehicle operation. For example, the dirty-up fuel may have the following properties:

Fuel Property	*Level*
Octane, (R+M)/2	*87 min.*
Existent gum, mg/dl	*3 min.*
Sulfur, ppm	*150 min.*
Hydrocarbon type, vol%	
Olefins	*20 min.*
Aromatics	*30 min.*
Reid vapor pressure, psi	*11.5 max.*
Distillation, °F	
50% evaporated	*170 min.*
90% evaporated	*374 max.*
Induction period, minutes	*240 min.*

b. *Section 7. Reagents and Materials, change the following:*

7.5 Test Fuel -- A test fuel shall be either a base fuel or a homogeneous blend of additives and base fuel. A single batch of base fuel shall be blended before the start of the test. The fuel may be stored in drums or tankage and shall be clearly labeled to prevent misfueling. During PFI testing, the test fuel shall be tested for the following properties using standard test methods: aromatics and olefins contents, full distillation range, gum, and sulfur. Quantities of fuel and additive blended and dispensed shall be measured and recorded. [~~Approximately 2300 L (600 gal) of fuel are required for this test method.~~]

c. *Section 9. Test Procedure, change the following:*

9.2 Mileage Accumulation -- The mileage accumulation is divided into two parts: the dirty-up phase and the clean-up phase. Mileage is first accumulated on the dirty-up fuel until at least one of the injectors is at the 10% flow restriction level. After completing the dirty-up phase, the fuel tank is drained and flushed as in 8.2.4. The fuel tank is then filled with the test fuel and mileage accumulation will continue up to a maximum of 10,000 miles on the test fuel or until all injectors measure less than 5% flow restriction. Mileage accumulation will be performed as follows:

The dynamometer, test track, road mileage accumulation cycle, or combination thereof, consists of a series of driving cycles and engine-off hot soak cycles. The test vehicle shall be started and accelerated to 88 kph (55 mph) within 30 s of start-up. The test vehicle shall be accelerated to 88 kph, driven for 15 min, or approximately 22 km (14 miles), and then allowed to coast, or vehicle may be braked, to a stop within 30 s. The engine is then turned off and the vehicle undergoes a 45-min hot soak cycle. The vehicle shall be allowed to soak for 45 min in calm air, with all fans turned off. These test cycles may be run 24 h per day or less. The vehicle shall repeat this cycle for 16,100 km (10,000 miles). The fuel injectors may be removed and flow tested, however, not more than every 1600 km (1000 miles) during the clean-up phase.

d. *Section 10. Determination of Test Results, change the following:*

10.5.1.1 Test Cycle Validation Criteria -- If the fuel injector No. 3 maximum skin tesmperature does not exceed 90° C (194° F) for more than 95% of the hot soak cycles ~~*[of a 16,100-km (10,000-mile) test length (or 685 of 725 hot soak cycles)]*~~ *then the test will be declared invalid. However, any hot soaks during the test for which PFI No. 3 skin temperature does not exceed 90° C, may be repeated until a minimum of* ~~*[685]*~~ *95% of the total hot soak cycles with PFI No. 3 exceeding 90° C are met* ~~*[within an additional 4000 km (2500 miles). Thus the maximum length for any fuel injector fouling test shall be 21,100 kilometers (12,500 miles) or a maximum of 910 hot soaks]*~~

e. *Section 11. Final Test Report, add the following:*

11.1.5 Fuel property test results.

~~ATTACHMENT A~~

~~BASE FUEL PROPERTIES~~

~~Fuel Properties~~	
~~Gravity, °API~~	~~59.9~~
~~Specific Gravity @ 15.6°C~~	~~0.74~~
~~Distillation, °C~~	
~~IBP~~	~~33~~
~~10%~~	~~48~~
~~50%~~	~~106~~
~~90%~~	~~188~~
~~EP~~	~~218~~
~~Total Olefins, % vol.~~	~~35~~
~~Induction Period, minutes~~	~~270~~
~~RVP (psi)~~	~~11.8~~
~~Gum, mg/100ml~~	
~~Unwashed~~	~~7.0~~
~~Washed~~	~~6.0~~
~~Sulfur, % wt.~~	~~0.08~~

ATTACHMENT B

Injector Leak Rate Test Procedure

1. Blow any residual fluids out of the injector with clean, dry shop air while holding the injector open.

2. While the injector is still open, rinse with acetone and blow dry. Repeat.

3. Mount injector in rig and attach hypodermic needle assemblies in the diagram.

4. Place a 5 ml, water-filled syringe over the hypodermic needle tip for gas collection and volumetric measurements at 0.25, 1.0 and 5.0 ml. Immerse in bath as illustrated.

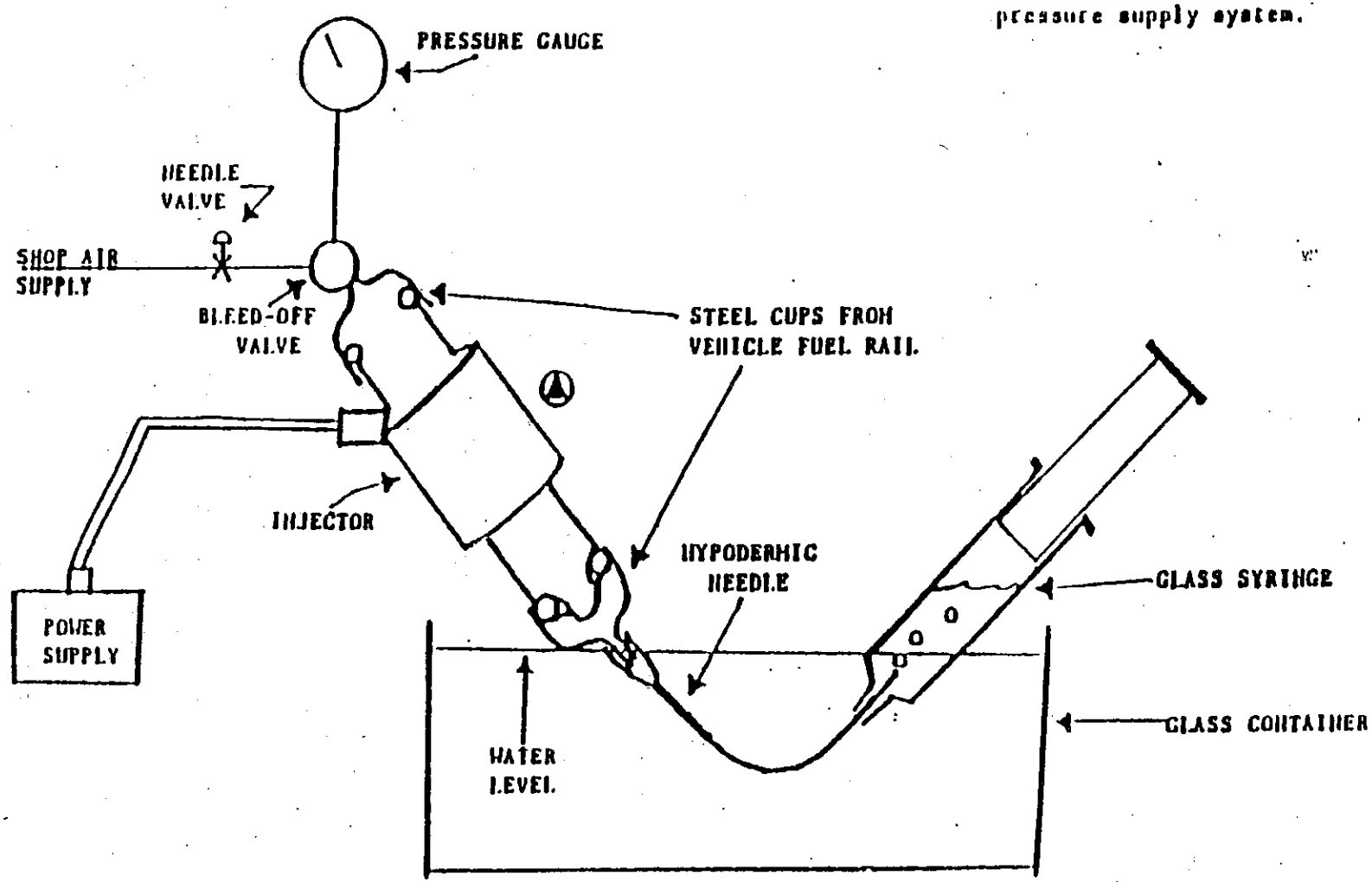
5. Apply 50 PSI air pressure and collect the air bubbles at the hypodermic needle tip using the 5 ml syringe measured over a suitable time period.

6. Record results as ml's of air collected per one minute time period.

7. Repeat until 3 consecutive results in the same range are obtained.

INJECTOR LEAK TEST APPARATUS

HOT SHOWN: A clamping device which holds the injector body into the air pressure supply system.



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