TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER TECHNICAL STATUS AND PROPOSED REVISIONS TO MALFUNCTION AND DIAGNOSTIC SYSTEM REQUIREMENTS FOR 1994 AND SUBSEQUENT MODEL-YEAR PASSENGER CARS, LIGHT-DUTY TRUCKS, AND MEDIUM DUTY VEHICLES AND ENGINES (OBD II)

The Air Resources Board (the "Board" or "ARB") will conduct a public hearing at the time and place noted below to review technical status and implementation of California's OBD II requirements. The Board will consider amendments to the applicable regulations to address manufacturers' implementation concerns, to clarify the regulations where necessary, and to improve the effectiveness of the regulations for future model year vehicles.

DATE: December 12, 1996

TIME: 9:30 a.m.

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

This item will be considered at a two-day meeting of the Board, which will commence at 9:30 a.m., December 12, 1996, and may continue at 8:30 a.m., December 13, 1996. This item may not be considered until December 13, 1996. Please consult the agenda for the meeting, which will be available at least 10 days before December 12, 1996, to determine the day on which this item will be considered.

INFORMATIVE DIGEST OF PROPOSED ACTION/PLAIN ENGLISH POLICY STATEMENT OVERVIEW

Sections Affected: Proposed amendments to the general OBD II requirements as set forth in Title 13, California Code of Regulations (CCR) section 1968.1.[1] This section was originally adopted by the Board on September 14, 1989. Section 1968.1 requires manufacturers to implement on-board diagnostic systems on new motor vehicles. Implementation of the regulation began with the 1994 model year, and the regulation requires that essentially all new 1996 and later model year passenger cars, light-duty trucks, and medium-duty vehicles and engines be equipped with OBD II systems. The section specifically requires monitoring of engine misfire, catalysts, oxygen sensors, evaporative systems, exhaust gas recirculation, secondary air systems, fuel systems, and all

[1]The requirements are referenced in other sections of Title 13, CCR, including sections 2030-2031 and documents incorporated therein, the substance of which could be affected by the technical review and subsequent proposed amendment to the regulations.

electronic powertrain components that can affect emissions when malfunctioning. The regulation also requires OBD II systems to provide specific diagnostic information in a standardized format through a standardized serial data link on-board the vehicles.

In 1989, when initially adopting section 1968.1, the Board directed the staff to provide an update within two years on the progress of manufacturers in designing and implementing monitoring systems to meet the OBD II requirements. It further directed the staff to propose any modifications to the regulation that were deemed necessary based on industry progress to date.

On September 12, 1991, the staff reported to the Board and proposed a number of modifications to address manufacturers' implementation concerns, to clarify misunderstood regulatory language, and to enhance the effectiveness of the requirements in some areas. The Board considered further amendments to the OBD II regulation on July 9, 1993, in response to a Petition from Ford Motor Company. At the Hearing, the Board adopted amendments to provide limited compliance relief to manufacturers that attempt in good faith to meet the requirements in full but are unable to certify a fully compliant system.

Another update on manufacturers' progress towards meeting the OBD II requirements was held on December 12, 1994. Again, the Board adopted modifications to the regulation to address manufacturers' implementation concerns, strengthen specific monitoring requirements, and to clarify regulatory language. Continuing with its practice, the Board again directed staff to follow manufacturers' progress and to report back in two years time with its findings and any necessary modifications to the regulation.

During the past two years, the staff has closely monitored vehicle manufacturers' progress with OBD II compliance. With the requirements of section 1968.1 becoming generally applicable to essentially all vehicle models with the 1996 model year, manufacturers and ARB staff have gained considerable experience with OBD II systems. To date, OBD II systems have, in the great majority of instances, been working reliably in-use to detect emission-related malfunctions. However, manufacturers have identified areas in which minor refinements to section 1968.1 would provide for improved monitoring system performance.

In response to these issues, ARB will be considering the following amendments, among others, to section 1968.1. Staff is proposing to amend subsection (b)(3.0) to provide vehicle manufacturers with some additional leadtime to meet the general misfire detection requirements. Staff is also proposing that the misfire detection requirements be amended to provide greater latitude to vehicle manufacturers with respect to the criteria for determining illumination of the Malfunction Indicator Light (MIL) so that continuing misfire events can more accurately be distinguished from temporary, non-repeatable misfire conditions. Regarding catalyst monitoring, staff is proposing to amend subsection (b)(1.0) to address manufacturers' concerns arising from evolving catalyst and monitoring technologies. Staff is also proposing amendments to subsection (b)(4.0) to address issues raised by a few vehicle manufacturers regarding the evaporative system monitoring requirements. Specifically, the manufacturers contend that the requirements should be amended

in light of new data on the emission impact of evaporative system leaks, and feasibility concerns associated with certain fuel tank designs. In response to implementation concerns raised regarding the tamper resistance requirements for electronically reprogrammable on-board computer designs, staff is proposing that those requirements be deleted from section 1968.1(d).

The industry has also expressed concerns regarding OBD II compliance on alternate fueled vehicles as required by section 1968.1(m)(5.1) and the provisions for certification of alternate fuel retrofit systems for OBD II-equipped vehicles as set forth at Title 13, CCR, sections 2030-2031. The staff has not proposed amending the above sections to address these particular concerns. Similarly, several vehicle manufacturers have requested that the provisions providing for deficiency allowances (section 1968.1(m)(6.0), et seq.) be broadened. As with the alternate fueled vehicle requirements, staff is not proposing any specific amendments to this section. However, the Board may consider further action on both subjects based on testimony received prior to and during the hearing.

Apart from addressing manufacturer issues regarding the existing requirements, the staff is also proposing new or modified requirements to further increase the effectiveness of OBD II systems in detecting emission-related malfunctions. Specifically, new monitoring requirements are proposed to address emissions resulting from Positive Crankcase Ventilation (PCV) system malfunctions (section 1968.1(b)(10)), and also malfunctioning engine coolant thermostats (section 1968.1(b)(11.0)). In addition, the staff is proposing revisions to the diagnostic and service information requirements contained in sections 1968.1(k) and (l). These amendments would update industry documents incorporated by reference, provide for access to more comprehensive on-board data, and enable better access to vehicle service information, including a requirement for service information to be made available in a standardized electronic format. Finally, staff is proposing several minor amendments and clarifications to existing requirements of section 1968.1.

Comparison With Similar Federal Requirements:

In February 1993, the U.S. EPA promulgated final on-board diagnostic requirements for federally certified vehicles. (40 CFR Part 86, sections 86.094-2, 86.094-17, 86.094-18(a), 86.094-21(h), 86.094-259(d), 86.094-30(f), 86.094-35(I), 86.095-30(f), 86.095-35(I); see 58 Fed.Reg 9468-9488 (February 19, 1993).) The requirements were last modified with a final rule published on August 30, 1996. (61 Fed.Reg 45898-45903) The federal OBD requirements are comparable in concept and purpose with California's OBD II regulation; however, differences exist with respect to the scope and stringency of both sets of requirements.

Under the OBD II requirements, manufacturers must implement monitoring strategies for essentially all emission control systems and emission-related components, as mentioned in the above summary. Generally, the OBD II regulation requires that components be monitored to indicate malfunctions when component deterioration or failure causes emissions to exceed 1.5 times the vehicle's emission standards. However, the regulation also requires the functional monitoring of those components for which failure would not cause emissions to exceed the 1.5

time the standards threshold. The federal requirements, in contrast, specifically call for the monitoring of only the catalyst, the presence of engine misfire, and oxygen sensors. Other systems or components need only be monitored if by malfunctioning, vehicle emissions would exceed specified tailpipe or evaporative emission thresholds.

Assuming that a component or system is monitored under the federal requirements, vehicles certified to California standards identical to the federal Tier 1 standards (0.25 grams per mile (g/mi) hydrocarbons (HC), 3.4 g/mi carbon monoxide (CO), 0.4 g/mi oxides of nitrogen (NOX)), vehicle emission levels should not be significantly different at the time a malfunction is indicated using either a California certified or federally certified OBD monitoring system. However, the OBD II requirements would provide for additional in-use emission reductions from the identification of malfunctions with respect to components and systems that are not monitored under the federal requirements, but are functionally checked under OBD II. Further, as vehicle emission standards are significantly reduced under the California Low-Emission Vehicle (LEV) program (Title 13, CCR, sections 1960.1), the fact that the OBD II regulation requires malfunction determinations relative to the lower standards will result in California's OBD II requirements being more stringent than those adopted by the U.S. EPA. The more stringent OBD II regulation is authorized pursuant to the Legislature's directive in Health and Safety Code section 43018, which requires that the ARB endeavor to achieve the maximum degree of emission reduction possible from vehicular sources in order to accomplish the attainment of the state standards at the earliest practicable date. Specifically, section 43018 requires that the Board adopt, among other things, regulations that would result in reductions in motor vehicle exhaust and evaporative emissions, and reductions in motor vehicle in-use emissions through improvements in emission system durability and performance. The OBD II requirements have been adopted in an effort to meet this directive.

In an effort to promote consistency between the California and federal OBD requirements and to minimize unnecessary duplication or conflicts between the two regulations, the Board, in the amendments approved for adoption in 1991 (and formally adopted in July 1992), modified the OBD II catalyst monitoring requirements to be almost identical to the federal requirements for vehicles meeting the Tier I federal standards. Further, the 1992 amendments to the OBD II regulation provide that after the 1998 model year, California will accept compliance with the federal OBD requirements for vehicles not certifying to the California LEV standards but rather to the California equivalent of the Tier 1 federal standards.

On October 3, 1996, the U.S. EPA formally granted California’s request for a waiver the OBD II regulation, as last amended in December 1994.[2]

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[2] *California State Motor Vehicle Pollution Control Standards; Waiver of Federal Preemption; Decision,* dated October 3, 1996, 61 Fed.Reg. ___ (Not as yet published in the Federal Registrar).

Documents Incorporated by Reference:

International Standards Organization (ISO) 9141-2, “Road vehicles - Diagnostic Systems - CARB Requirements for Interchange of Digital Information,” February, 1994

ISO 14230-4, “Road vehicles - Diagnostic systems - KWP 2000 requirements for Emission-related systems,” April, 1996.

Society of Automotive Engineers (SAE) Recommended Practice J1850, "Class B Data Communication Network Interface," July, 1995.

SAE Recommended Practice J1930, "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms," September, 1995.

SAE Recommended Practice J1962, "Diagnostic Connector," January, 1995.

SAE Recommended Practice J1978, "OBD II Scan Tool," June, 1994.

SAE Recommended Practice J1979, "E/E Diagnostic Test Modes," July, 1996.

SAE Draft Technical Report J2008, “Recommended Organization of Service Information,” November, 1995.

SAE Recommended Practice J2012, "Recommended Format and Messages for Diagnostic Trouble Codes," October, 1994.

Speed Versus Time Data for California’s Unified Driving Cycle, December 12, 1996.

AVAILABILITY OF DOCUMENTS AND CONTACT PERSON

ARB staff has prepared a Staff Report: Initial Statement of Reasons for the proposed actions which includes a summary of the environmental impacts of the proposal. Copies of the Staff Report and the full text of the proposed regulatory language may be obtained from the Board's Public Information Office, 2020 L Street, Sacramento, CA 95814, (916) 322-2990.

ARB staff has compiled a record which includes all information upon which the proposal is based. This material is available for inspection upon request to the contact person identified immediately below.

ARB has determined that it is not feasible to draft the regulation in plain English due to the technical nature of the regulation. The Staff Report, however, presents a summary of the regulation in plain English.

Further inquiries regarding this matter should be directed to Allen Lyons, Manager, Advanced Engineering Section, Mobile Source Control Division, at (818) 575-6833, P.O. Box 8001, El Monte, CA 91734-2301.

COSTS TO PUBLIC AGENCIES AND TO BUSINESSES AND PERSONS AFFECTED

The determinations of the Board's Executive Officer concerning the costs or savings necessarily incurred in reasonable compliance with the proposed regulations are presented below.

The Executive Officer has determined that the proposed regulatory action will not create costs or savings, as defined in Government Code section 11346.5(a)(6), to any state agency or in federal funding to the state, costs or mandate to any local agency or school district whether or not reimbursable by the state pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code, or other nondiscretionary savings to local agencies.

In developing the regulatory proposal, ARB staff evaluated potential economic impacts on private persons and businesses. Since the proposed amendments are, for the most part, intended to facilitate compliance with the OBD II requirements, the Executive Officer has also determined that there will be no, or an insignificant, potential cost impact, as defined in Government Code section 11346.5(a)(9), on private persons or businesses directly affected resulting from the proposed action.

The Executive Officer has further determined, pursuant to Government Code section 11346.5(a)(8), that adoption of the proposed regulatory actions will not have a significant adverse economic impact on businesses, including the ability of California businesses to compete with businesses in other states. A more detailed assessment of the economic impacts of the proposed regulatory actions can be found in the Staff Report.

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action should overall have a minor or positive impact on the creation or elimination of jobs within the State of California, the creation of new businesses or elimination of existing businesses within California, and on the expansion of businesses currently doing business within California. An assessment of the economic impacts of the proposed regulatory action can be found in the Staff Report.

Pursuant to Government Code section 11346.5(a)(3)(B), the Executive Officer has determined that the proposed amendments may affect small businesses.

Before taking final action on the proposed regulatory action, the Board must determine that no alternative considered by the agency would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.

SUBMITTAL OF COMMENTS

The public may present comments relating to this matter orally or in writing. To be considered by the Board, written submissions must be addressed to and received by the Board Secretary, Air Resources Board, P. O. Box 2815, Sacramento, CA 95812, no later than 12:00 noon, December 11, 1996, or received by the Board Secretary at the hearing.

The Board requests but does not require that 20 copies of any written statement be submitted and that all written statements be filed at least 10 days prior to the hearing. The Board encourages members of the public to bring to the attention of staff in advance of the hearing any suggestions for modification of the proposed regulatory action.

STATUTORY AUTHORITY AND HEARING PROCEDURES

This regulatory action is proposed under that authority granted in sections 39515, 39600, 39601, 43006, 43013, 43018, 43101, 43104, and 44036.2 of the Health and Safety Code, and sections 27156 and 38395 of the Vehicle Code. This action is proposed to implement, interpret and make specific sections 39002, 39003, 39667, 43000, 43004, 43006, 43008.6, 43013, 43018, 43100, 43101, 43101.5, 43102, 43104, 43105, 43106, 43204, and 44036.2 of the Health and Safety Code, and sections 27156, 38391, and 38395 of the Vehicle Code.

The public hearing will be conducted in accordance with the California Administrative Procedure Act, Title 2, Division 3, Part 1, Chapter 3.5 (commencing with section 11340) of the Government Code.

Following the public hearing, the Board may adopt the regulatory language as originally proposed, or with nonsubstantial or grammatical modifications. The Board may also adopt the proposed regulatory language with other modifications if the text as modified is sufficiently related to the originally proposed text that the public was adequately placed on notice that the regulatory language as modified could result from the proposed regulatory action; in such event the full regulatory text, with the modifications clearly indicated, will be made available to the public, for written comment, at least 15 days before it is adopted. The public may request a copy of the modified regulatory text from the Board's Public Information Office, 2020 L Street, Sacramento, CA 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

Michael P. Kenny
Executive Officer

Date:

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR RULEMAKING

Technical Status and Proposed Revisions to Malfunction and Diagnostic System Requirements for 1994 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II)

Date of Release: October 25, 1996
Scheduled for Consideration: December 12, 1996
Agenda Item No.: [___-__-___]

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State of California
AIR RESOURCES BOARD

Staff Report: Initial Statement of Reasons for Proposed Rulemaking[1]

PUBLIC HEARING TO CONSIDER TECHNICAL STATUS AND PROPOSED REVISIONS TO MALFUNCTION AND DIAGNOSTIC SYSTEM REQUIREMENTS FOR 1994 AND SUBSEQUENT MODEL-YEAR PASSENGER CARS, LIGHT-DUTY TRUCKS, AND MEDIUM-DUTY VEHICLES AND ENGINES (OBD II)

Date of Release: October , 1996
Scheduled for Consideration: December 12, 1996
Agenda Item No.: [___-__-___]

I. INTRODUCTION

The Air Resources Board (ARB or Board) originally adopted its second generation on-board diagnostic regulation (commonly referred to as OBD II), Section 1968.1, Title 13, California Code of Regulations (CCR), on September 14, 1989. The section contains malfunction and diagnostic system requirements for new passenger cars, light-duty trucks, and medium-duty vehicles and engines. These systems are for the monitoring of vehicle emission-control and emission-related components and systems. Manufacturers began phasing-in OBD II systems with the 1994 model year. The 1996 model year marked the first year for implementation on all vehicles subject to the regulation, with the exception of some diesel applications that will begin in 1997.

Since adoption of the regulation, the Board has directed staff to follow manufacturers' progress in developing OBD II system technology to meet the requirements, and to report back with updates and proposed modifications to the requirements if necessary. The last such review was conducted on December 8, 1994. At that hearing, the staff reported that manufacturers had generally been able to develop systems meeting the requirements of the regulation; however, several modifications to the regulation were proposed to address remaining concerns, and to ensure that the monitoring requirements remained consistent with the latest technological developments.

The staff has carefully followed manufacturers' efforts and experiences in implementing OBD II systems across their product lines with the 1996 model year. The staff has also followed

[1]To satisfy the requirements of Government Code Section 11343.2 that requires a non-controlling, "plain-english" summary of the regulations be made available to the public, see Appendix A.

manufacturers' progress in developing enhanced monitoring strategies required by the regulation between the 1997 and 2002 model years. Manufacturers have generally been successful in meeting the requirements for the 1996 model year, and most are nearly finished certifying 1997 model year vehicles. However, with the experience gained to date, manufacturers have brought suggestions to the ARB for some regulatory modifications to provide for more efficient compliance with the intent of the regulation. Further, concerns have been expressed regarding some of the enhanced monitoring requirements. Industry has commented that some specific requirements are burdensome relative to the emission benefits offered, or that cost and/or resources needed to implement monitoring strategies compliant with the current requirements are too high. The staff is proposing modifications to the regulation to address these concerns without jeopardizing the overall effectiveness of the regulation in reducing in-use emissions from motor vehicles. The proposed amendments to the regulation are attached as Appendix B.

In addition to addressing the implementation issues identified by the industry, the staff is proposing two new monitoring requirements regarding detection of emission malfunctions of positive crankcase ventilation systems and engine coolant thermostats. The staff is also proposing amendments that would provide for better access to vehicle service information to facilitate proper repair of OBD II-identified malfunctions.

II. SUMMARY OF BOARD ITEM

The following is an abbreviated summary of the Board item including the current status of the OBD II program, the amendments proposed by staff, and the associated environmental and cost impacts.

Implementation Status

Early feedback on OBD II implementation from the manufacturers and the service industry indicates that the systems are working properly. Even though most OBD II-equipped vehicles are only one to two years old, several manufacturers have already experienced some malfunction indications. In general, these instances have been the result of actual malfunctions (due to out of specification components, factory mis-builds, sensor disconnections, mis-routed hoses, broken sensors, etc.) that previously may have gone undetected for several years or perhaps indefinitely. Thus, despite the apparent complexity of the OBD II system, field experience suggests it is working as intended by correctly alerting the consumer when a malfunction is present.

Proposed Amendments

The regulation currently requires manufacturers to phase-in enhanced catalyst monitoring in the 1998 through 2000 model years. The enhanced requirements include identifying a catalyst malfunction when tailpipe emission levels exceed 1.5 times the hydrocarbon (HC) standard. Manufacturers have expressed concern about reliably meeting the yearly phase-in percentages. The level of variability in catalyst monitoring results and the associated difficulty in ensuring that all vehicles identify a malfunction before 1.5 times the HC standard given existing manufacturing

tolerances and vehicle-to-vehicle variability have been cited as issues. To address these concerns, staff proposes to extend the phase-in through the 2002 model year to provide manufacturers with additional leadtime to comply with the requirements in the most cost effective manner. Additionally, staff is proposing other amendments to improve the reliability of the catalyst monitoring system.

Staff is also proposing changes to the misfire monitoring requirements to ensure the system in not overly sensitive. The proposed changes would allow the manufacturer additional monitoring time to verify that a misfire problem is present and repeatable before alerting the operator to the presence of a malfunction. Additionally, the changes allow for a "period of stability" in order to obtain field experience with present systems by extending the phase-in requirements for enhanced misfire monitoring by two years, resulting in full implementation by the 2002 model year. Lastly, the regulation allows for more flexibility in determining compliance on engines with more than eight cylinders.

The proposed amendments also include two new monitoring requirements. The staff has determined that certain positive crankcase ventilation (PCV) system malfunctions contribute significantly to excess in-use emissions. To address this problem, the staff has proposed an amendment to require manufacturers to implement appropriate monitoring strategies beginning with the 2002 model year. The requirements target only those PCV system failures determined by the staff to significantly affect emissions, and provisions are included to minimize any impact on vehicle hardware.

To address excess in-use emissions resulting from deteriorated or malfunctioning engine coolant thermostats, staff is proposing an amendment to require monitoring of this component. The manufacturers would be required to detect thermostat failures preventing the coolant temperature from reaching the normal stabilized value necessary for optimum fuel system performance and operation of other OBD II monitoring strategies. Manufacturers would be required to begin phasing-in monitoring strategies to meet this requirement beginning with the 2000 model year, with full implementation by the 2002 model year.

Regarding service information, staff is proposing several changes to make emission-related diagnostic and repair procedures easier for independent repair facilities to obtain. These amendments include a standardized format for organization of service information (which could allow substantially faster access via a commonized computer program for most vehicle models) as well as same day availability of service bulletins. Further, requirements for access to software calibration identification information and an off-board software integrity verification are proposed to facilitate incorporation into a future Inspection and Maintenance (I/M) program.

Other Issues

Additionally, while the staff is proposing several amendments to address manufacturers' concerns, staff anticipates that the manufacturers will be asking the Board directly for relief in two additional areas. The current regulation includes deficiency provisions that allow a manufacturer

to certify a vehicle as OBD II compliant even if the vehicle falls short of satisfying all of the requirements. When the Board originally adopted the deficiency provision, it was intended as an interim policy to account for last minute problems or other unforeseen circumstances. Currently, these provisions expire with the 2000 model year and do not allow for any deficiencies on 2001 and later model year vehicles. The manufacturers have requested that additional deficiencies be allowed without penalty through the 2000 model year and that the current deficiency provision be extended indefinitely. The staff, however, seeks to have fully compliant systems available at the earliest possible time and believes that the need for deficiencies will likely be mitigated by many of the proposed amendments. Thus, the staff did not recommend that the deficiency policy be extended beyond the 2000 model year.

Likewise, the staff has not proposed any revisions to the current requirements for alternate fuel vehicles to be fully compliant with OBD II in the 1999 model year. However, manufacturers have requested an extension of the current relief for alternate fuel vehicles to extend beyond the 1998 model year. The relief allows manufacturers to omit certain monitors where the effects due to operation on the alternate fuel may not be fully understood. While the staff does not want to hinder the development of these typically lower emission vehicles, it believes that all vehicles, including alternate fuel vehicles, should come into compliance with the OBD II requirements as soon as possible to achieve the lowest possible in-use emissions. As such, staff has not proposed additional leadtime for alternate fuel vehicle compliance with OBD II.

Impact on the Environment and the State Implementation Plan

The proposed amendments are expected to cumulatively result in an overall reduction of in-use emissions from vehicles. Although some of the amendments proposed could result in slightly increased in-use emissions when evaluated individually, the staff expects any such increases to be compensated by other monitoring system improvements, particularly the addition of positive crankcase ventilation system monitoring and thermostat monitoring. Maintaining or enhancing emission benefits is imperative because OBD II is an important element of the baseline calculation used in the State Implementation Plan (SIP). In the original 1989 staff report supporting the adoption of the OBD II regulation, staff quantified the emission benefits expected from OBD II to be 125 tons per day of hydrocarbon (HC) and oxides of nitrogen (NO_X). As such, staff has considered the proposed amendments carefully to ensure that there will be no overall loss of emission benefit in the program.

Impact on Costs

Regarding costs, staff does not expect that the potential action will result in any adverse economic impacts. Cost per vehicle should not be affected by the proposed amendments as they would generally restructure and clarify currently adopted OBD II requirements. Further, neither the proposed amendments nor the new requirements necessitate additional vehicle hardware. Lastly, for several of the enhanced requirements, the proposed amendments would lessen the overall cost impact of the current regulation by providing additional leadtime to the manufacturer, thus allowing implementation in the most cost effective manner.

III. BACKGROUND INFORMATION

What Problem is Addressed by OBD Systems?

New vehicles are being designed to meet more and more stringent exhaust and evaporative emission standards. However, when emission-related malfunctions occur, emissions can increase well beyond the standards the vehicle is intended to meet. A recent report estimates that approximately 40-50 percent of the total hydrocarbon and carbon monoxide emissions from fuel injected vehicles are emitted as a result of emission-related malfunctions.[2] As fleet average emissions are reduced under the Low Emission Vehicle requirements, emissions from malfunctions of emission control systems are likely to be proportionately much greater. Such malfunctions commonly occur as vehicles age, and vehicles tend to be driven more and last longer in California than in other parts of the country. As of 1995, 44% of all light-duty passenger cars on the road in California had accumulated more than 100,000 miles, 27% had more than 125,000 miles, and 17% had more than 150,000 miles. Additionally, in 1995, 10% of all light-duty passenger car miles traveled were by vehicles with more than 150,000 miles on the odometer.[3]

How Do OBD Systems Help to Solve the Problem?

OBD systems are designed into the vehicle's on-board computer to detect emission malfunctions as they occur. With a couple of exceptions, no additional components are required to perform the monitoring; rather, the powertrain control computer is designed to better evaluate the electronic component signals that are already available, thereby minimizing any added complexity. By alerting the vehicle operator to the presence of a malfunction, the time between the occurrence of the problem and necessary repairs is shortened. As a result, fewer emissions from vehicles occur over their lifetime. Besides alerting the vehicle operator of the problem by means of a malfunction indicator light (MIL) on the instrument panel, OBD II systems store important information that will identify the malfunctioning component or system and describe the nature of the malfunction and the driving conditions under which it was detected. These features help to ensure that problems are properly fixed as soon as possible after they occur.

What Does the OBD II Regulation Require?

For most emission control systems and components, the OBD II regulation requires malfunctions to be identified before any problem becomes serious enough to cause vehicle emissions to exceed the standards by more than 50 percent (i.e., when emissions exceed 1.5 times the standards). This requires manufacturers to correlate component and system performance with emission levels to determine when deterioration of the system or component will cause emissions to exceed 1.5 times the standard. When this occurs, the regulation requires the diagnostic system

[2] Analysis of Causes of Failure in High Emitting Cars, American Petroleum Institute, Publication Number 4637, February 1996.

[3] California's Motor Vehicle Emission Inventory (MVEI 7G), Version 1.0, September 27, 1996

to alert the operator to the problem by illuminating the MIL.

For the components and systems in which the 1.5 times the standard criterion is not sufficient or cannot easily be applied, the regulation establishes different malfunction criteria to identify emission problems. For example, in addition to having to detect engine misfire before the standards are exceeded by a factor of 1.5, the regulation requires that misfire levels be detected that will cause catalyst damage due to overheating.

Further, the 1.5 times the emission standard criterion is currently not applicable to evaporative system malfunctions. The regulation requires (through the 1999 model year) the OBD II system to detect leaks equivalent or greater in magnitude to a 0.040 inch diameter hole. Beginning with the 2000 model year, manufacturers will be required to phase-in monitoring strategies for detecting 0.020 inch leaks. Data from current evaporative system designs show that leaks approaching a 0.020 inch hole begin to rapidly generate excess evaporative emissions (up to 15 times the standard). Therefore, it is important to detect leaks as small as technology allows.

The 1.5 times the emission standard criterion is also not applicable to the monitoring of electronic powertrain components that can cause emissions to increase when malfunctioning, but generally to less than 1.5 times the standard. The regulation requires such components to be monitored for proper function. For example, for components that provide input to the on-board computer, the OBD II system monitors for out-of-range values (generally open or short circuit malfunctions) and input values that are not reasonable based on other information available to the computer (e.g., sensor readings that are stuck at a particular value, or biased significantly from the correct value). For output components that receive commands from the on-board computer, the OBD II system monitors for proper function in response to these commands (e.g., the system verifies that a valve actually opens and closes when commanded to do so). Monitoring of all such components is important because, while a single malfunction of one of these components may not cause an exceedance of the emission standards, multiple failures could synergistically cause high in-use emissions.[4] Further, the OBD II system relies on many of these components to perform monitoring of the more critical emission control devices. Therefore, a malfunction of one of these components, if undetected, could lead to incorrect diagnosis of emission malfunctions, or even prevent the OBD II system from checking for malfunctions.

In addition to malfunction detection requirements, the OBD II regulation contains requirements for providing diagnostic repair information to aid service technicians in isolating and fixing detected malfunctions. For each malfunction detected, a specific fault code is stored identifying the area and nature of the malfunction (e.g., a mass air flow sensor with an inappropriately high reading). In addition, the OBD II system provides technicians with access to current engine operating conditions such as engine speed, engine load, coolant temperature, fuel system status, etc. The OBD II system even stores the operating conditions that exist at the time

[4]Due to the overwhelming time and cost resources that would be required to evaluate the additive emission impacts from multiple components that are partially deteriorated, the regulation only requires detection of any single component failure which can affect emissions.

a malfunction is detected. All of this information helps the technician to accurately diagnose and repair problems.

OBD II and Inspection and Maintenance

Current Inspection and Maintenance (I/M) programs rely on tailpipe testing to find vehicles with emission malfunctions. When a high emitting vehicle is identified, a repair technician must diagnose the cause of the emission failure and then perform necessary repairs. The effectiveness of the repairs in bringing the vehicle back into compliance can be known with certainty only when the vehicle again undergoes a tailpipe test. OBD II systems offer the potential to greatly simplify and improve this process.

Instead of measuring tailpipe emissions directly, the OBD II system looks for emission problems by monitoring virtually every component and system that can cause emissions to increase significantly. Due to the comprehensive nature of OBD II, the staff believes that the information it generates will eventually be used in place of tailpipe testing during I/M. Using OBD II, if an emission-related malfunction was detected, the vehicle operator would be immediately notified and information stored to assist in quick diagnosis and repair of the problem. If the MIL were not illuminated, nor any fault codes stored, there would be considerable assurance that the vehicle is not emitting excessively (i.e., virtually all the potential sources for an emission problem are operating without defect). OBD II monitoring includes emission-related components and systems that cannot be checked during an I/M test such as cold start emission reduction devices (e.g., electrically-heated catalysts, oxygen sensor heaters, or air injection systems)[5], or misfire and fuel system malfunctions that occur exclusively outside of the I/M driving conditions. Thus, with the use of the OBD II system, the smog check program could be reduced to verifying that the vehicle owner has serviced the vehicle for any malfunctions detected.

Further, as mentioned previously, OBD II malfunction criteria are tailored to the emission control equipment and calibration parameters for each individual vehicle and the emission standards that the vehicle is certified to meet. In contrast, tailpipe emission tests use "cut points" (the test limits above which vehicles are failed) that must take into account the various vehicle types and emission standards that pertain to a particular model year grouping to ensure minimal false errors of commission for all vehicles within the grouping. These cut points do not effectively identify out-of-compliance vehicles until emissions are potentially many times the allowable standard. This shortcoming is true especially for low emission vehicles.

OBD II Implementation Status

Several manufacturers have made presentations to ARB staff regarding the in-use

[5]State of California-Smog Check-Inspection Manual instructs technicians to make sure the vehicle engine is at normal operating temperature (i.e., warmed-up) before beginning the inspection. Thus, malfunctions that occur only on cold starts or only affect cold start emission controls are not likely to be detected during a I/M test. Unfortunately, the highest emissions also occur during cold starting and warm up.

performance of OBD II systems to date. Generally, OBD II systems have proven to be very effective in detecting emission-related problems in-use. Some manufacturers have acknowledged that OBD II systems have been a tremendous help in improving overall vehicle quality.[6] Since OBD II-equipped vehicles are still, at most, only one to two years old, most of the detected problems to date have been assembly and/or manufacturing problems. Problems that have been detected include, but are not limited to, misrouted wires and hoses, loose connectors, sensors broken upon installation, and components operating outside of design tolerances.

Regarding the reliability of OBD II systems, some false malfunction indication problems have been found by manufacturers. However, the frequency of such incidents is very low, and the problems have been generally addressed quickly by manufacturers through the issuance of a running change and/or field fix to minimize any impact on customer satisfaction. Overall, consumer reporting surveys such as J. D. Powers and Associates and Consumer Reports have not indicated a decline in reliability in their initial quality surveys for 1996 models. In many instances, initial quality indications have improved for 1996 model year vehicles, the first year of full OBD II implementation.

In terms of service, initial indications from technicians are that OBD II will help in the diagnosis and repair of emission-related malfunctions. Without the type of information generated by the OBD II system, finding and fixing vehicle malfunctions can be a lengthy, difficult, and very frustrating process.[7]

IV. TECHNICAL STATUS AND PROPOSED MONITORING SYSTEM AMENDMENTS

CATALYST MONITORING

Introduction

At the December 1994 hearing, the Board amended the catalyst monitoring requirements for low emission vehicles to specify a tailpipe emission level malfunction criterion in place of a front catalyst efficiency criterion. The regulation, as amended, requires manufacturers to phase-in the use of a malfunction criterion based on 1.5 times the vehicle's hydrocarbon (HC) emission standard between the 1998 and 2000 model years. Low emission vehicles that are not included in the phase-in schedule can employ higher interim emission malfunction criteria.

Background of Catalyst Monitoring Requirement

Emission control systems on virtually all new California vehicles include three-way

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[6] OBD not all bad, Autoweek, July 15, 1996, page 5

[7] Feed Back: Technicians-only network addresses OBD II concerns, Automotive News, July 19, 1996

catalysts. These catalysts consist of ceramic or metal honeycomb structures (commonly referred to as "substrates"), coated with precious metals such as platinum, palladium, or rhodium. These precious metals are dispersed within an alumina washcoat containing ceria, and the substrates are mounted in a stainless steel container in the vehicle exhaust system. Three-way catalysts are so-designated because they are capable of simultaneously oxidizing HC and carbon monoxide (CO) emissions into water and carbon dioxide (CO_2), and of reducing oxides of nitrogen (NO_X) emissions (by reacting with CO and hydrogen) into elemental nitrogen, CO_2, and water.

This three-way conversion activity only takes place efficiently, however, when the fuel system operates at a single air-fuel ratio, called stoichiometric (where there is just the required amount of air to completely burn all of the fuel in the engine). To achieve and maintain stoichiometric fuel delivery, manufacturers have incorporated closed-loop fuel control systems that utilize an exhaust gas oxygen sensor to provide feedback on the status of the air/fuel ratio being achieved. Most closed-loop fuel control systems actively cycle the air-fuel ratio slightly above and below the stoichiometric point to maximize three-way catalyst conversion efficiency. The precious metals are used to temporarily retain the HC, CO, and NO_X molecules in the catalyst while the ceria in the washcoat is used to store and release oxygen that is needed to complete the reactions. Oxygen is stored in the catalyst during the lean portion of the fuel system's cycling (i.e., when the air/fuel ratio is slightly higher than stoichiometric) and is released during the rich excursion. Without ceria, there would be insufficient oxygen at the active sites of the catalyst to achieve the most efficient performance.

As emission conversion efficiency of catalysts containing ceria deteriorates, generally the oxygen storage capacity is also diminished. Accordingly, oxygen storage can be used as an indicator of catalyst performance, discriminating between catalysts with sufficient and insufficient oxygen storage capability. By utilizing the information from the upstream oxygen sensor and a second sensor located downstream of the catalyst (or catalysts), the oxygen storage can be measured by comparing the oxygen sensor signals. In addition to being used for catalyst monitoring, the rear sensor can be used to monitor and correct for front oxygen sensor aging as needed to maintain the stoichiometric air-fuel mixture at high mileage. With a properly functioning catalyst, the rear oxygen sensor signal will be fairly steady since the fluctuating oxygen concentration (due to the fuel system cycling about stoichiometric) at the inlet of the catalyst is damped by the storage and release of oxygen in the catalyst (see figure below). When a catalyst is deteriorated, such damping is reduced, causing the frequency and peak-to-peak voltage of the rear oxygen sensor to approximate the signal from the oxygen sensor before the catalyst because the catalyst is no longer capable of storing and releasing oxygen.

Current Requirement

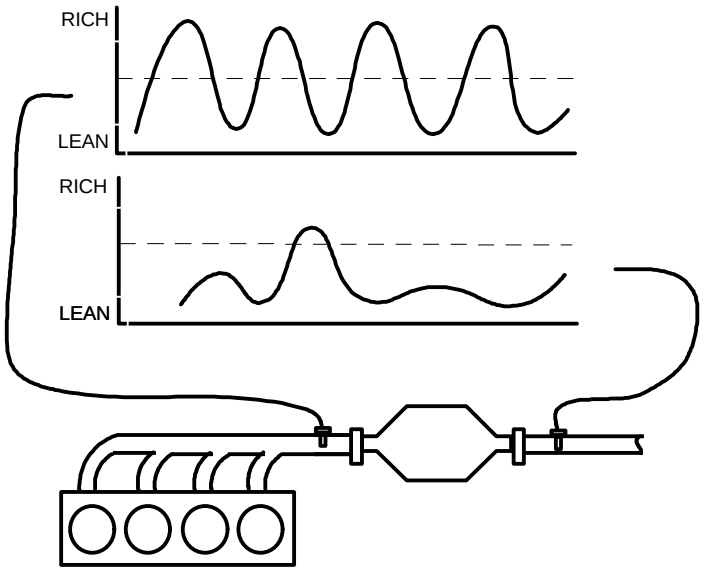

Figure 1--Catalyst Monitoring Diagram

As mentioned previously, the OBD II regulation currently requires manufacturers to identify a malfunction on low emission vehicles when the catalyst system has deteriorated to the point that tailpipe emissions exceed 1.5 times the applicable HC standard. Manufacturers are required to phase-in use of this malfunction criterion for low emission vehicles on 30 percent of the 1998 model year vehicles, 60 percent of the 1999 model year vehicles, and 100 percent of the 2000 model year vehicles. Higher interim thresholds are provided for Transitional Low Emission Vehicle (TLEV) and Low Emission Vehicle (LEV) applications not included in the phase-in schedule.

At this time, it appears that manufacturers generally will be able to meet the 1998 model year 30 percent phase-in requirement with TLEV applications. Additionally, the staff has received data from manufacturers demonstrating that the requirements can be met on LEV and Ultra Low Emission Vehicle (ULEV) applications as well. However, some manufacturers have expressed concerns with having a sufficient number of available models meeting the requirements, particularly for the 1999 and 2000 model years.

Most manufacturers have worked to develop strategies that monitor the oxygen storage capability of a front portion of the catalyst system (virtually all low emission vehicle applications have multiple catalyst substrates in series in the catalyst system). The oxygen storage measurement is then used to correlate overall catalyst system conversion efficiency. Proper selection of the front catalyst volume is important for success in developing the monitoring system. If the portion is too small relative to the entire catalyst system volume, a malfunction could be indicated too soon (i.e., when catalyst system efficiency is still acceptably high), or if the portion is too large, the malfunction indication can come too late

(i.e., after the specified emission limit is exceeded). Factors that manufacturers have considered in selecting the correct front volume include the configuration of the catalyst system, washcoat formulation, engine-out emission level, and others.

Upon adoption of these requirements, manufacturers made initial estimates for the sizing of the catalyst substrates for purposes of vehicle design, layout, and proper monitoring. The estimates were based on the catalyst technology that existed at that time. However, as manufacturers and catalyst suppliers have worked towards meeting the more stringent LEV and ULEV emission standards, catalyst technology has been continually evolving. Improvements in washcoat formulations and substrate materials as well as a shift towards precious metal combinations which are more resistant to high temperature excursions have resulted in significant improvements in catalyst performance and durability. In some cases, manufacturers' original estimates for the volume of the catalyst system needed for proper monitoring are no longer appropriate for the new technology catalysts. As discussed above, this can result in emission values which are too high or too low at the time a malfunction is indicated. Manufacturers have expressed further concern regarding monitoring to a 1.5 times the standard threshold due to some uncertainty of the representativeness of techniques used to simulate catalyst aging for developmental purposes. If the aging technique yields a hydrocarbon efficiency versus oxygen storage relationship that is different from that in-use, MIL illumination may not occur at the right tailpipe emission level.

The recent improvements in catalyst technology appear to have significantly altered the deterioration characteristics of the catalyst. Accordingly, manufacturers are currently in the process of re-evaluating the bench aging techniques used by comparing collected data from actual vehicles with the improved catalysts to the bench aged catalysts. In order to carry out this process, however, manufacturers have requested more leadtime in the introduction of the LEV catalyst monitor to validate their current aging procedures and make any necessary corrections to ensure the accuracy of the catalyst monitor on future model year vehicles.

Manufacturers have also expressed concern with the current malfunction criterion of 1.5 times the HC standard. Manufacturers have submitted data to the staff that suggests a higher amount of variability exists with the catalyst monitor than with other OBD II monitors due to catalyst manufacturing processes, vehicle production tolerances, fuel quality, and variability in real-world driving patterns. Because the malfunction criterion must be selected such that *all* vehicles will identify a catalyst malfunction before the tailpipe emission level exceeds 1.5 times the standard, manufacturers have stated that the wide distribution of monitoring system results caused by this variability may result in a malfunction indication at tailpipe emission levels below the standards on a percentage of vehicles.

Lastly, some manufacturers have requested the ARB to accept catalyst monitoring strategies that operate over the "Unified Cycle" instead of over the Federal Test Procedure (FTP) cycle that the current regulation requires. The Unified Cycle was developed by the ARB for emission inventory purposes, and contains more high speed and load driving conditions than the FTP cycle. The manufacturers have stated that the expanded speed and

load regions on this cycle would better facilitate reliable monitoring due to the higher exhaust flow rates and catalyst temperatures.

Proposed Monitoring Requirement Amendments

As stated earlier, data indicate that the OBD II monitoring requirements are technologically feasible. However, to assure sufficient model availability, and to allow manufacturers to best utilize their resources to account for improved catalyst technology, the staff is proposing to extend the phase-in for meeting the enhanced catalyst monitoring malfunction criterion from three to five years. The proposed phase-in percentages would be 20/40/60/80/100 percent of low emission vehicle sales spanning the 1998 through 2002 model years. Extending the phase-in is intended to provide manufacturers with adequate leadtime to make adjustments to the monitored portion of the catalyst system as well as provide enough time for verification of the bench aging procedures with actual catalysts that utilize the new technology. Although it appears that most manufacturers are set to meet the current 1998 model year phase-in requirement of 30 percent, the staff proposes that it be reduced to 20 percent. This will afford manufacturers with additional compliance flexibility should concerns such as those mentioned above arise prior to production.

In conjunction with the proposed modification to a five year phase-in, the staff proposes to define an interim criterion of 3.0 times the applicable FTP HC standard plus the emission level with a representative 4000 mile catalyst system for ULEV applications introduced prior to 2002 and not included as part of the required phase-in. This criterion is consistent with the interim criteria under the present regulation for TLEV and LEV applications and provides manufacturers with considerable flexibility for the early introduction of ULEV applications in cases where the original estimates for the catalyst configuration may not be optimized for catalyst monitoring.

To address manufacturers' concerns regarding catalyst monitor variability, the staff proposes to increase the malfunction criterion to 1.75 times the HC standard. Increasing the malfunction criterion to 1.75 times the HC standard should allow manufacturers to, on average, indicate a catalyst malfunction still very close to 1.5 times the standard, but without the MIL illuminating below the emission standards on some vehicles.

Further, the staff proposes to extend the existing provisions for reduced recall liability for this monitoring requirement through the 2003 model year for all low emission vehicles. Currently, manufacturers are not subject to recall for catalyst system failures which result in tailpipe emission levels less than 2.0 times the standard through the 2000 model year. The extension of 2.0 times the standard through the 2003 model year will further address manufacturers' concerns regarding the performance of catalyst monitoring systems in-use.

Lastly the staff proposes to include a provision in the OBD II regulation to allow (with Executive Officer approval) manufacturers to utilize the Unified Cycle as an option to the FTP cycle for demonstration of monitoring system performance. The Unified Cycle was

developed by the ARB to represent real world driving and quantify in-use vehicle emission levels. As mentioned previously, the cycle includes some engine speed and load regions not encountered on the FTP cycle. This provision would allow manufacturers greater flexibility in designing monitoring strategies without diminishing the frequency with which the monitor executes during typical driving. Because this flexibility may be useful for other monitoring requirements, the provision would not be limited to just catalyst monitoring. Manufacturers demonstrating a specific need for a particular monitor would be allowed to utilize the Unified Cycle for demonstration and monitoring purposes.

MISFIRE MONITORING

Introduction

The OBD II requirements presently include monitoring for proper combustion in each engine cylinder to ensure that misfiring does not contribute either to excess emissions or to catalyst damage as a result of overheating. The regulation also requires the OBD II system to identify the cylinder or cylinders that are misfiring under most conditions. During the initial phase-in of OBD II requirements for 1994 through 1996 models, manufacturers were only required to monitor for misfire over the engine operating conditions encountered during the FTP test. Beginning with the 1997 models, however, all but small volume manufacturers are required to phase-in misfire detection over nearly the entire engine operating range. The phase-in of full range misfire monitoring covers 50 percent of the vehicles in the 1997 model year, 75 percent in 1998, 90 percent in 1999, and full compliance of all manufacturers' models in the 2000 model year.

Status of Development

Early field information on the performance of misfire detection systems in 1994-1996 models indicates that the current OBD II MIL illumination requirements may need some revision to delay illuminating the MIL until misfire is more repeatable than under the current requirements. Some manufacturers have been experiencing MIL illumination for actual misfire events on a small percentage of vehicles, but examination does not always readily identify the underlying malfunction. Manufacturers are generally confident that the OBD II system is properly detecting real misfire as opposed to falsely indicating a problem that is not present, but that the events are not sufficiently repeatable to be readily diagnosed when the vehicle is serviced. Most of these occurrences seem to be taking place during engine warm up and/or at lower engine speeds. Possible explanations for the temporary occurrence of misfire include poor fuel quality, unusual ambient conditions, or other causes. The staff and manufacturers have worked closely to consider changes to the MIL illumination protocol to better ensure that technicians will be able to find and fix detected problems while maintaining system effectiveness in preventing catalyst damage and reducing in-use emissions.

Another request from industry is for more definitive criteria allowing for temporary disablement of the misfire monitor under certain conditions. Although the regulation states

that misfire detection is to occur at all positive torque engine speed and load conditions, the regulation also recognizes that temporary suspension of the monitor may be necessary under specific conditions, such as driving on rough roads, during gear changes, or during extremely rapid throttle changes. Further, at certain specific operating points, drivetrain resonance can cause engine roughness that masks misfire. For this reason, the regulation provides that manufacturers may request exemption from detecting misfire when such conditions exist. However, because any disablement requires Executive Officer approval, the manufacturers contend that they cannot be certain that their misfire detection systems will be accepted until the time of certification, at which point, significant modifications generally cannot be made in time for vehicle production.

Finally, industry has stated that a high level of resources is needed to properly calibrate a full range misfire detection system for each engine family. Manufacturers contend that they have implemented full range detection for the 1997 model year on the engines that are the easiest to monitor, and are still working to refine and calibrate misfire detection systems for the more difficult engines. In addition, because there is some indication of MIL illumination on a small percentage of low-mileage vehicles in which identifiable causes cannot be found, industry has expressed concern that such occurrences may increase on older, higher mileage vehicles. As a result, industry is urging a slower implementation schedule for enhanced misfire monitoring. They maintain that this could allow more field information to be received from vehicles with higher mileage and would enable them to feed this information back into their design process. However, the engineers who would do this work are likely the same ones who would be responsible for developing the new systems meeting the full range monitoring requirements on the more difficult models. Therefore, industry requests a "period of stability" before moving forward as required under the current full range misfire monitoring implementation schedule.

Proposed Misfire Monitoring Amendments

At this time, virtually all manufacturers have certified 50 percent of their 1997 models to the full range misfire monitoring requirements and several manufacturers have indicated that they are on track to meet the current phase-in schedule. However, to assure sufficient model availability, to allow manufacturers to best utilize their resources, and to help maximize misfire monitoring system performance, the staff has worked closely with industry and is proposing amendments to address issues raised by manufacturers.

The staff proposes to permit additional evaluation time to illuminate the MIL for both catalyst damaging misfire and misfire causing excess emissions to ensure repeatability before service is sought. Although the proposed evaluation periods are three to four times longer than under the current requirements, misfire causing catalyst damage will generally be detected in less than a minute, and lower levels of misfire will still be detected within two trips. Staff and industry have generally achieved consensus on these proposed revisions.

The staff is also proposing amendments to clarify the criteria for meeting the full range

detection requirements. The amendments clarify the primary misfire patterns for which detection is most important (i.e., random misfire, single cylinder continuous misfire, and paired cylinder misfire), and more specifically set forth the factors that will be examined in approving minor monitoring system limitations, (e.g., the extent of the conditions at which misfire is not detectable and how likely it is for such conditions to be encountered in-use). Again, these clarifications were developed with the input of industry. The amendments still require Executive Officer approval for minor system disablements. The proposal would both ensure that misfire detection systems are effectively designed and would prevent unwarranted rejection of misfire detection systems due to inflexible regulatory language.

Apart from these clarifications, the staff is proposing greater compliance latitude for engines with more than eight cylinders. Specifically, manufacturers may request that the requirements for full range monitoring be waived if it can be demonstrated that the requirements cannot be achieved using the same monitoring technology used for compliance on engines with less cylinders. To obtain a waiver, the manufacturers would still be required to utilize the monitoring technology to its full capability over the entire engine speed and load range, and in no case would a monitoring system be accepted that is not capable of detecting misfire over the range of conditions encountered during an FTP test. This amendment is proposed by the staff in view of the limited sales volume of such engines[8] and the inherently greater difficulty in meeting the full range requirements for these engines.

Concerning industry's request for a "period of stability" before completing the currently adopted phase-in schedule for full range misfire monitoring, staff believes some additional leadtime to ensure misfire systems are working as intended is reasonable. Although the staff has already received confirmation from some manufacturers that the current phase-in requirements can be met, the staff believes manufacturers would use any added leadtime to further refine the monitoring technology to maximize detection while ensuring that the MIL illuminates only when the underlying cause can be found by service technicians. Such efforts should safeguard consumer confidence in the accuracy and reliability of the OBD II system, which will ensure prompt response to MIL illumination and, consequently, minimal increased emissions due to misfire malfunctions. The staff's proposal is to carry-over the 1997 model year full range detection phase-in requirement of 50 percent of vehicle sales through the 1999 model year, thereby delaying full implementation until the 2002 model year. The phase-in percentages for the 2000 and 2001 model year would be 75 and 90 percent, respectively.

EVAPORATIVE SYSTEM MONITORING

Introduction

The OBD II regulation requires manufacturers through the 1999 model year to monitor the evaporative system for leaks equal or greater in magnitude than a 0.040 inch diameter

[8]Manufacturer-supplied sales figures indicate that less than 0.15% of all 1996 California vehicle sales were comprised of vehicles with engines larger than eight cylinders.

hole. With the 2000 model year, manufacturers must begin to phase-in monitoring for small leaks equal or greater in magnitude than a 0.020 inch diameter hole. Compliance with the 0.020 inch requirements on all vehicles is scheduled to take place with the 2002 model year. The requirements were developed in response to data indicating that small system leaks can cause evaporative emissions to exceed 30 grams per test (over 15 times the standard) on the 105 degree Fahrenheit test procedure.

Status of Development

Manufacturers are complying with the current leak detection requirements utilizing monitoring techniques that create either a vacuum or pressurized condition in the fuel tank and evaporative system. The pressure inside the system is monitored over an interval of time. If the pressure or vacuum changes toward ambient at a significant rate, a leak is considered to be present. If the pressure or vacuum holds reasonably steady, the system is considered leak free. Although the pressure based technologies appear better suited to detect leaks down to 0.020 inches, the staff has received indication from manufacturers that vacuum based techniques also should be capable of meeting the requirements. Based on this assessment, and the fact that three years of leadtime still exist before 0.020 inch leak detection systems must be produced, the staff is not proposing modifications to the basic requirements at this time. However, two additional provisions are being proposed to increase compliance flexibility.

Proposed Amendments

Some manufacturers have argued that for evaporative system designs meeting on-board refueling vapor recovery system (ORVR) requirements, the impact of small leaks on evaporative emissions will be far less than the 30 grams per test yielded on current designs. In fact, the manufacturers argue that the emission impact may not be significant at all. As such, staff has been requested to remove the 0.020 inch leak detection requirements.

The staff is reluctant to propose deleting the requirement because the impact of a small leak on evaporative emissions appears highly dependent on subtle design factors, specifically the pressure drop between the fuel tank and the canister. Instead, the staff is proposing an amendment to exempt manufacturers from detecting small leak sizes if they provide sufficiently reliable data demonstrating that evaporative emissions will not exceed 1.5 times the applicable standards. This amendment should provide the relief requested by manufacturers and should encourage manufacturers to design systems that have less of an impact on emissions when deteriorated. For those system designs for which a larger emission impact would result from small leaks, the requirements would remain unchanged.

Secondly, manufacturers have expressed concerns regarding meeting the evaporative system requirements on some vehicles with specific types of fuel tank designs. The regulation already contains a provision to adjust the requirements for larger fuel tanks (i.e., greater than 25 gallons) if necessary to facilitate reliable monitoring. However,

manufacturers are concerned about some smaller fuel tank designs that may also be difficult to monitor due to the nature of the design. The manufacturers cite plastic fuel tanks as the primary example. These tanks are generally more flexible than steel tanks, possibly causing some slight deformation when pressure or vacuum is applied. Although slight, the manufacturers indicate that the deformation may change the pressure in the tank sufficiently to alter the results of the monitoring system and possibly cause false malfunction detections. The manufacturers have stated that they are making modifications to strengthen the tank walls to resolve false malfunction detection concerns; however, it is unclear, at this time, if the improvements will be completed in time to meet the regulatory phase-in schedule.

To further facilitate meeting the monitoring requirements on all vehicles in a reliable manner, the staff is proposing an amendment that would allow manufacturers to request Executive Officer approval to use a revised target leak size for malfunction detections on such problematic fuel tank designs. The amendment would allow use of the provision through the 1999 model year. The staff believes that manufacturers should be able to make modifications to the tank design to resolve the monitoring concerns in the extra time provided.

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM MONITORING

Introduction

Currently, the OBD II regulation does not contain specific monitoring requirements for the detection of PCV system failures. Additionally, monitoring of the PCV system is not required under the comprehensive component monitoring section of the regulation because such systems generally do not use electronic components. Nonetheless, certain failure modes of the PCV system can cause a substantial increase in emissions by venting crankcase hydrocarbon emissions directly to the atmosphere. To address these excess in-use emissions, the staff is proposing to add a PCV system monitoring requirement to the OBD II regulation.

Background

Combustion in each cylinder is achieved by drawing air and fuel into the cylinder, compressing the mixture with a piston, and then igniting the mixture. After the combustion event, the mixture is exhausted from the cylinder with another stroke of the piston. However, during the combustion process, exhaust gases can escape past the piston into the crankcase. The PCV system is then used to remove these gases (known as “blow-by”) from the crankcase and directs them to the intake manifold to be burned by the engine. Prior to the introduction of PCV systems in the early 1960's, these vapors were vented to the atmosphere. The PCV system generally consists of a fresh air inlet hose, a crankcase vapor outlet hose, and a PCV valve to control the flow through the system (see figure below). Fresh air is introduced to the crankcase via the inlet (typically a connection from the intake air cleaner assembly). On the opposite side of the crankcase, vapors are vented from the crankcase through the valve by way of the outlet hose to the intake manifold. The intake

manifold provides the vacuum that is needed to accomplish the circulation while the engine is running.

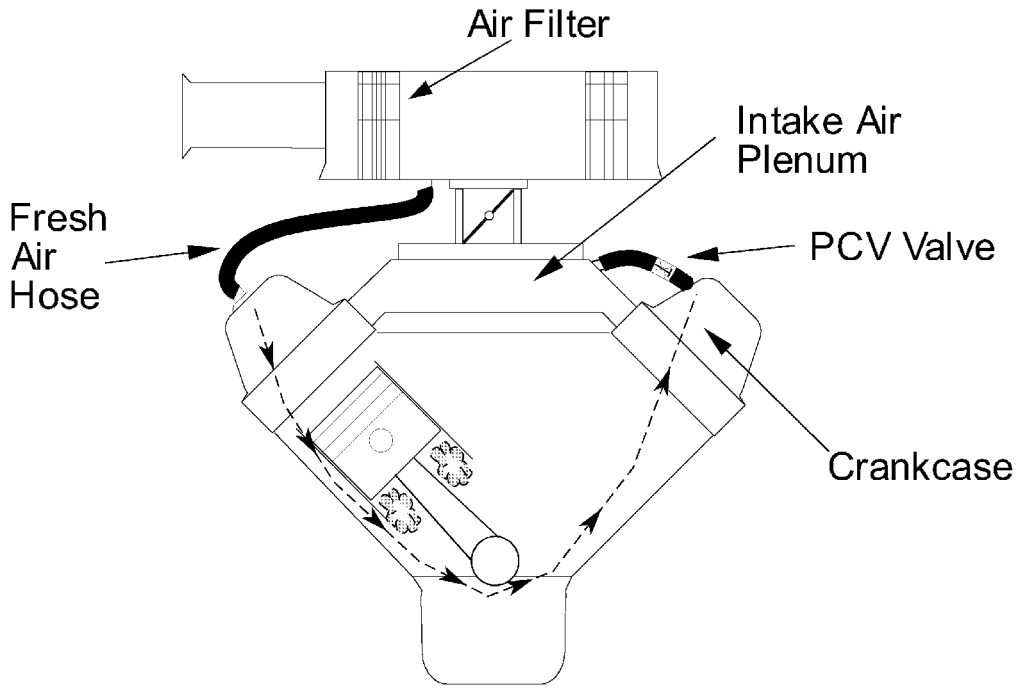

Figure 2--Typical PCV System

The valve is used to regulate the amount of flow based on engine speed. During low engine load operation (e.g., idle), the valve is nearly closed allowing only a small portion of air to flow through the system. With open throttle conditions, the valve opens to allow more air into the system. At high engine load operation (i.e., hard accelerations), the valve begins to close again, limiting air flow to a small amount. For most systems, a mechanical valve is all that is necessary to adequately regulate PCV system air flow.

Emission Impact

In-use studies of vehicles failing I/M tests cite failure rates of up to approximately five percent for the PCV system on fuel injected cars.[9] The technician notes associated with the PVC system failures indicate that the majority of failures fall into two primary categories. The first category of reported PCV system malfunctions are failures attributed to cracked or deteriorated hoses. The staff does not believe that such failures have a significant impact on emissions because vapors are drawn by intake manifold vacuum into the engine. Therefore, air is likely to be drawn into the hose through the crack as opposed to crankcase vapor being

[9] Analysis of Causes of Failures in High Emitting Vehicles, American Petroleum Institute, publication number 4637, October, 1995, page 2-40.

forced out. In the second category, however, an approximately equal number of failures appear to be caused by tampering or improper service. These failures specifically are misrouted or disconnected hoses, and missing valves. Of these failures, hose disconnections on the vapor vent side of the systems and/or missing valves can cause emissions to be vented to the atmosphere. Further analysis of the data suggests that approximately one in five PCV failures may fall into this category (or one percent of the total vehicles tested).

The U.S. EPA's Mobile5a emission model quantifies these emissions at 1.2 grams per mile (g/mi) hydrocarbons (HC).[10] While the percentage of PCV failures causing high emissions appears to be small (one percent of the vehicles tested), the total emissions from tampered and improperly serviced PCV systems would raise the 2003 fleet average standard of 0.062 g/mi HC by 0.012 g/mi, or nearly 20 percent.

It is generally acknowledged that crankcase blow-by increases as a vehicle ages due to the wear of engine parts (cylinder walls, piston rings, etc.) over the life of the vehicle. Thus, although one manufacturer presented data at the July 1996, workshop showing running loss emissions from a disconnected hose on current technology vehicles ranging from 0.025 g/mi to 0.620 g/mi compared with the modeling value of 1.2 g/mi, the mileage of the vehicles tested was less than 45,000 miles. Thus, the staff does not believe the data adequately represent typical high mileage vehicles where the malfunction is most likely to occur.

Proposed Monitoring Requirements

To address the excess in-use emissions from PVC problems, staff proposes that manufacturers be required to monitor the PCV system for disconnections between the crankcase and the intake manifold on the valve side of the system. As discussed above, failure modes of this type are the most likely to cause a large increase in emissions. The staff is not proposing to require monitoring of the identified PCV valve failures that generally do not have a significant impact on emissions such as disconnected fresh air lines and plugged valves. The impact is generally minimal (if any effect at all) due to the fact that vapors are not directly vented to the atmosphere. Further, detection of these additional failure modes would almost certainly require additional vehicle hardware. Considering the small emission benefit expected, monitoring would not be cost-effective.

Accordingly, the proposed amendment would only require the detection of a disconnection in the system between either the crankcase and the PCV valve or between the PCV valve and the intake manifold. Because disconnections between the valve and the intake manifold will result in a significant intake air leak, effective monitoring should be readily achievable through the existing monitoring strategies for the idle air control system or the fuel system. Additionally, if the leak is sufficiently large, the disconnection will render the vehicle inoperable by causing the engine to stall. The staff's proposal does not require the stored fault code to specifically identify the disconnection if additional hardware would be

[10]The applicable evaporative running loss standard is 0.05 g/mi HC.

required for this purpose, and provided service information generated by the manufacturer directs technicians to examine the connection as a possible cause of the indicated fault.

Regarding disconnection between the valve and the crankcase, detection would be significantly more difficult with existing monitors, and would likely require additional hardware such as a pressure switch to ensure flow between the crankcase and the PCV valve. However, in order to facilitate cost-effective compliance, the staff proposes to exempt manufacturers from detecting this type of disconnection if the PCV valve is fastened directly to the crankcase in a manner that makes technicians more likely to disconnect the intake manifold hose from the valve rather than disconnect the valve itself from the crankcase during service. Staff believes that this would eliminate most of the disconnected hose and valve events observed in the I/M test programs because technicians who do not reconnect the hose when the service procedure is completed will be alerted to a diagnostic fault as explained in the previous paragraph that will lead the technician back to the disconnected hose.

For PCV system designs that utilize tubing between the crankcase and the valve, an exemption from detecting disconnection in this area could still be obtained under the staff's proposal if it is demonstrated that all of the connections between the valve and the crankcase are resistant to deterioration or accidental disconnection, are significantly more difficult to remove than the connections between the intake manifold and the valve, and are not subject to disconnection during any of the manufacturer's repair procedures for non-PCV system repair work. Again, the staff believes these safeguards will eliminate most of the disconnected hose and valve failures previously observed in the field while still providing manufacturers with adequate design flexibility to meet the requirement.

Lastly, manufacturers that utilize PCV systems that do not have any external hoses or tubing would be exempted from these monitoring requirements completely. These systems typically use internally machined passageways or other similar arrangements which are not subject to failure modes causing emissions to be vented to the atmosphere.

To provide manufacturers with sufficient leadtime to make any system design changes necessary to meet the PCV monitoring requirement, the staff proposes a phase-in beginning with the 2002 model year. The proposed phase-in schedule would require compliance for 30 percent of a manufacturer's projected sales in model year 2002, 60 percent compliance in model year 2003, and full compliance in model year 2004. Small volume manufacturers would not be required to meet the phase-in schedule but would be required to fully comply in model year 2004.

THERMOSTAT MONITORING

Introduction

Currently, the OBD II regulation does not contain specific monitoring requirements for

the detection of thermostat failures. Additionally, monitoring of the thermostat is not required under the comprehensive component monitoring section of the regulation because thermostats are generally non-electronic. However, certain failure modes of the thermostat can cause an increase in emissions and affect the operation of other OBD II monitors. To address these issues, the staff is proposing to add a thermostat monitoring requirement to the OBD II regulation.

Background

Manufacturers typically use a thermostat to block the flow of coolant within the engine block during cold starts to promote rapid warming of the engine. As the coolant approaches a specific temperature, the thermostat begins to open and allows circulation of coolant through the radiator. The thermostat then acts to regulate the coolant to the specified temperature. If the temperature rises above the regulated temperature, the thermostat opens further to allow more coolant to circulate, thus reducing the temperature. If the temperature drops below the regulated temperature, the thermostat partially closes to reduce the amount of coolant circulating, thereby increasing the temperature. If a thermostat malfunctions in such a manner that it does not adequately restrict coolant flow during vehicle warm-up, an increase in emissions could occur do to the prolonged operation of the vehicle at temperatures below the stabilized, warmed-up value (i.e., due to cold start engine control strategies). The emission impact may vary considerably from one manufacturer to another based on cooling system design and air-fuel control strategies; however, it is generally acknowledged that the component can impact emissions significantly, particularly at lower ambient temperatures (e.g., 50 degrees Fahrenheit). Further, virtually all manufacturers utilize the engine coolant temperature as an enable criterion for other OBD II diagnostics. If the vehicle's coolant temperature does not reach a manufacturer-specified warmed-up value, several diagnostics may effectively be permanently disabled from identifying other emission-related malfunctions.

Proposed Monitoring Requirements

To address these issues, the staff proposes to add a thermostat monitoring requirement to the regulation. Manufacturers would be responsible for detecting thermostat malfunctions that do not allow the coolant temperature to reach the highest temperature required by the manufacturer to enable other monitoring strategies (including fuel system monitoring). Additionally, manufacturers would be responsible for detecting thermostat malfunctions that prevent the vehicle from reaching a warmed-up operating temperature that is within 20 degrees Fahrenheit of the manufacturer-specified thermostat regulating temperature. Subject to Executive Officer approval, a manufacturer would be permitted to monitor the thermostat for a larger deviation from the nominal warmed-up temperature if it adequately demonstrates that a thermostat operating at the lower temperature will not cause an emission increase of 50 or more percent of any of the applicable standards (e.g., a 50 degree Fahrenheit emission test). Manufacturers would be required to submit test data and/or an engineering analysis of the coolant temperature-based modifications to the engine control strategies to support their

request.

The staff foresees that the requirement could be satisfied by verifying that the coolant temperature reaches a stabilized value after a period of engine operation, possibly taking into account engine load and coolant temperature at engine start. One manufacturer currently monitors the thermostat for proper operation on all of its 1996 model year vehicles in this manner with no additional hardware. While this appears to be the most logical approach to meet the monitoring requirements, other strategies that are equally effective and timely in identifying malfunctions could also be used to satisfy the requirements.

The staff proposes that the monitoring requirement take effect beginning with the 2000 model year, with full compliance by the 2002 model year. Phase-in percentages of 30, 60, and 100 percent of vehicle sales are proposed for the 2000 through 2002 model years respectively. Small volume manufacturers would not be required to implement this monitoring strategy until the 2002 model year. Alternate phase-in schedules which result in equivalent emission reductions and timeliness overall in implementing these requirements would also be allowed.

ALTERNATE FUEL VEHICLES

Under the current regulation, manufacturers have until the 1999 model year to fully comply with the OBD II requirements for alternate fuel vehicles. The leadtime beyond the 1996 general implementation date was provided based on manufacturers' statements that the small volume of alternate fuel vehicles produced did not justify the expenditure of resources necessary to develop unique monitoring systems for some of the major monitors. They argued that if required to comply fully with the requirements, they probably would have elected to eliminate the vehicles from their product offerings. The leadtime allowed manufacturers to continue to produce alternate fuel vehicles in the small quantities needed to meet current market demand without devoting the full amount of resources necessary to calibrate and validate a fully compliant OBD II system.

At this time, manufacturers continue to maintain that sufficient OBD developmental resources are still not available to bring alternate fuel vehicles into full compliance with the regulation. The manufacturers point to the ongoing level of effort necessary to implement OBD II on gasoline vehicles, and the continued low demand for alternate fuel vehicles. Makers of alternate fuel retrofit systems likewise state that insufficient resources exist to produce retrofit kits that are fully compatible with OBD II systems by the 1999 model year. The staff understands the basis for the manufacturers' request and does not want to impede the progress of alternate fuel vehicles in the market place. However, it believes that all vehicles, including alternate fuel vehicles, should come into compliance with the OBD II requirements as soon as possible in order to realize the lowest possible in-use emissions, and thus, staff has not proposed additional leadtime for alternate fuel vehicle compliance with OBD II. Considering the low sales volume of alternate fuel vehicles, and the fact that they generally operate cleaner overall than the gasoline vehicles they would replace, staff does not believe that some additional leadtime, should it be

granted by the Board, would result in a significant in-use emissions increase.

DEFICIENCY PROVISIONS

As discussed in the introduction, the OBD II regulation requires monitoring of virtually all components and systems that can cause vehicle emissions to increase. Most components and systems are monitored for more than one type of failure. Therefore, OBD II systems contain many diagnostic algorithms. In the early stages of OBD II implementation, some manufacturers encountered unforeseen and generally last minute problems with some monitoring strategies despite a good faith effort to comply with the requirements in full. In 1993, the Board adopted a provision to permit certification of 1994 and 1995 model year vehicles with monitoring system "deficiencies" in cases where a good faith effort had been demonstrated. The Board expanded the provision in 1994 for vehicles produced up through the 2000 model year. To prevent misuse of the provision and ensure equity for manufacturers able to meet the requirements in full, manufacturers are subject to fines for deficiencies in excess of two for a particular model in the 1995 and 1996 model years. For the 1997 through 2000 model years, manufacturers are subject to fines for deficiencies in excess of one. The fines are in the amount of $25 or $50 per deficiency per vehicle depending on the significance of the monitoring strategy in question. Some manufacturers have been able to certify vehicles without deficiencies while others have some deficiencies on some models, but rarely has a vehicle model been subject to fines.

Nevertheless, vehicle manufacturers are requesting that at least two deficiencies be available without fines through at least the 2000 model year, and that the deficiency provision extend beyond the year 2000. While fewer and fewer vehicles are being certified with deficiencies, manufacturers are concerned that unanticipated problems may still arise in the future, especially if the amendments proposed by staff are adopted causing new and enhanced monitoring requirements to be phased-in until the 2004 model year. Further, manufacturers have indicated plans to change on-board computer hardware and software designs over the next few years and that errors or other issues could arise that could prevent compliance with the minimum requirements of the regulation.

The current deficiency provisions have facilitated OBD II implementation by mitigating the danger of manufacturers not being able to certify vehicles with relatively minor implementation problems. While recognizing this benefit, staff also seeks to have fully compliant systems available at the earliest possible time and believes that the need for deficiencies after the 2000 model year will likely be mitigated because of the various amendments presently being proposed to the Board. Thus, the staff did not recommend that deficiencies be continued beyond the year 2000.

TAMPERING PROTECTION

Section (d) of the regulation currently requires manufacturers to take steps to prevent unauthorized modifications to the computer-coded engine operating parameters of the on-board computer. Such modifications may adversely impact the performance of OBD II systems in

detecting or reporting malfunctions. The Board originally adopted this section in 1989 to ensure maximum OBD II system performance, and to protect the integrity of future I/M programs that may rely on OBD II checks instead of a tailpipe emission test.

The regulation as initially adopted established separate requirements for electronically reprogrammable and non-reprogrammable on-board computers. Regarding non-reprogrammable units, the regulation requires that manufacturers must design the system so that the operating parameters cannot be changed without the use of specialized tools and procedures (e.g., the computer chips which hold the software and calibration data must be sealed or soldered to the circuit board).

Some manufacturers use electronically reprogrammable on-board computers. These computers offer an advantage in that software field fixes or running changes can be implemented without replacing or removing any vehicle hardware. For these units, the original regulation required manufacturers to utilize proven methods to deter unauthorized reprogramming. To better ensure adequate system security, the Board amended the tamper resistance requirements in 1994 for the 1999 and later model years. These enhanced requirements included data encryption and write protect features which require access to an off-site computer maintained by the manufacturer, or other equally effective measures.

Aftermarket parts manufacturers and motor vehicle manufacturers have expressed concern with the requirements for electronically reprogrammable units. The aftermarket parts manufacturers claim that the 1990 federal Clean Air Act Amendments (CAAA) grant parts manufacturers access to software contained in vehicles, and that such access is necessary to produce OBD II compatible replacement parts and specialty equipment. Therefore, they believe that the OBD II tamper resistance requirements violate the CAAA. Further, the aftermarket representatives claim that the language in the tamper resistance requirements imply that attempts to "reverse-engineer" vehicles for the purposes of producing compatible aftermarket parts constitutes illegal tampering, and that the requirement for access to an off-site computer permits vehicle manufacturers to prohibit the installation of software developed by aftermarket companies.

In issuing a federal waiver of the OBD II requirements, the U.S. EPA has concluded that the OBD II tamper resistance requirements are not inconsistent with the CAAA. The decision states that the on-board computer access required by the CAAA is only with respect to the output of the OBD II system (i.e, malfunction fault codes and other diagnostic information) and not to software making up the system.[11] The waiver decision is also consistent with the EPA's service information rulemaking, which states that vehicle manufacturers may incorporate safeguards to prevent access to on-board computer software.[12]

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[11]*California State Motor Vehicle Pollution Control Standards; Waiver of Federal Preemption; Decision*, Dated October 3, 1996, 61 Fed Reg ___(not yet published in the Federal Register)

[12]Federal Register, August 9, 1995, (Volume 60, Number 153), page 40492

Regarding the OBD II regulatory language, the staff has stated that the tamper resistance requirement is not intended in any way to address the legality of the concept of reverse engineering for the purposes of producing OBD II compatible aftermarket parts. The requirement is intended only to ensure that vehicle manufacturers employ adequate safeguards to ensure against software modifications that could reduce the effectiveness of the OBD II system in detecting or reporting emission-related malfunctions. Likewise, the language does not require vehicle manufacturers to "lock-out" legitimate aftermarket calibrations (those exempted under Vehicle Code 27156) by specifying access to an off-site computer. While the regulation does not absolutely require the use of an off-site computer (other alternatives can be accepted), it is assumed that manufacturers could implement such a measure on their own to protect proprietary information.

Vehicle manufacturers have stated that the 1999 model year security requirements are too restrictive by prescribing specific (and in their opinion, somewhat redundant) tamper resistance techniques. As a result, some manufacturers have stated that they will incur significant costs in redesigning equipment to accomplish reprogramming in the manner dictated by the regulation (e.g., to set up host computer access). Further, the manufacturers point to the fact that they will implement methods to deter unauthorized reprogramming for their own purposes. While their methods may not be fully equivalent to the methods specified in the regulation, the manufacturers believe their provisions will be adequate to deter tampering, and will be upgraded as the need arises.

As stated previously, the purpose of this requirement is to ensure maximum OBD II system performance. Therefore, since manufacturers will in any event implement safeguards that are expected to be effective, the need for this requirement is diminished. Further, in attempting to address the vehicle manufacturers' specific concerns, the staff originally contemplated removing just the added specific requirements applicable for the 1999 and later model years. However, after further consideration, the remaining language for electronically reprogrammable units would likely not be specific enough to enforce, and appears to be unnecessary in light of manufacturers' current practices. Therefore, the staff's proposal is to completely remove the tamper resistance requirements for electronically reprogrammable vehicles. For non-reprogrammable vehicles, the staff believes the requirements to deter chip replacement are likewise consistent with the CAAA, enforceable, and do not present a technical challenge or significant cost burden to manufacturers.

OFF-BOARD SOFTWARE VERIFICATION

As an alternative to tamper resistance requirements for electronically reprogrammable vehicles, the staff has discussed with industry the feasibility of incorporating a routine to detect improperly modified vehicle software at an I/M test. The vehicle manufacturers believe that an algorithm can be incorporated into the on-board computer that can be invoked to verify the integrity of a vehicle's software, and report the results through the OBD II serial data link. The staff is proposing a requirement for vehicle manufacturers to develop and implement a standard protocol for this purpose beginning with the 2000 model year, with full compliance by the 2002 model year. Phase-in percentages of 30 and 60 percent of vehicle sales are specified for the 2000

and 2001 model year vehicles, respectively. Aftermarket parts organizations have also agreed that this is a reasonable approach for ensuring the integrity of OBD II systems.

Vehicle manufacturers have begun to develop an effective and reliable protocol for this requirement, which will be laid out specifically in SAE Recommended Practice J1979, "E/E Diagnostic Test Modes." When completed, the document reference will be updated in the OBD II regulation. The protocol would not prevent on-board computer reprogramming, but would ensure the integrity of software contained in the on-board computer, whether it is a vehicle manufacturer calibration or an exempted aftermarket calibration.

SERVICE INFORMATION

The OBD II regulation currently has several requirements for standardized protocols. Fault codes, generic scan tool connections, communication protocols, and emission-related powertrain test information all must comply with Society of Automotive Engineers (SAE) standards. The staff has been in communication with vehicle manufacturers and the service industry regarding the implementation and effectiveness of the OBD II service and diagnostic information requirements. Out of these discussions, the staff has identified the need for several amendments to the requirements to further the goal of providing information necessary to identify and fix OBD II-detected malfunctions.

Availability and Format of Service Information

Once a vehicle malfunction has been detected by OBD II, the emission reduction benefits are obtained only when the problem is corrected. Therefore, access to adequate service information is an important part of the OBD II program. Historically, such information has not always been available, particularly to independent service providers, which have been reported to be responsible for up to 80 percent of all vehicle repairs.[13]

In an attempt to address this concern, the U.S. Environmental Protection Agency (EPA) adopted requirements for manufacturers to provide to independent service technicians any and all information necessary to make use of the OBD system and to perform emission-related repairs. Additionally, manufacturers are required to post on the EPA Internet site "Fed World" what service information is available and how it can be obtained. However, for practical purposes, the information is generally available only in a printed format. Technicians are increasingly turning toward electronic formats for service information in order to efficiently service today's vehicle designs. While some manufacturers have developed electronic service information systems for dealerships, the equipment is usually prohibitively expensive for independent shops, especially if multiple vehicle makes are serviced. Further, current aftermarket electronic service information systems which cover multiple vehicle makes are often limited in content due to the workload required to enter the information in the new format.

[13]Federal Register: August 9, 1995 (Volume 60, Number 135), pg 40475

To further facilitate access to necessary service information, the staff proposes to adopt a requirement for manufacturers to make available emission-related diagnostic and service information in the electronic format specified by SAE J2008 Draft Technical Report "Recommended Organization of Vehicle Service Information."[14] Manufacturers would be required to comply with this requirement beginning January 1, 2002, for 2002 and newer model year vehicles. As new models become available, manufacturers would be required to make the information available to the aftermarket industry within 30 days of making it available to the manufacturer-franchised repair facilities. Information to be made available would include emission-related diagnostic and repair information provided to the dealer.

Manufacturers would be required to make the information available for a fair and reasonable cost. The staff intends to use essentially the same criteria employed by the U.S. EPA to determine if prices set by the manufacturers are "fair and reasonable." Factors to be considered include cost to the manufacturer for preparation and distribution of the information, the type of information provided, the price charged by other manufacturers for similar information, and the quantity and detail of the information.

Once the information is made available by the manufacturers, the staff expects that one means for getting the service information distributed to independent technicians in the service industry would be through independent service information vendors, or intermediaries. These vendors generally manufacture products which contain service information for all or the majority of vehicle makes and models via a localized database (on CD-ROM or other storage device) and a software program which accesses the information in the database. After initially purchasing the product from the vendor, technicians can then subscribe to some form of update schedule (yearly, quarterly, etc.) to receive additional information as it becomes available. It is envisioned that use of a standardized database format would allow more direct access to the appropriate information by directly linking the technician to the relevant repair procedures. For instance, a technician could input a few parameters identifying the vehicle year, make, and model and the stored diagnostic fault code and the database could automatically return the diagnostic and repair procedure for the specific fault on that particular vehicle. This in turn should allow independent technicians to provide more effective (e.g., accurate, quick, and cost-efficient) repairs to consumers.

Some small volume manufacturers (i.e., those that produce less than 3000 vehicles per year for sale in California) have expressed concerns regarding this requirement citing significant cost burdens and lack of market demand for the limited number of vehicles produced and sold. Based on the comments received and discussion with service information providers, the staff has confirmed that there does not appear to be sufficient market demand in the independent service industry for standardized service information for these vehicles. Such vehicles are generally serviced at the manufacturer's franchised facilities, even after the manufacturer's warranty has expired. Accordingly, the staff proposes to indefinitely exempt

[14]While J2008 is still a draft document that has not yet been formerly adopted, there do not appear to be any technical obstacles to achieving industry consensus on the format currently specified.

small volume manufacturers from this requirement. These manufacturers would still be required to meet the requirements of the EPA's federal service information requirements. Therefore, diagnostic information will still be available for these vehicles if needed by independent service technicians, but likely not in the standardized electronic format.

Service Information Content

The regulation currently requires manufacturers to make readily available to the automotive repair industry effective service procedures that utilize only a generic scan tool and commonly available, non-microprocessor based tools. The intent of the regulation was to require manufacturers to document effective diagnosis and repair procedures that the automotive repair industry could utilize with a generic scan tool instead of requiring the use of a manufacturer-specific diagnostic scan tool. As such, some manufacturers have satisfied this requirement by implementing the recommended practices of SAE J2205 "Expanded Diagnostic Protocol for OBD II Scan Tools." Under this standard, proprietary test modes were defined so that a generic scan tool can execute the commands. In practice, however, both industry and staff believe this protocol is so difficult, cumbersome, and time consuming for a technician to use that it is not likely to be utilized by a significant percentage of technicians. Further, both vehicle manufacturers and scan tool manufacturers have found implementation of the software and hardware necessary to support the protocol to be burdensome and redundant with current manufacturer-specific protocols.

The staff proposes to modify the existing requirement to provide a less burdensome and more effective alternative that meets the original intent of this requirement. Specifically, the staff proposes an amendment that would allow manufacturers to specify in service literature developed under this section, proprietary diagnostic routines in their original format (i.e., not formatted for use by a generic scan tool). Manufacturers may do this if they make available (e.g., to independent service information vendors) the protocol and command information needed for independent tool makers to implement the routines into their products so that they will provide for emission-related diagnosis and repair in a comparable manner relative to manufacturer-specific diagnostic scan tools. Currently, many manufacturers already provide independent service information vendors (e.g., Equipment Tool Institute (ETI)) with the protocol and commands used by the manufacturers' equipment to access most, if not all, available diagnostic information. The service information vendors in turn distribute the information to service tool manufacturers. This allows independent scan tool manufacturers to produce products containing all of the expanded diagnostic commands and routines that the manufacturer's dealership repair facilities utilize for diagnosis and repair and is a process that appears to work effectively for both the vehicle manufacturers and the tool makers.

Lastly, as part of this requirement, the staff proposes to require that manufacturers make technical service bulletins (TSB's) available to the independent service industry on a same day basis, most likely via facsimile transmission. These TSB's are generally released separate from service manuals as issues arise in the field for which additional information is needed for effective service. Although independent technicians generally attempt to keep up to date on

all TSB's issued for particular vehicle makes, the staff has received indications from technicians that sometimes a specific TSB is not included in the service information on-hand due to its newness, or because it has somehow been left out by the service information provider. In such instances, the need for the TSB is often immediate to address a problem with a vehicle in the shop. Currently, the technician may order the TSB under federal requirements by overnight mail; however, by the time the order is processed and shipped, actual delivery time may be up to two days. The regulation would permit manufacturers to assess a reasonable charge for this expedited service.

Calibration Identification

Vehicle manufacturers issue calibration identification numbers (cal ID's) for the software contained in the on-board computer. As explained below, the staff believes that access to the cal ID will become more and more important in the near future to ensure proper vehicle service and inspection. As such the staff proposes a requirement for standardized access to the cal ID for the powertrain controller through the vehicle's serial data link.

During the course of a model year, manufacturers often issue "running change" or "field fix" software updates to correct driveability problems or other concerns. With manufacturers turning increasingly to electronically reprogrammable computers, technicians will increasingly need access to the cal ID to verify that the correct, and most up-to-date software is installed in a particular vehicle. In some instances, service procedures are predicated on the most up-to-date calibration being installed.

Electronic access to the cal ID would also provide a means to further reduce the chance for fraud in an OBD II based I/M program. The cal ID number is unique, at a minimum, to a particular vehicle model for a given model year. Therefore, should there be an attempt to enter the vehicle identification number (VIN) from one vehicle and download the OBD II information from another vehicle, for the purpose of hiding the presence of a detected malfunction, the mismatch between the VIN and the cal ID would be detected. Although such fraud would not be detected if the second vehicle were the same model and model year (including in some cases, the same engine size, transmission, and trim level) as the first, the staff believes that the availability of a similar second vehicle would not be likely.[15]

The staff proposes that manufacturers begin phasing in this requirement in the 2000 model year with full implementation in the 2002 model year. Manufacturers would be required to meet the cal ID requirements on 30 percent of the 2000 model year vehicles, 60 percent of the 2001 model year vehicles, and 100 percent of the 2002 model year vehicles. Small volume manufacturers would not be required to meet the 2000 and 2001 phase-in

[15]Electronic access to the VIN itself would further minimize this possibility for fraud; however, at this time, including the VIN as part of the on-board computer's software would be very burdensome for most manufacturers. Such an effort would require each vehicle coming off the assembly line to be uniquely programmed.

percentages. The format for the standardized access would be specified in Recommended Practice SAE J1979, incorporated by reference in the OBD II regulation. Industry representatives have already begun work to design the necessary computer commands.

Lastly, the proposed requirement will also help in addressing issues relative to aftermarket parts. For some aftermarket products, modifications to the vehicle's software are developed to ensure proper performance. Currently, the cal ID is generally not modified by the aftermarket manufacturer when installing the new product, making it difficult for service technicians to know that software changes have been made. Standardized electronic access to the cal ID would provide the groundwork for a future amendment to the current regulations governing aftermarket parts manufacturers. The aftermarket parts regulations could be amended to require aftermarket companies to assign a unique cal ID to modified software. Upon acceptance (i.e., "exemption" under Vehicle Code 27156) by ARB of an aftermarket part containing software modifications, staff would issue a new calibration number to the aftermarket company for their exempted modification. The aftermarket manufacturer would then be required to change the calibration identification number along with their other software changes and the list of valid calibrations for the vehicle in question would be updated. In this manner, approved aftermarket products would contain a unique calibration identification number that would be accepted as a valid number during I/M testing, further reducing confusion that currently happens in the field when technicians attempt to inspect a vehicle with an approved aftermarket modification but have no obvious means of verifying the installed software in the on-board computer.

OTHER PROPOSED MODIFICATIONS

In addition to the proposed modifications to the OBD II requirements that have already been discussed, the staff is proposing a number of more minor modifications. As manufacturers have implemented OBD II systems across all of their product lines, the staff has found that manufacturers have misunderstood or have been uncertain of the intent of some requirements. The proposed modifications would clarify the regulation in this respect, and would make adjustments to the requirements when necessary based on the staff's experience in reviewing OBD II system designs. The more notable modifications are presented below. A full listing of proposed amendments can be found in Appendix A.

Comprehensive Component Monitoring

In reviewing manufacturers' applications for OBD II system approval over the past few years, the staff has noted that the malfunction criteria for some comprehensive components have widely varied from manufacturer to manufacturer. To remove uncertainty regarding the minimum acceptable malfunction criteria for a few specific components, the staff has developed some guidelines for manufacturers.

Specifically, regarding the requirements to monitor for the time to reach closed-loop enable temperature for the engine coolant temperature sensor (section (b)(12.1.1)(C)), staff

proposes to identify maximum limits for the times manufacturers use in their diagnostics on most vehicles to ensure that the diagnostic employs a reasonable time limit. The diagnostic time is not to exceed two minutes for engine start temperatures above 50 degrees Fahrenheit or five minutes for engine start temperatures between 20 and 50 degrees Fahrenheit. However, with Executive Officer approval, manufacturers are allowed to extend the time for vehicles that normally take longer to warm-up or during driving conditions which may lead to false diagnosis of the sensor.

Staff is also proposing to clarify minimum acceptable malfunction criteria for idle air control system functional monitoring to ensure that manufacturers do not utilize unnecessarily excessive malfunction criteria. Staff has worked with industry to reach a common agreement as to acceptable malfunction criteria and has determined that at a minimum, the diagnostic must identify a malfunction when the idle air control system can no longer maintain the engine at a speed less than 200 rpm above or 100 rpm below the manufacturer's target idle speed. Again, with Executive Officer approval, manufacturers may utilize larger tolerances if justified and necessary to ensure monitoring system reliability.

V. IMPACT ON COSTS, THE ENVIRONMENT, AND BUSINESS AND ECONOMY OF THE STATE

COSTS

The staff believes that these amendments should not result in an incremental cost per vehicle. Although new monitoring requirements are proposed for PCV systems and thermostat monitoring, the requirements do not necessitate additional monitoring hardware. Further, the leadtime provided should allow for any necessary hardware modifications in a cost effective manner (e.g., in conjunction with normal engine design changes). Similarly, the inclusion of access to the software calibration identification and the algorithm to ensure the integrity of the software should not necessitate a new or even modified on-board computer design. In light of the proposed changes in the area of catalyst monitoring and misfire detection, the staff expects that the amendments proposed by staff will lessen the overall impact of the regulation on current vehicle designs. Specifically, manufacturers would have additional leadtime to implement vehicle and monitoring system changes to facilitate improved catalyst monitoring system performance and reliability. Further, the misfire detection amendments would allow manufacturers to foregoe additional substantial expenditures to bring engines with very low sales volumes (i.e., some 10 and 12 cylinder engines) into compliance.

Development costs also should not impact the cost per vehicle significantly in that the software developed can be used across multiple vehicle models and over multiple model years. Considering the large number of vehicles produced for most manufacturers, any cost per vehicle impact is expected to be negligible. Further, in addition to lessening the impact on vehicle hardware, the catalyst and misfire monitoring amendments should also decrease manufacturers' development costs, possibly in greater measure than those required for the new monitoring requirements.

Regarding the requirement for service information, the staff believes that manufacturers may encounter some initial added expense to convert service information into the required electronic format. However, overall, the electronic format is expected to provide for more efficient and less costly access to vehicle service information, as is evidenced by the fact that several manufacturers have already been working on converting service information to the proposed format. Further, the regulation allows for reasonable fees to be charged, permitting manufacturers to recover costs associated with this requirement.

THE ENVIRONMENT

The modifications proposed to the catalyst and misfire monitoring requirements may have some initial negative impact on the emission benefit of OBD II systems in that manufacturers would have additional leadtime to design systems complying with the enhanced requirements adopted in 1994. However, the staff believes that any negative impact will be more than offset by the emission benefits derived from PCV system monitoring, thermostat monitoring, and improved access to service information. Therefore, overall, the staff expects the proposed amendments would result in additional emission reductions from OBD II-equipped vehicles. The adjustment of the malfunction criterion for catalyst monitoring from 1.5 to 1.75 times the hydrocarbon standard is not expected to have a significant impact on the environment because it is still expected that catalyst system deterioration will on average be detected before emissions exceed 1.5 times the emission standard for all vehicles.

BUSINESS AND ECONOMY OF THE STATE OF CALIFORNIA

The modifications proposed by the staff should not have a negative impact on the economy of California, or employment or business within the state. The requirements are directed at manufacturers of new motor vehicles, nearly all of which are located outside of the state and, overall, would further facilitate OBD II compliance. By facilitating compliance, the amendments should, in fact, benefit California businesses, particularly new car dealerships by better ensuring full model availability within the state. Further, the amendments should benefit independent service establishments within the state by providing for better access and improved content of emission-related service and diagnostic information.

VI. REFERENCES

In addition to the sources cited in the body of this report, below is a list of comments and information that have been submitted to the ARB by motor vehicle manufacturers and other interested parties, which the ARB staff relied upon in proposing the amendments to the OBD II regulation. Some of the information has been identified as confidential by the providing parties.

Data and comments provided by Chrysler Corporation on April 30, 1996, regarding PCV system malfunctions.

Data and comments provided by Honda on July 22, 1996, regarding catalyst monitoring

Data and comments provided by General Motors on September 19, 1996, regarding misfire detection

Data and comments separately provided by Chrysler Corporation, Ford Motor Company, and General Motors on July 24, 1996, regarding catalyst monitoring

Data and comments provided by Toyota Motor Company on September 4, 1996, regarding catalyst monitoring

APPENDIX A

Listing of Proposed Regulatory Amendments in "Plain English"

Section (a)(1.1): In response to requests from manufacturers, a modification is proposed to allow the use of the International Standards Organization (ISO) engine symbol in place of the phrase "Check Engine" for purposes of the Malfunction Indicator Light (MIL). The staff believes use of the symbol will provide for equal effectiveness in alerting vehicle operators of malfunction concerns.

Sections (a)(1.9), (g)(3.0), (g)(4.2), (g)(4.3), (g)(4.4), and (n)(22.0): An amendment is proposed that would allow manufacturers to utilize a drive cycle other than the Federal Test Procedure (FTP) drive cycle for purposes of monitoring and demonstration testing. Specifically, the proposal would allow the use of the Unified Cycle if the manufacturer demonstrates that the alternative cycle will provide for more effective monitoring.

Section (a)(1.9): An amendment is proposed that would provide manufacturers an additional year to revise the protocol for illuminating the MIL and storing fault codes in compliance with changes adopted at the last Board hearing in 1994.

Section (a)(1.10): This section has been added to clarify that OBD II monitoring is also required for emission control devices not specifically addressed in the current requirements (e.g., future devices which have not yet been fully developed).

Section (a)(2.0): Language has been added to clarify that ambient engine starting temperature can be determined by either the intake air temperature sensor or the engine coolant temperature sensor.

Section (b)(1.2.2): Language has been added to establish an interim catalyst malfunction criterion for vehicles certified to meet the ultra-low emission vehicle (ULEV) standard prior to the 2002 model year. The malfunction criterion for all low emission vehicles has also been revised such that a catalyst system malfunction would be indicated when the tailpipe emission level exceeds 1.75 times the hydrocarbon standard instead of 1.5 times the standard. Additionally, the staff proposes to provide additional leadtime to manufacturers to meet the catalyst monitoring requirements for low emission vehicles by extending the final implementation date by two years.

Sections (b)(1.2.2), (b)(3.3.2), and (b)(4.2.2): A sentence is proposed in each of these sections which allows manufacturers to use equivalent phase-in schedules instead of the phase-in schedule specified in the regulation.

Section (b)(3.2)(A): In accordance with the proposed amendments to the MIL illumination protocol for misfire monitoring, language is proposed in this section to clarify the use of extended evaluation intervals before indicating a problem to the driver.

Section (b)(3.2)(B): For purposes of clarity, a sentence is proposed indicating that, with Executive Officer approval, manufacturers may use alternative evaluation intervals for misfire monitoring if the manufacturer demonstrates that it is equally effective and timely in detecting misfire malfunctions.

Section (b)(3.2)(C): To simplify the misfire monitoring requirements, the staff proposes to remove the requirement that manufacturers detect the amount of misfire that would fail an Inspection and Maintenance (I/M) program test. This request has proven to be somewhat redundant to that specified in section (b)(3.2)(B). Accordingly, the section has been deleted as well as the respective language in section (g)(2.4).

Section (b)(3.3.2): To provide more flexibility to manufacturers for meeting the phase-in requirements for enhanced misfire monitoring, amendments are proposed to provide additional leadtime. Further, language is proposed to clarify the requirement for misfire monitoring to begin immediately after engine starting.

Section (b)(3.3.3): Additional language is proposed to clarify the criteria for compliance with the misfire monitoring requirements regarding engines with small regions of limited misfire detection. Language is also proposed to more specifically define the monitoring requirements by listing specific evaluation criteria to be used by the Executive Officer and to clarify that manufacturers may disable misfire monitoring for no more than the first five seconds after engine start through the 2000 model year. Additionally, a sentence is proposed to exempt engines with more than eight cylinders from the expanded range monitoring requirements if the manufacturer employs the same misfire detection system (hardware and software) as used on smaller, fully compliant engines. At a minimum, misfire must be detected over the speed and load region of the FTP cycle.

Sections (b)(3.4.1) and (b)(3.4.2): To provide manufacturers with additional flexibility in meeting the misfire monitoring requirements, several changes are proposed to the protocol for illumination of the MIL and storage of fault codes. Manufacturers are allowed additional monitoring time to verify that a malfunction exists before any indication to the vehicle driver.

Section (b)(3.4.3): A clarification is proposed stating that manufacturers shall store engine operating conditions concurrently with storing a temporary misfire fault code. For purposes of determining if a misfire fault still exists during specific engine operating conditions, the engine operating window has been enlarged.

Section (b)(3.5.1): Diesel engine vehicle manufacturers have stated that, in general, diesel engines do not currently have engine hardware that allows them to identify which specific cylinder is misfiring. An amendment is proposed to exempt diesel engine vehicles from the requirement for cylinder identification if the vehicle does not have the hardware necessary to meet the requirement.

Section (b)(4.2.3): In response to manufacturers requests, staff proposes to provide limited short-term relief for evaporative system monitoring on vehicles with large and unique fuel tank configurations.

Section (b)(4.2.4): To be consistent with other monitoring requirements and encourage improved system design, an amendment is proposed to exempt manufacturers from detecting small leaks in the evaporative system if the small leak does not cause the vehicle emissions to exceed 1.5 times the applicable emission standards.

Section (b)(7.4.3): To be consistent with the proposed language in section (b)(3.4.3), staff proposes to enlarge the operating window used in fuel system monitoring for determining if a fault is present in the vehicle.

Section (b)(8.2.1): For purposes of clarification, language is proposed stating that oxygen sensors utilized for other monitors (e.g., catalyst monitoring) must be monitored for maintaining a minimum level of performance.

Section (b)(10): The staff proposes to add a new monitoring requirement for the positive crankcase ventilation (PCV) system. This previously unmonitored system can cause a significant emission impact if components in the system are disconnected. Thus, beginning in the 2002 model year, manufacturers would be required to detect disconnections in the system and indicate a system malfunction.

Section (b)(11): The staff proposes to add a new monitoring requirement for the thermostat. Under the proposal, beginning with the 2000 model year, manufacturers would be required to indicate a malfunction if the thermostat did not properly regulate coolant flow during engine warm-up.

Section (b)(12): This section has been renumbered from section (10) to section (12) to reflect the addition of the previous two requirements.

Section (b)(12.1.1)(A): For purposes of clarity, an additional sentence is proposed to state that input component monitoring must (if possible) identify malfunctions when a sensor reading is too high or too low.

Section (b)(12.1.1)(C): To ensure the coolant temperature sensor monitoring requirements are reasonably met, the staff proposes to define a maximum allowable time for diagnosing coolant temperature sensor malfunctions.

Section (b)(12.2.2)(B): To ensure monitoring systems implemented for idle speed control systems perform reasonably, language is proposed to identify a minimum acceptable level of performance for the diagnostic.

Section (b)(12.2.2)(C): An amendment is proposed to define the minimum acceptable functional diagnostic requirements for diesel engine glow plug monitoring.

Section (d): In response to requests from vehicle manufacturers, the staff proposes to remove all requirements for tampering protection of reprogrammable on-board computers.

Sections (f), (h)(3), (k)(1.0), (k)(2.0), (k)(3.0), and (k)(4.0): The staff proposes to update the referenced industry standards to the most recent published versions. The industry has incorporated a number of modifications to the referenced documents since they were referenced in 1994.

Section (g)(2.1): The staff proposes to delete text which is redundant with new text added in section (g)(4.6).

Sections (g)(2.3.3) and (g)(2.8): The staff proposes to change language to allow manufacturers to simulate fuel system malfunctions with control unit software modifications for purposes of demonstration testing.

Section (g)(4.6): The proposed section is added to allow manufacturers additional flexibility in meeting the demonstration testing requirements by allowing alternative testing procedures to be utilized.

Section (h)(7): For clarification, an added sentence is proposed to require manufacturers to submit detailed data quantifying the capability of their misfire monitor to detect misfire in three distinct patterns.

Section (i)(5): To be consistent with the additional leadtime proposed for catalyst monitoring in section (b)(1.2.2), the staff proposes to extend the higher, interim recall standards for catalyst failures through the 2003 model year for TLEV applications, and through the 1998 model year for all other applicable requirements. For LEV and ULEV applications, the staff proposes to extend the interim recall standards for all applicable malfunctions through the 2003 model year. The staff also proposes to extend the higher threshold recall provisions for all applicable malfunctions on early model year vehicles to include the 1997 model year.

Section (k)(1.0): By request from vehicle manufacturers, language is proposed to allow the use of a newer standardized communication protocol between a scan tool and the vehicle on-board computer.

Section (k)(2.1): Staff proposes to add language in this section to provide manufacturers with an additional option to satisfy this requirement. Specifically, manufacturers who make the software protocol and commands for enhanced diagnostic commands available to other diagnostic tool vendors will not be required to support any additional service procedures. Additionally, proposed language is added to require manufacturers to provide same day availability (e.g., fax transmission) of service information less than 20 pages in length upon request.

Section (k)(6.0): To improve serviceability of emission-related malfunctions in the field, the staff proposes to require manufacturers to provide their service information (e.g., service manuals and technical bulletins) in a standardized database format for electronic access beginning with the

2002 model year. This would allow independent service information vendors to compile the large quantities of service information for each vehicle make and model into a manageable format for non-dealer service facilities. Small volume manufacturers would be exempted from this requirement.

Section (l)(1.0): An amendment is proposed to require manufacturers to make the software calibration identification number (similar to a software version number) available through the diagnostic system connector. This would allow technicians to easily determine if the most recent software was installed on the vehicle.

Section (l)(3.0): Language is proposed to clarify that current oxygen sensor voltages must be made available through the standardized data link to assist technicians when diagnosing and repairing oxygen sensor faults. Additionally, a sentence is proposed to clarify that diagnostic test results shall not be stored as a value indicating a "failure" when all components and systems on the vehicle are functioning properly.

Section (l)(4.0): An amendment is proposed to require manufacturers to execute a "self-check" on the software in the on-board computer to confirm that the data is valid (e.g., not corrupted or altered).

Section (m)(6.1): The staff proposes to renumber the section references to reflect the addition of the two new requirements previously mentioned.

Section (n)(1.0): A sentence is proposed to define references to emission standards for catalyst malfunction determinations as only applicable to useful life emission standards.

Section (n)(6.0): The staff proposes to redefine a warm-up cycle for diesel vehicles to reflect the lower operating temperature at which diesel vehicles operate relative to gasoline vehicles.

Section (n)(13.0): Language is proposed to update the definition of a small-volume manufacturer to be consistent with the definition used in the California Low Emission Vehicle regulations.

Section (n)(20.0): For purposes of clarity and consistency, a definition of engine start is proposed.

Section (n)(21.0): Consistent with the proposed language to allow manufacturers to utilize an equivalent phase-in instead of the prescribed phase-in, a definition is proposed for an equivalent phase-in (i.e., one that achieves equal or higher emission reductions in the same time allotted for the required phase-in). A sample calculation is also included.

Section (n)(22.0): Consistent with the proposed language allowing the use of the Unified Cycle instead of the FTP cycle for monitoring purposes, language is proposed defining the Unified Cycle.