California Environmental Protection Agency

Air Resources Board

LOCATION:
Air Resources Board
Byron Sher Auditorium, Second Floor
1001 I Street
Sacramento, California 95814

This facility is accessible by public transit. For transit information, call (916) 321-BUSS, website: http://www.sacrt.com
(This facility is accessible to persons with disabilities.)

PUBLIC MEETING AGENDA

May 28,2009

TO SUBMIT WRITTEN COMMENTS ON AN AGENDA ITEM IN ADVANCE OF THE MEETING GO TO:
http://www.arb.ca.gov/lispub/comm/bclist.php

May 28,2009
9:00 a.m.

Agenda Item #

09-5-1: Health Update:· Reductions in Fine Particulate Matter (PM) and Improvements in life Expectancy

Staff will highlight a study that examines the changes in life expectancy associated with changes in ambient levels of fine PM in 51 cities, including San Francisco, San Jose, Los Angeles, and San Diego. The investigators were able to show a significant association between PM reductions and improvements in life expectancy.

09-5-5: Research Update: Assessment of Particulate Matter and Oxides of Nitrogen Retrofits for Diesel Control Program

Staff will update the Board on the status on an ongoing research study conducted by ARB to investigate the characteristics of tailpipe emissions from vehicle technologies meeting the latest emission standards. The emission control technologies tested include diesel oxidation catalysts, continuously regenerating diesel particulate filter systems, and selective catalytic reduction systems. Sample collection for heavy-duty vehicles over a range of driving conditions has been completed and shown to be highly effective.

09-5-3: Public Meeting to Consider the Local Government Toolkit for Reducing Greenhouse Gases

Staff will present ARB's California's Local Government Toolkit (Toolkit) which provides a "one-stop-shop" of guidance and resources to assist local governments with reducing greenhouse gas emissions. The Toolkit includes cost-saving actions, financial resources, California case studies, a decision-support tool, a peer-networking online discussion forum, and a climate leadership recognition program. (The Toolkit is located at www.coolcalifornia.org.)

09-5-2: Public Hearing to Consider the Proposed Amendments to the On-Board Diagnostic Regulations for Light-Duty, Medium-Duty, and Heavy-Duty Engines and Vehicles (OBD II and HD OBD) and Proposed Adoption of a Heavy-Duty On-Board Diagnostic Specific Enforcement Regulation

Staff's proposal would update the HD aBO requirements for heavy-duty engines, with most of the proposed amendments related to the diesel requirements. The proposed amendments to the aBO /I regulation are aimed at making the diesel-related requirements for medium-duty vehicles consistent with those being proposed for the HD aBO regulation. The proposal would also adopt an enforcement regulation which would detail enforcement procedures to be used for noncompliance issues of the HD aBO regulation.

09-5-4: Continuation of Public Hearing to Consider Adoption of Aftermarket Parts Certification ReqUirements for Plug-In Hybrid Electric Vehicles

Staff developed modifications to the new certification and installation requirements for aftermarket kits converting hybrid electric vehicles to plug-in hybrid electric vehicles originally presented at the January 23, 2009, Board hearing. The modified requirements will be presented for adoption.

09-5-6: Update the Board on Existing Grant Agreements for the Proposition 1B: Goods Movement Emission Reduction Program and the Lower-Emission School Bus Program

Staff will provide an update on the first installments of bond funding received to support this program. Staff will also describe and request Board support for the changes needed to existing grant agreements to reflect the delay in funding and incorporate other amendments requested by local agencies or ARB staff to improve implementation.

CLOSED SESSION - LITIGATION

The Board will hold a closed session, as authorized by Government Code section 11126(e), to confer with, and receive advice from, its legal counsel regarding the following pending litigation:

Central Valley Chrysler-Jeep, Inc. etal. v. Goldstene, US. Court of Appeals, Ninth Circuit, No. 08-17378 on appeal from US. District Court (E.D. Cal. - Fresno).

Fresno Dodge, Inc. et al. v. California Air Resources Board et al., Superior Court of California (Fresno County), Case No. 04CE CG03498.

General Motors Corp. et al. v. California Air Resources Board et al., Superior Court of California (Fresno County), Case No. 05CE CG02787.

State of California by and through Arnold Schwarzenegger, the California Air Resources Board, and the Attorney General v. US. Environmental Protection Agency and Stephen L. Johnson, Administrator, US. Court of Appeals, District of Columbia Circuit, Case No. 08-1178.

California Business Properties Association, et al. v. California Air Resources Board, Superior Court of California (Sacramento), Case No. 34-2009-80000232.

Green Mountain Chrys/er-Plymouth-Dodge-Jeep, et al. v. Crombie, 508 F.Supp.2d 295, U.S. District Court Vermont (2007), appeal to U.S. Court of *Appeals, Second Circuit, Nos. 07-4342-cv(L) and 07-4360-cv(CON).*

*Pacific Merchant Shipping Association v. Goldstene, U.*S. *District Court, EDCA,* Case *No. 2:09-CV-01151-MCE-EFB*

OPPORTUNITY FOR MEMBERS OF THE BOARD TO COMMENT ON MATTERS OF INTEREST

Board members may identify matters they would like to have noticed for consideration·at future meetings and comment on topics of *interest; no formal action on these topics will be taken without further notice.*

OPEN SESSION TO PROVIDE AN OPPORTUNITY FOR MEMBERS OF THE PUBLIC TO ADDRESS THE BOARD ON SUBJECT MATTERS WITHIN THE JURISDICTION OF THE BOARD

Although no formal Board·action may be taken, the Board is allowing an opportunity to interested members of *the public to address the Board on items* of *interest that are within the Board's jurisdiction, but do not specifically appear on the agenda. Each person will be allowed* a *maximum* of *three minutes to ensure that everyone* has a *chance to speak.*

THE AGENDA ITEMS LISTED ABOVE MAY BE CONSIDERED IN A DIFFERENT ORDER AT THE BOARD MEETING.

TO SUBMIT WRITTEN COMMENTS ON AN AGENDA ITEM IN ADVANCE OF THE MEETING GO TO:
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IF YOU HAVE ANY QUESTIONS, PLEASE CONTACT THE CLERK OF THE BOARD:
1001 I Street, 23rd Floor, Sacramento, California 95814
ARB Homepage: www.arb.ca.gov
(916) 322-5594

To request special accommodation or language needs, please contact the following:

If you require special accommodations or language needs, please contact the Clerk of the Board at (916) 322-5594 or by facsimile at (916) 322-3928 as soon as possible, but no later than 10 business days before the scheduled board hearing. TTYffDD/Speech to Speech users may dial 711 for the California Relay Service.

SMOKING IS NOT PERMITTED AT MEETINGS OF THE CALIFORNIA AIR RESOURCES BOARD

California Environmental Protection Agency Air Resources Board PUBLIC MEETING AGENDA	LOCATION: Air Resources Board 'Byron Sher Auditorium, Second Floor 1001 I Street Sacramento, California 95814
INDEX	This facility is accessible by public transit. For transit information, call (916) 321-BUSS, website: http://www.sacrt.com (This facility is accessible to persons with disabilities.)

May 28,2009
at 9:00 a.m.

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER TECHNICAL STATUS AND PROPOSED REVISIONS TO ON-BOARD DIAGNOSTIC SYSTEM REQUIREMENTS FOR PASSENGER CARS, LIGHT-DUTY TRUCKS, AND MEDIUM-DUTY VEHICLES AND ENGINES AND HEAVY-DUTY ENGINES ON-BOARD DIAGNOSTIC SYSTEM REQUIREMENTS, AND TO CONSIDER ENFORCEMENT PROVISIONS FOR HEAVY-DUTY ENGINES ON-BOARD DIAGNOSTIC SYSTEM REQUIREMENTS

The Air Resources Board (ARB or the Board) will conduct a public hearing at the time and place noted below to review the technical status and implementation of California's On-Board Diagnostic System Requirements for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II) and Heavy Duty Engines On-Board Diagnostic System Requirements (HD OBD) requirements. The Board will consider amendments to the aBO II and HD OBD regulations to update the diesel monitoring requirements, to make some requirements consistent between the aBO II and HD aBD regulations, and to clarify and improve the regulation where necessary, among other revisions. The Board will also consider adoption of enforcement provisions for heavy-duty engines with aBO systems.

DATE: May 28,2009

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium, Second Floor
1001 I Street
Sacramento, California 95814

This item will be considered at.a two-day meeting of the Board, which will commence at 9:00 a.m., May 28,2009, and may continue at 8:30 a.m., May 29,2009. This item may not be considered until May 29, 2009. Please consult the agenda for the meeting, which will be available at least ten days before May 28, 2009, to determine the day on which this item will be considered.

If you require special accommodations or language needs, please contact the Clerk of the Board at (916) 322-5594 or by Fax at (916) 322-3928 as soon as possible, but no later than 10 business days before the scheduled board hearing. TTYITDD/Speech to Speech users may dial 711 for the California Relay Service.

INFORMATIVE DIGEST OF PROPOSED ACTION AND POLICY STATEMENT OVERVIEW

Sections Affected: Proposed adoption of amendments to California Code of Regulations, title 13, section 1968.2 and section 1971.1; and proposed adoption of California Code of Regulations, title 13, section 1971.5 for 2010 and subsequent model year heavy-duty engines.

Documents Incorporated by Reference:

International Standards Organization (ISO) 15765-4:2005 "Road Vehicles - Diagnostics on Controller Area Network (CAN) - Part 4: Requirements for emission-related systems," January 2005.

Society of Automotive Engineers (SAE) J1.699-3 - "OBD II Compliance Test Cases", May 2006.

SAE J1930 "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms - Equivalent to ISOrrR 15031-2," October 2008.

SAE J1978 "OBD II S·can Tool- Equivalent to ISO/DIS 15031-4:December 14, 2001," April 2002.

SAE J1979 "E/E Diagnostic Test Modes," May 2007.

SAE J2012 "Diagnostic Trouble Code Definitions," December 2007.

SAE J2403 "Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature," August 2007.

SAE J2534-1 - "Recommended Practice for Pass-ThruVehicle Programming", December 2004.

SAE J1939 consisting of:

J1939 Recommended Practice for a Serial Control and. Communications Vehicle Network, March 2009;
J1939/1 Recommended Practice for Control and Communications Network for On-Highway Equipment, September 2000;
J1939/11 Physical Layer, 250K bits/s, Twisted Shielded Pair, September 2006;
J1939/13 Off-Board Diagnostic Connector, March 2004;
J1939/15 Reduced Physical Layer, 250K bits/sec, UN-Shielded Twisted Pair (UTP), August 2008;
J1939/21 Data Link Layer, December 2006;
J1939/31 Network Layer, April 2004;
J1939fi1 Vehicle Application Layer (Through February 2008), January 2009;
J1939fi3 Application Layer-Diagnostics, September 2006;
J1939/81 Network Management, May 2003; and
J1939/84 OBO Communications Compliance Test Cases For Heavy Duty Components and Vehicles, December 2008.

Background: OBO systems serve an important role in helping to ensure that engines and vehicles maintain low emissions throughout their full life. OBO systems monitor virtually all emission" controls on gasoline and diesel engines, including catalysts, particulate matter (PM) filters, exhaust gas recirculation systems, oxygen sensors, evaporative systems, fuel systems, and electronic powertrain components as well as other components and systems that can affect emissions when malfunctioning. The systems also provide specific diagnostic information in a standardized format through a standardized serial data link on-board the vehicles.

The Board originally adopted comprehensive OBO regulations in 1989, requiring all 1996 and newer model year passenger cars, light-duty trucks, and medium-duty vehicles and engines to be equipped with OBO systems (referred to as OBO II)." The Board has modified the regulation in regular updates since initial adoption to address manufacturers' implementation concerns and, where needed, to strengthen specific monitoring requirements. Most recently, the Board updated the OBO II requirements in 2006 to address several concerns and issues regarding the regulation (Cal Code Reg., title 13, §1968.2) and enforcement requirements (Cal. Code Regs., title 13, §1968.5). In 2004, the Board adopted the Engine Manufacturer Diagnostic system (EMD) regulation (Cal. Code Regs., title 13, §1971), which requires manufacturers of heavy-duty en"gines and vehicles (Le., vehicles with a gross vehicle weight rating greater than 14,000 pounds) to implement diagnostic systems on all 2007 and subsequent model year on-road heavy-duty Otto-cycle (gasoline) and diesel engines. However, the EMO regulation is much less comprehensive than the OBO II regulation, requiring the monitoring of only a few major emission control technologies and containing no standardized requirements, and was developed to require heavy-duty engine manufacturers to achieve a minimum level of diagnostic capability while focusing most of their resources on meeting the new 2007 exhaust emission standards. Subsequently, in 2005, ARB adopted California Code of Regulations, title 13, section 1971.1, which established comprehensive OBO requirements for "2010 and subsequent model year heavy-duty engines and vehicles.

Staff Proposal: In adopting the HO OBO requirements in 2005, the Board directed the staff to continue to follow manufacturers' progress towards meeting the regulation's requirements and to report back should modifications to the.requirements be deemed appropriate. Since then, staff has identified areas in which modifications to section 1971.1, would provide for improved monitoring system performance.

The proposed changes include revisions to the HO OBO regulation for diesel engines that relax the malfunction thresholds until 2013 model year for three major emission controls (PM filters, oxides of nitrogen (NOx) catalysts, and NOx sensors) based on the current limits of technical feasibility, delay the monitoring requirements for some catalyst-based components until 2013 to provide further leadtime for emission control strategies to stabilize, clarify terms or definitions for several monitors, expand the monitoring requirements for exhaust gas recirculation (EGR) and boost control to cover all types of system architectures, and provide for additional data to be output to a scan tool for use by technicians or ARB staff for diagnosis, repair, and determining compliance.

The proposed changes also include revisions to the HO OBO regulation for gasoline engines that are similar to those adopted in 2006 for light-duty gasoline vehicles. These changes would ensure robust detection of oxygen sensor slow response faults and specific fuel system faults that result in an imbalance from cylinder to cylinder.

Changes are also proposed to the light- and medium-duty OBO II "regulation primarily to harmonize the medium-duty diesel vehicle requirements with the proposed revisions noted above for HO OBO diesel engines to allow manufacturers of both heavy-duty and medium-duty diesel engines to design to and meet essentially the same requirements. Some of the proposed amendments, however, would also apply to light-duty vehicles covered by the aBO II regulation. "

Finally, a separate enforcement regulation for HO OBO is proposed (similar to the stand-alone enforcement regulation for the light- and medium-duty vehicles covered under the OBO II regulation) to define the procedures and criteria staff and manufacturers would be required to use in determining compliance of in-use engines with the HO OBO regulation.

Proposed amendments to the HO OBO regulation include:

- Clarifying storage and erasure of permanent fault codes.
- Adding flexibility to calculate the infrequent regeneration adjustment factors.
- Revising in-use monitoring frequency tracking for the PM filter monitor.
- Revising the definition of "idle" for several tracking requirements.
- Clarifying the definition of "continuous" monitoring for several monitors
- Revising diesel fuel system monitoring requirements for non-common rail systems to allow less frequent monitoring.
- Expanding monitoring for slow response faults in diesel boost pressure control systems to all types of boost control systems.
- Revising the 2010 through 2012 model year malfunction thresholds for the diesel PM filter monitor, the NOx catalyst monitor, and the NOx sensor monitor.
- Delaying some monitoring requirements for catalyzed PM filters and diesel NMHC converting catalysts to the 2013 model year.
- Oeleting the monitoring requirement for MIL circuit faults.
- Revising the gasoline fuel system monitoring requirements to add detection of failures caused by an air-fuel ratio cylinder imbalance.
- Revising the gasoline primary and secondary oxygen sensor monitoring requirements to clarify the minimum acceptable monitoring.
- Revising the cooling system monitoring requirements to include monitoring of faults that cause the coolant temperature to drop after the system reaches "warmed-up" temperature.
- Adding specific language for monitoring of emission control strategies.
- Updating the SAE and ISO document references.
- Adding data parameters that manufacturers must output to generic scan tools for diesel vehicles.
- Adding tracking requirements for emission-increasing auxiliary emission control devices (EI-AECO).

- Revising the service information requirements to be consistent with the stand-alone service information regulation (California Code of Regulations, title 13, §1969) for. the 2010-2012 model years.
- Revising the aging requirements and test data collection requirements for certification demonstration testing.

Concurrently, as stated, the staff is proposing to update the medium-duty vehicle diesel-related requirements in the light- and medium-duty aBO II regulation (§1968.2) to be consistent with the proposed diesel-related amendments to the HO aBO regulation. These proposed changes for medium-duty vehicles include diesel monitoring . requirements and diesel-related standardization requirements mentioned above. These changes also include clarification for several monitoring requirements that would apply to light- and medium-duty diesel vehicles. Additionally, in the aBO II regulation, staff is proposing to delay until the 2011 model year, the implementation of the gasoline primary 'oxygen sensor monitoring requirement that requires manufacturers to submit data demonstrating proper calibration and detection of all response rate malfunctions.

Lastly, staff had indicated during the adoption of the HO aBO regulations in 2005 that it intended to' develop and implement an HO aBO-specific enforcement regulation similar to that already implemented for light- and medium-duty aBO II (California Code of Regulations, title 13, §1968.5). Thus, staff is also proposing detailed procedures .. (proposed California Code of Regulations, title 13, §1971.5) for in-use enforcement testing of HO aBO systems installed on 2010 and subsequent model year heavy-duty engines. The proposed regulation would.set forth engine procurement and testing procedures that both ARB and engine manufacturers would have to follow for initial determination of possible HO aBO nonconformance. In addition, the proposal sets forth procedures that would be followed by both ARB and manufacturers if, after such testing, HD aBO systems of a tested engine group were found to be nonconforming. Among other provisions, the procedures would authorize ARB to take remedial action, which may include recall of vehicles in which the nonconforming systems are installed and assessment of monetary penalties against the affected manufacturer. Finally, staff is proposing a specific protocol to be followed by the Executive afficerand affected manufacturers in implementing remedial action plans.

At the Board's discretion, additional changes to the HO aBO or aBO II regulations may be considered to address concerns or provide additional flexibility or compliance options.

COMPARABLE FEDERAL REGULATIONS

In February 1993, the United States Environmental Protection Agency (U.S. EPA) promulgated final aBO requirements for federally certified light-duty vehicles and trucks. (40 CFR Part 86, §§ 86.094-2, 86.094-17, 86.094-18(a), 86.094-21 (h), 86.094-25(d), 86.094-30(f), 86.094-35(1), 86.095-30(f), 86.095-35(1); see 58 Fed.Reg. 9468-9488 (February 19, 1993).) The requirements were later amended to require aBO systems on medium-duty vehicles by the 2008 model year. The final rule with the latest modifications of the requirements was signed on November 29, 2005. A central part of the federal regulation is that, for purposes of federal certification of vehicles, U.S. EPA

Executive Officer has determined that the proposed regulatory action will not create eosts or savings in federal funding to the State, costs to any local agency or school district whether or not reimbursable by the State pu"rsuant to the Government Code, title 2, division 4, part 7 (commencing with section 17500) or other nondiscretionary savings to State or local agencies.

In developing this regulatory proposal, ARB staff evaluated the potential economic impacts on representative private persons and businesses, and has determined that any business or individual purchasing a light-, medium-duty, or heavy-duty diesel vehicle equipped with an OBO system would not incur additional costs as a result of these amendments. The agency is not aware of any cost impacts that a representative private person or business would necessarily incur in reasonable compliance with the proposed action.

The Executive Officer has made an initial determination, pursuant to Government Code section 11346.5(a)(8), that the proposed regulatory action will not have a significant statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with business in other states, or on representative private persons. Support for this determination is set forth in the Staff Report (ISOR).

In accordance with Government Code section 11346.3, the Executive Officer has determined that the proposed regulatory action would have minor or no impact on the creation and elimination of jobs within the State of California, the creation of new businesses or elimination of existing businesses within the State of California, or the expansion of businesses currently doing business within the State of California. A detailed assessment of the economic impacts of the proposed regulatory action can be found in the ISOR.

For manufacturers of light- and medium-duty gasoline and diesel engines and vehicles, the costs to comply with the proposed regulatory action are expected to be negligible. The proposed revisions consist primarily of modifications to existing computer software. Incorporation.and verification of the revised OBO software would be accomplished during the regular design updates at no additional cost. Asa result, costs to manufacturers, and therefore consumers, are anticipated to remain virtually unchanged.

Of the 34 domestic and foreign corporations that manufacturer California-certified passenger cars, light-duty trucks, and medium-duty gasoline and diesel vehicles' equipped with OBO II systems, only one motor vehicle manufacturing plant, the New United Motor Manufacturing, Inc. (NUMMI), a joint venture between Toyota Motor Corporation and General Motors Corporation, is located in California. As stated, the costs associated with the amendments principally involve research and development costs and. do not affect assembly line production.

Heavy-duty engine manufacturers, the businesses to which the proposed requirements primarily apply, are located outside of California. Although the proposed requirements have some application to manufacturers of heavy-duty vehicles (assemblers, coach builders, etc.) installed with California-certified heavy-duty engines, the requirements imposed are negligible.

The Executive Officer has also determined, pursuant to California Code of Regulations, title 1, section 4, that the proposed regulatory action will have no significant adverse effect on small businesses. The OBO II regulation primarily affects vehicle . manufacturers, none of which are small businesses.. For the HO OBO regulation, the additional costs per engine were determined to be negligible. Further, small businesses which service or repair vehicles should not see any increased cost in equipment or tools or any reduction in the number of vehicles needing repair as a result of these amendments. Small businesses that own or operate light-, medium-, and heavy-duty vehicles would incur the same costs as individuals or other businesses, which was determined to be negligible.

In accordance with Government Code sections 11346.3(c) and 11346.5(a)(11), the Executive Officer has previously found that the reporting requirements of the regulation which apply to businesses are necessary for the health, safety, and welfare of the people of the State of California.

Before taking final action on the proposed regulatory action, the Board must determine that no reasonable alternative considered by the agency or that has been otherwise identified and brought to the attention of 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

Interested members of the public may present comments relating to this matter orally or in writing at, the hearing, and in writing or bye-mail before the hearing. To be considered by the Board, written comments, not physically submitted at the hearing, must be received no later than 12:00 noon, May 27,2009, and addressed to the, following:

Postal mail: Clerk of the Board, Air Resources Board
1001 I Street, Sacramento, California 95814

Electronic submittal: http://www.arb.ca.gov/lispub/comm/bclist.php

Facsimile submittal: (916) 322-3928

Please note that under the California Public Records Act (Gov. Code, § 6250 et seq.), your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email, etc.) become part of the public record and can be released to the public upon request. Additionally, this information may become available via Google, Yahoo, and any other search engines.

The Board requests, but does not require, that 30 copies of any written statement be submitted and that all written statements be filed at least 10 days prior to the hearing so that ARB staff and Board Members have time to fully consider each comment. 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 REFERENCES

This regulatory action is proposed under that authority granted in Health and Safety Code, sections 39600,39601,43000.5,43013,43016,43018,43100,43101, 43104, 43105,43105.5,43106,43154,43205,43211, and 43212. This action is proposed to implement, interpret and make specific sections 39002, 39003, 39010-39060, 39515, 39600-39601,43000,43000.5;43004,43006,43013,43016,43018,43100,43101, 43102,43104,43105,43105.5,43106,43150-43156,43204,43205,43211, and 43212 of the Health·and Safety Code.

HEARING PROCEDURES

The public hearing will be conducted in accordance with the California Administrative Procedure Act, Government Code, title 2, division 3, part 1, chapter 3.5 (commencing with section 11340). Following the public hearing, the Board may adopt the regulatory language as originally proposed, or with non substantial 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" and that the regulatory lang,uage as modified could result from the proposed regulatory action; in such event, the full regulatory text, with the modifications clearly indicated, will be made ava,Hable 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 ARB's Public Information Office, 'Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, First Floor, Sacramento, California, 95814, (916) 322-2990.

CALIFORNIA AIR RESOURCES BOARD

James N. Goldstene
Executive Officer

Date: March 30, 2009

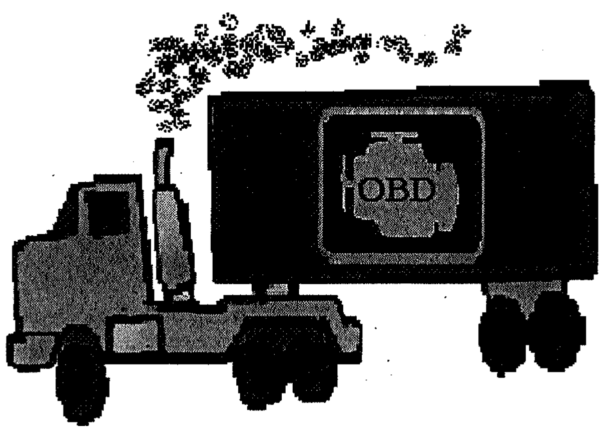
The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs see our Web site at www.arb.ca.qov.

State of California
AIR RESOURCES BOARD

STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

Technical Status and Revisions to Malfunction and Diagnostic System Requirements for Heavy-Duty Engines (HD OBD) and Passenger Cars, Light-Duty,Trucks, and Medium-Duty Vehicles and Engines (OBD II)

Date of Release: April 10, 2009
Scheduled for Consideration: May 28, 2009



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I. SUMMARY OF STAFF PROPOSAL AND RELATED POLICY ISSUES

Background

On-board diagnostic (aBO) systems are comprised mainly of software designed into the vehicle's on-board computer to detect emission control system malfunctions as they occur by monitoring virtually every component and system that can cause an increase in emissions. When an emission-related malfunction is detected, the aBO system alerts the vehicle owner by illuminating the malfunction indicator light (MIL) on the instrument panel. By alerting the owner of malfunctions as they occur, repairs can be sought promptly, which results in fewer emissions from the vehicle. Additionally, the aBO system stores important information including identification of the faulty component or system and the nature of the fault, which would allow for quick diagnosis and proper repair of the problem by technicians. This helps owners achieve less expensive repairs and promotes repairs done correctly the first time.

The California Air Resources Board (ARB) originally adopted the light- and medium-duty vehicle aBO regulation (aBO II) in 1989 for the 1996 and newer model years. As directed by the Board, the regulation has been reviewed and updated at regular updates since then. ARB also adopted separate heavy-duty aBO requirements (HO aBO) in 2005 that apply to 2010 and subsequent model year heavy-duty engines and vehicles (Le., vehicles with a gross vehicle weight rating greater than 14,000 pounds). Again, as directed by the Board, ARB staff has been meeting with manufacturers since the original rulemaking to review progress in meeting the requirements and has identified a number of issues that necessitate amendments to the regulations.

To address the issues, staff is proposing changes to the HO aBO regulation, California Code of Regulations (Cal. Code Regs.), title 13, section 1971.1 (included as Attachment A). Further, to harmonize these changes for heavy-duty engines and for medium-duty engines, staff is also proposing changes to the aBO II regulation, Cal. Code Regs., title 13, section 1968.2 (included as Attachment B). Lastly, as ARB staff indicated during the 2005 HO aBO rulemaking process, staff is proposing adoption of a HO aBO enforcement regulation, Cal. Code Regs., title 13, section 1971.5 (included as Attachment C), which would establish enforcement procedures and requirements.

Summary of Proposed Amendments

A summary of the issues and technical amendments is provided below while detailed explanations of each of these issues and amendments are provided in sections II . through VII of this report. Of the proposed amendments to the HO aBO and aBO II regulations, many have been largely agreed upon between ARB and manufacturers based on various discussions and meetings, and include the following:

- Clarifying storage 'and erasure of permanent fault codes.
- Revising in-use monitoring frequency tracking for the particulate matter (PM) filter monitor.

- Revising the definition of "idle" for several tracking requirements.
- Revising diesel fuel system monitoring requirements for .non-common rail systems.
- Revising the diesel PM filter monitor malfunction thresholds for 2010-2012 model years.
- Delaying some monitoring requirements for catalyzed PM filters and diesel NMHC converting catalysts to the 2013 model year.
- Deleting the monitoring requirement for MIL circuit faults.

Staff is also proposing amendments to the HD OBD requirements for gasoline engines to be consistent with those already required in the OBD II regulation, including the following:

- Requiring detection of air-fuel ratio cylinder imbalance failures. ,
- Clarifying the gasoline primary and secondary oxygen sensor monitoring requirements.

In addition to these proposed amendments, there are a few issues that ARB and manufacturers have not completely agreed upon. While manufacturers have expressed concerns with them, staff believes that they are necessary to ensure the integrity of the OBD systems. These amendments include:

Monitoring of *transmission vehicle speed sensors*
At the manufacturers' request, the HD OBD regulation currently excludes transmission components from the system unless the manufacturer specifically uses such a component for other monitors (e.g., uses transmission vehicle speed sensor to enable/disable PM filter monitoring). However, manufacturers have now indicated they need to use the vehicle speed input from the transmission but do not want to thoroughly monitor the vehicle speed sensor itself or to cover it under the emission warranty if it fails. Fundamentally, staff disagrees and stands behind the OBD policy-if a component is used for monitoring something else, the component itself must be monitored to ensure the integrity of the whole system. Deviation from this policy would allow development of non-robust system designs in which certain components (e.g., speed sensor) could fail and disable monitoring of more crucial emission controls (e.g., PM filter), and yet go undetected and uncorrected for indefinite periods of time.

NOx catalyst emission thresholds
Another issue is the malfunction threshold for NOx converting catalysts such as selective catalytic reduction (SCR) systems. Currently, manufacturers are required to detect a catalyst fault before tailpipe emissions exceed 0.5 g/bhp-hr NOx on 2010 engines with a NOx standard of 0.2 g/bhp-hr. Manufacturers have argued such a level is infeasible given current NOx sensor technology and that the threshold should be raised to 0.8 g/bhp-hr. After meeting with manufacturers, sensor suppliers, and analyzing what little data is available, ARB believes some increase is warranted although it is not convinced that the current NOx sensor capability necessitates raising the threshold as high as manufacturers have requested. Consequently, it is proposing a new threshold of 0.6 g/bhp-hr. ARB staff has identified several possible monitoring strategies that could be done with current NOX sensor technology and still meet the

proposed threshold. Additionally, manufacturers have not provided any data supporting their proposed threshold. .

AECD tracking .

Another proposed amendment of concern to heavy-duty manufacturers is the requirement to track in-use activity of auxiliary emission control devices (AECOs) that adversely affect emissions (emission-increasing AECOs, or EI-AECOs). Light- and medium-duty diesel manufacturers made similar arguments against tracking EI-AECOs when it was first adopted in the OBO II regulation in 2006. Then and now, manufacturers have argued that the OBO regulation is not the appropriate place for this requirement, that confidentiality would be compromised, and that the requirement would impose a large resource burden. Staff finds these arguments to be unsubstantiated and that this requirement is necessary to ensure that these EI-AECOs are active as infrequently as possible in-use (to minimize any associated adverse emission impact) and are implemented equitably by all manufacturers. In the OBO II regulation, staff modified its initial proposal to address or eliminate manufacturer concerns and the same amendments are now being proposed for the HO OBO regulation.

In addition to the above issues, there are three issues where staff and industry have stronger disagreements. These 'issues of controversy' involve provisions of the new enforcement regulation, aging requirements for demonstration testing, and accounting for emissions from infrequent regeneration events (e.g., PM filter regenerations) when calibrating.

Enforcement regulation

Manufacturers have objected to provisions within the newly-proposed HO OBO enforcement regulation (§1971.5) citing lack of legal authority and resource limitations. Specifically, the proposal requires manufacturers to perform testing on a limited number of their own engines after they have reached high mileage to ensure that OBO monitors are working properly. Since these requirements would require manufacturers to remove engines and emission controls from actual in-use vehicles and to emission test each threshold monitor on an engine dynamometer, manufacturers have argued that ARB has no authority to adopt requirements beyond certification and that this would impose significant added workload and costs that should instead be borne by ARB. Staff disagrees as ARB has clear authority to adopt enforcement test procedures to ensure its regulations are met and there is no restriction that such procedures are limited to items that are conducted prior to certification or limited to those ·carried out only by ARB. Further, performing these procedures would be a condition for certification and would be used to ensure engines are compliant with the other certification requirements consistent with other ARB regulations that require manufacturer compliance testing. Under the procedures, ARB would also have the authority to perform enforcement testing but given the complexity, expense, and lack of an ARB facility capable of such engine dynamometer emission testing, it is expected that ARB will be heavily reliant on the self-testing done by manufacturers for enforcement purposes. Manufacturers on the other hand, have the facilities and expertise to test their own engines and emission controls as it is already a necessary part of development, calibration, and certification.

Regarding workload and costs to perform such testing, ARB is proposing manufacturers test 1-3 engines per year (depending on the number of engine families sold by the engine manufacturer) and has done a cost analysis (see section XI.) for this testing. Staff's analysis found the increased costs to be less than $2 per engine produced by a typical manufacturer (or less than 0.01 percent of the engine retail cost). Given that the testing would not typically be conducted until three to four years after the engine is first sold, staff also believes that testing resources (personnel, lab availability, etc.) will be adequately available and will not infringe upon the testing needed for 2010 or 2013 model year calibration workloads. Further, ARB investigated cheaper alternatives to engine dynamometer testing such as screening engines using portable emission measurement systems while the engine is still in the vehicle or using chassis (vehicle) dynamometers to determine if further testing is warranted. Unfortunately, several complications were encountered that, at this time, render such screening infeasible. Staff has discussed this with industry and, given that the first engines would not likely be tested until the 2013 calendar year, has indicated that it is still open to alternative testing suggestions that may be taken into consideration in a future regulatory update.

Demonstration Testing

An essential element of the current regulation requires manufacturers to perform demonstration testing prior to certification. Depending on the size of the manufacturer, manufacturers would have to perform a series of emission tests on 1-3 engine families per year to confirm a subset of aBD monitors are calibrated correctly (e.g., that a fault is detected before emissions exceed 2.0 times the tailpipe standards). While this 'spot-check' testing is done on a prototype engine prior to certification, manufacturers and staff have disagreed as to the level of aging that is needed on the engine and emission controls for this testing. Staff has proposed amendments that would require a manufacturer, by 2016, to develop and validate aging procedures that would allow them to rapidly simulate high mileage and do the demonstration testing on a complete system (engine and emission controls) that is aged to the equivalent of full useful life (the point up to which the tailpipe emission standards apply such as 435,000 miles for the heaviest engines). Manufacturers have instead proposed that they be allowed to age only portions of the emission controls (specifically, the aftertreatment) and not age the engine or other emission controls. Further, they have proposed that they be required to age to a much lower mileage point and 'extrapolate' or project likely emission levels from there. They argue that staff's proposed requirement that they validate their aging cycles by gathering data on actual in-use high mileage engines is unnecessary. Staff disagrees, having found that because diesel engines and emission controls are becoming more and more complex, staff's proposal is the only way to accurately determine how high emissions will be when a fault occurs. Accordingly, manufacturers should be required to generate high-mileage systems that represent both the engine and emission controls in that it is the only way to ensure that a manufacturer's aging procedure produces aged systems similar to those of engines in-use.

Infrequent Regeneration Adjustment Factors (IRAFs)

For normal tailpipe certification, manufacturers are currently required to include the emissions from infrequent regeneration events, such as a PM filter regeneration that may happen every 300 miles, and account for such emissions by averaging them out over the frequency with which they occur. For example, an event that happens once every ten FTP emission tests would be spread out over all ten so that 1/10th of the increase is.added to each individual test before being compared to the emission standard. Similarly, when calibrating for OBO emission threshold monitors (e.g., NMHC catalyst conversion efficiency faults that must be detected before emissions exceed 2.5 times the FTP standard), manufacturers are required to assess the impact of the fault on their baseline calc,ulated IRAF.so that a fault is detected before the emissions exceed the threshold including accounting for these infrequent regeneration events. Much concern has been raised by manufacturers about the current requirements to account for IRAFs when calibrating HO OBO systems including the necessity of it and especially the cost and resources to do so. Staff and manufacturers made progress towards a common ground by agreeing to account for IRAFs primarily by using engineering analysis and/or data to estimate modifications to the baseline IRAFs rather than full rigorous development of new IRAFs for each malfunction. However, staff and manufacturers have disagreed on how best to implement such engineering jUdgment/allowances in the regulation. The current proposal requires manufacturers to develop and submit their estimates to ARB and for ARB to approve the estimates upon the manufacturer providing data and/or engineering evaluation demonstrating the procedure used to develop the 'estimates is consistent with good engineering judgment. The manufacturers, however, have argued that they are unsure as to what constitutes good 'enough' engineering judgment to be accepted by ARB. Manufacturers have proposed modifications that would limit the number of monitors they would have to investigate or develop separate IRAFs for because they are concerned that staffwill be unreasonable or disagree as to what is good engineering judgment. This argument seems specious in that sound engineering judgment underlies a number of OBO decisions that ARB must make and has not previously been a significant issue of controversy. This includes determining what kind of malfunction is most likely to yield the highest emissions for a given threshold-based monitored component and deciding what kind of driving cycle will reveal the highest emission increase to determine whether a component even needs to be functionally monitored. What matters most in all engineering evaluations is that the analysis and data used in arriving at the decision are documented and well-founded. Further, in the case of IRAF adjustment factors, should an engineering evaluation ultimately contain a flaw that isn't easily anticipated by the manufacturer or ARB and results in higher than expected regeneration emission impacts during in-use compliance testing, the proposed heavy-duty OBO enforcement regulation provides relief in two forms. First, through the 2012 model year, ARB will use the adjusted IRAF estimated by the manufacturer at the time of certification for determining compliance even if testing of in-use engines shows the estimate to be wrong. Second, the ARB will not consider a system noncompliant if it is 'caused by something that could not have been reasonably foreseen by the manufacturer.

Emission and cost impacts

Emission benefits, costs, and cost-effectiveness were calculated when the HO OBO regulation was originally adopted in 2005. While the proposed amendments to the HO

OBD regulation do not materially alter the previously calculated values, changes to the base emission inventory in the last few years has necessitated new calculations. The proposed HD enforcement regulation also adds new costs that have not previously been considered. The new analysis has found the lifetime HD OBD emission benefits including the amendments would be 165 pounds of ROG, 2000 pounds of NOx, and 14 pounds of PM per heavy-duty engine. It has further found that, including the proposed amendments, the HD OBD requirements result in a $132.39 increase in retail price of the engine plus an additional $1.97 for the new enforcement regulation. When combined with an estimated $496 increase in emission repair costs for items that previously would have gone undetected and uncorrected, the cost-effectiveness of the HD OBD program would be $0.15 per pound of ROG + NOx and $22.50 per pound of PM. Both values compare favorably with the cost-effectiveness of other recently adopted regulations. Further details of the emission benefit, costs, and cost-effectiveness calculations are in sections X. and XI.

Recommendation

ARB staff recommends that the Board adopt the amendments to the OBD II and HD OBD regulations and adopt the HD OBD enforcement regulation as proposed in the Initial Statement of Reasons.

II. TECHNICAL STATUS UPDATE AND PROPOSED REVISIONS TO HEAVY-DUTY' OBD MONITORING REQUIREMENTS

A. INFREQUENT REGENERATION ADJUSTMENT FACTORS

Diesel emission control technology has been rapidly evolving in recent years to allow engines to achieve compliance with lower tailpipe standards. However, some of the new emission controls do not work in a traditional manner of continuously reducing emissions. Instead, these components effectively reduce emissions for some amount of time and then temporarily require an alternate mode of operation to renewlregenerate the component before it can resume effectively reducing emissions. Two examples of such emission controls are the particulate matter (PM) filter, which typically requires an active regeneration event every 300 to 500 miles to burn off the accumulated soot, and an oxides of nitrogen (NOx) adsorber, which periodically requires a desulfurization event. When these infrequent, but periodic, events occur, tailpipe emissions can increase dramatically and exceed the allowable tailpipe standards. Accordingly, the tailpipe standards require diesel engine manufacturers to account for these infrequent emission increases and include them as part of their emission measurement when determining compliance with the tailpipe standard. Since these events occur infrequently, the emission test procedures define a method for manufacturers to account for the additional emissions by taking into account the frequency of the events, the magnitude of emission increase of the event, and the duration of the event. For a simple example, take a regeneration event that is active once within every ten emission tests, causes an emission increase of 1.3 grams per brake-horsepower hour (g/bhp-hr) NOx, and takes less than one emission test to complete. The emission test procedures would require one-tenth of the 1.3 g/bhp-hr increase, or 0.13 g/bhp-hr, to be added to emission test results obtained without the event, and this total would be compared to the tailpipe emission standard. This method allows the excess emissions generated during the infrequent event to be spread out across all emission tests between successive events and to provide a representative average emission level from the vehicle. Manufacturers are all aware of these provisions and have been performing such measurements as part of .their certification process since they began using emission controls with infrequent regeneration events.

Within OBO, there are several malfunctions that are required to be detected prior to emissions exceeding defined tailpipe levels (e.g., prior to emissions exceeding 2.0 times the standard). Because infrequent regeneration events do affect overall emissions from the vehicle, the OBD regulation also requires diesel engine manufacturers to account for these events when calibrating diagnostics that are tied to defined emission levels. Further, the presence of the malfunction itself can affect the regeneration event (in frequency, duration, or even magnitude of emission increase) so manufacturers are currently required to take those effects into account and calibrate such that the average emission level from the engine, including adjustments for infrequent regeneration events with a malfunction present, is at or below the required aBO malfunction threshold. However, engine manufacturers have requested this requirement to account for impacts on infrequent regeneration adjustment factors when calibrating OBO monitors (§1968.2(d)(6.2)) be eliminated or changed.

First, manufacturers have argued that the additional testing time and resources to properly determine the adjustment factors are significant and costly. Second, the tailpipe emission certification process already ensures the emission solution is robust and includes the emission impact of the infrequent regeneration processes. Thus, they argue, there is little added benefit in determining unique infrequent regeneration adjustment factors (IRAFs) for each OBO malfunction. Accordingly, they have asked staff to eliminate the requirement to account for changes in IRAFs due to threshold parts and to either ignore IRAFs altogether or to allow the certification IRAFs to be applied instead. ARB, however, does not agree with the manufacturers' position and is not proposing elimination or modification of this requirement.

Manufacturers have indicated it takes substantial test time and resources to establish IRAFs for tailpipe certification and repeating that process for each OBO threshold would be an enormous task. ARB staff, however, believes manufacturers would not need to repeat the entire process to determine what, if any, impact the presence of a malfunctioning component will have on IRAFs. The costs and resources necessary should be very limited, requiring only a small amount of additional resources and emission testing (if needed), and should be nowhere near the level of effort required to generate the baseline factors for tailpipe certification. For this reason, staff's cost analysis apportioned only a small amount of resources to the specific task of determining unique IRAFs. The engineers that are carrying out calibration of OBO malfunctions (which involves iterative emission testing with a varying degree of a malfunctioning part) must have a detailed understanding of the engine and interactions between various components, especially in cases where a component is, malfunctioning. This knowledge is necessary to design a robust diagnostic that will comprehend these interactions and still make correct decisions. This is the very same type of knowledge staff expects manufacturers to use to determine if there is an impact to the adjustment factors that warrants further analysis or testing to identify the magnitude of the change to the baseline factors. Specifically, the baseline factors would only be affected if the implanted malfunction causes significantly higher PM accumulation rates in the PM filter (such that active regeneration would be triggered more frequently) or causes emissions during an actual regeneration event to be significantly different. Staff expects manufacturers to be able to reasonably estimate whether either of those two cases is likely and, for those that are, use existing or additional emission test data to determine the impact. The baseline factors would then be scaled accordingly.

Manufacturers have argued that they conduct lengthy test processes to accurately quantify the interval between regeneration events for tailpipe certification and repeating such tests would be a costly use of resources. However, it is not expected that a manufacturer would have to implant the fault and continue testing until a regeneration event occurs to be able to make that determination. Manufacturers would be able to reasonably extrapolate the fmpact using shorter test intervals by looking at data captured during the iterative emission testing being done for the OBO threshold calibration. As an example, by gathering data of the PM filter loading (e.g., by looking at engine-out PM emissions or more likely, the rate of accumulation for the various regeneration triggers) during testing with an implanted malfunction and comparing it to baseline testing, manufacturers would be able to determine if the malfunction is likely going to lead to more frequent or less frequent regeneration and by how much. Such data would be sufficient to determine the necessary adjustment to the baseline .frequency factor. For those malfunctions that the manufacturer has determined are likely to have an impact on regeneration emissions themselves, manufacturers may have to carry out an additional test with a malfunctioning component present and regeneration active and compare the results to the baseline'to determine the magnitude of the adjustment to the baseline factors. However, even this 'additional' test may likely be encountered during the normal calibration of the OBO threshold or could be intrusively triggered by inserting a loaded PM filter or altering the regeneration triggers to force the regeneration to happen while the faulty part is in'stalled. As the manufacturer applies similar strategies and controls across its product line, this process would likely be refined even further to make capturing the necessary data an automatic step during the calibration process and thus, virtually eliminate the need for any additional testing. , .

Some manufacturers have suggested they would encounter substantial additional testing to develop adjusted IRAFs in spite of staff examples of how the process could be shortened using engineering judgment. Manufacturers claim that they cannot be sure their own engineering.judgment is "good enough." They believe that, to ensure emissions are below required IRAF-based OBO thresholds with a faulty component present, nothing short of full-scale·testing could be used. Manufacturers have even proposed modifications that would limit the number of monitors they would have to investigate or develop separate IRAFs for because they are concerned that staff will be unreasonable or disagree as to what good engineering jUdgment consists of. This argument seems specious, however, since a great deal of aBO decisions require sound engineering judgment to be applied - from determining what kind of malfunction is most likely to yield the highest emissions for a given threshold-based monitored component to deciding what kind of driving cycle will reveal the highest emission increase to determine whether a component even needs to be functionally monitored. What matters most is that the analysis and data used in arriving at the adjusted IRAF are documented and well-founded. Should an estimating methodology contain a flaw that isn't easily antfcipated, leading .to higher than expected regeneration emission impacts during in-use compliance testing or some other reasonably non-anticipated effect takes place, the proposed heavy-duty aBO enforcement regulation (§1971.5) provides relief in that ARB may not consider a system noncompliant if it is caused by something that could not have been reasonably foreseen by the manufacturer.

In aBO, there are several malfunction thresholds that require calibration to ensure malfunctions are detected before they exceed prescribed emission limits. These malfunctions may affect engine-out emission levels or aftertreatment performance (e.g., conversion efficiency of pollutants) which, in turn, can alter the regeneration frequency or emission levels during a regeneration event much more than when all components in the system are operating normally. Therefore, the manufacturers' position that the baseline tailpipe emission certification process already accounts for the emission impact of the infrequent regeneration processes is incorrect. Without re-determining the frequency or measuring the new emission levels, a manufacturer cannot verify that the total emissions from the vehicle, on average, will be at or below the required aBO threshold levels when a fault is.detected. For example, if manufacturers were not required to adjust the IRAF for a malfunctioning oxidation catalyst when calibrating the oxidation catalyst monitor, the manufacturer would likely be able to calibrate the system to only detect a fault when an oxidation catalyst was completely missing since the impact of the catalyst on emissions during non-regeneration is generally very small. However, during a regeneration event, where emission levels can be 10 or more times above the emission standard with a properly operating system, a missing catalyst can cause those emissions to be substantially higher still. One manufacturer reported to ARB that emissions were so high during a regeneration event with a malfunctioning catalyst that they were unable to measure the results in their emission test cell. The manufacturers' suggested approaches of applying the baseline IRAFs and/or n·ot taking into account the higher emissions would lead to a much higher emission level in the real world before a malfunctioning catalyst would be detected.

After further discussions with engine manufacturers, the manufacturers have generally agreed to the need to account for IRAFs when calibrating malfunction thresholds, but have proposed language that imposes substantial limitations on what is required of manufacturers, attempts to define what data is good enough and acceptable for approval, and sets timelines for approval of a manufacturer's IRAFs. Specifically, manufacturers proposed that the number of emission threshold monitors for which they would be required to obtain new data to support the IRAF estimations be limited (e.g., maximum of two to four monitors), regardless of how many monitors actually impact need new IRAF estimations. Additionally, they proposed that ARB be required to approve the IRAFs at least six months before the manufacturer's target approval date for the aBO system or one month after they submitted the IRAF estimations and data for review and approval, and proposed that they be allowed to carry-over the IRAF estimations for up to three model years if errors were found in the estimation between the time of IRAF approval and the target aBO approval date. Staff does not believe any of the proposed modifications are appropriate and the manufacturers concerns are unfounded. As noted above, there are many aspects of emission regulations and compliance (and engine design, for that matter) that rely on manufacturers using sound engineering judgment. Further, the aBO staff has a demonstrated history of working with manufacturers for well over 10 years and the aBO program could not be where it is now if the staff was unreasonable with manufacturers on the eve of certification or could not reach common ground on what constitutes good engineering judgment. Artificially limiting the number of monitors for which a modified IRAF needs to be calculated when' it is known that other monitors definitively adversely effect emissions in-use is also inappropriate. Manufacturers that define robust emission control solutions that are tolerant of faults will have fewer monitors that affect IRAFs while those that define less robust solutions may have more adverse interactions when components deteriorate. Limiting the number of monitors that have to be accounted for would reward those with inferior design solutions and result in higher in-use emissions when faults occur relative to those that design robust solutions.

B. DIESEL FUEL SYSTEM MONITORING

The regulation currently requires diesel manufacturers to continuously monitor for fuel system pressure control malfunctions. While some manufacturers have implemented common rail fuel systems, which can readily be monitored continuously for pressure malfunctions, others have expressed concerns that fuel pressure monitoring cannot be done continuously for non-common rail systems such as electronically controlled, mechanically actuated, unit injector systems. Based on the current design of the unit injector system, where fuel pressure is generated within each individual injector as opposed to via a high-pressure fuel pump as used in a common-rail system, the only method identified by the manufacturers to continuously monitor the fuel pressure would be to add a pressure sensor in each injector, which may not be a practical solution. Manufacturers contend there are no other viable solutions for continuous fuel pressure monitoring for unit injector systems. Manufacturers indicate, however, that they can monitor for fuel pressure faults by running an intrusive monitor once per trip under constrained conditions and believe such a monitor will be able to robustly detect all faults that would affect fuel pressure. Accordingly, manufacturers have asked ARB to change the regulation to only require monitoring to be conducted once per trip on non-common rail systems.

It is important to achieve proper fuel pressure in a diesel engine to maintain low emission levels. Continuous monitoring of the fuel pressure would ensure that if there was a problem, even it if only affected a portion of the engine operating conditions or if it had a varying impact (e.g., a big impact in some regions and a small impact in other regions), it would reliably get detected as long as operation in impacted regions was encountered. Conversely, with a once-per-trip monitor that only runs under a subset of engine operating conditions, only faults that impact the region where monitoring occurs will be reliably detected.

However, ARB does agree that it would be very difficult, if possible, to continuously monitor the fuel pressure on unit injector systems or fuel systems that achieve injection fuel pressure within the injector or increase pressure within the injector (e.g. in the injector of an amplified common rail system) given their current design, and is thus proposing to not require continuous fuel pressure monitoring for these systems. Proper fuel pressure, however, is still critical for emissions and staff is concerned about different faults that may only impact specific regions of the engine operating conditions. As a compromise, staff is proposing a change that would allow once per trip monitoring of fuel pressure, but manufacturers would be required to demonstrate that the diagnostic (or diagnostics) can detect all failure modes which would lead to a fuel pressure problem within the entire range of engine operating conditions and before emissions exceed the aBO malfunction thresholds. A manufacturer would be required to submit details of their system and a failure analysis, such as a failure mode and effects analysis, identifying all possible failure modes and the effect each has on fuel pressure across the entire range of engine operating conditions. If different faults can cause pressure problems in exclusive regions (e.g., some only affect idle and some only affect off-idle), the manufacturer would be required to implement more than one diagnostic or enable the diagnostic in various operating conditions to cover the regions where faults could occur and use logic to ensure such faults are robustly detected.

In addition to the above proposal, based on discussions with some manufacturers working on their fuel pressure control monitors, ARB has identified an area where further clarification would be beneficial. Specifically, manufacturers have asked questions about whether they should be using a single injector fault or a fault that equally affects all cylinders when calibrating the fuel pressure, quantity, and timing monitors to the aBO thresholds. Staff generally tries to pick a reasonable compromise between calibrating for all possible combinations of failures and a manageable number of combinations. Therefore, staff is proposing that for fuel pressure, quantity, and timing monitoring for systems that have single component failures which could affect a single injector (e.g., systems that build injection pressure within the injector that could have a single component pressure fault caused by the injector itself), manufacturers would be responsible for calibrating for both a single cylinder fault that causes the system to reach. the malfunction criterion as well as a fault tHat equally affects all cylinders such that the malfunction criterion is reached starting in the 2013 model year. Staff believes this represents reasonable coverage for failures in use, be it a gradual deterioration or fault that affects all cylinders virtually equally or a more severe degradation or malfunction of a single injector that by itself causes such an emission increase. For systems that achieve injection pressure outside of the injector (e.g., common-rail systems), staff is proposing that for fuel quantity and timing monitoring, manufacturers would be required to calibrate for both a single cylinder fault and a fault that equally affects all cylinders, while for fuel pressure monitoring, manufacturers would only be required to calibrate for a fault that equally affects all cylinders. Staffs rationale for the difference in fuel pressure monitoring is that systems like a common-rail system achieve injection pressure independent of the individual injectors and are unlikely to have a pressure fault affecting a single cylinder (but are still susceptible to quantity or timing faults that would affect a single cylinder or all cylinders equally).

Staff is also proposing modifications to the MIL illumination and fault code storage protocol for fuel pressure control monitoring that are similar to the current requirements for gasoline fuel system monitoring. Specifically, the regulation would require fault detection to be more robust to failures that only occur within· specific operating conditions by using similar conditions for maturing and clearing of faults. The use of similar conditions, which include engine speed, load, and warm-up status, provides for more consistent detection of faults that are routinely present in some operation conditions (e.g., high load) but are not present in others (e.g., idle). Manufacturers have indicated that they are controlling fuel pressure to substantially different levels during various engine operating conditions and staff is concerned that, as a result, faults are more likely to have inconsistent impacts across the engine speed and load map. Absent the use of similar conditions, a fault that is present every time high load conditions are encountered and absent every time idle is encountered could go for extended periods of time where the fault is detected and subsequently erased based solely on driver behavior. Similar conditions would only allow such a fault to be matured or erased under high load conditions and provide for more Gonsistent detection. These modifications would apply to 2013 and subsequent model year engines.

C. DIESEL EXHAUST GAS RECIRCULATION (EGR) SYSTEM MONITORING

Staff is proposing amendments to the monitoring requirements that would clarify the requirements for various types of EGR systems. Currently, the monitoring requirements were written with the premise that the system would have direct feedback-control of EGR flow, as staff had believed that almost all manufacturers would use such systems. However, based on discussions with manufacturers as they review their plans for 2010 and later engines, the monitoring requirements needed to be modified to account for a broader range of systems. Examples include control systems that technically use closed-loop control of other parameters such as fresh air flow or cylinder intake air concentration and control EGR flow to achieve the desired target instead of direct closed loop control of EGR flow. As detection of emission-related faults of these systems is important, regardless of whether or not they are directly feedback controlled, staff proposed amendments to the malfunction criteria for these monitors to indicate a fault tied to the "expected" EGR flow, rather than solely referring to the "commanded" EGR flow.

Staff is also proposing amendments regarding EGR catalysts. Several manufacturers have implemented or proposed configurations which utilize a dedicated catalyst in the EGR system to convert hydrocarbons or soluble organic fractions (SOFs) prior to the exhaust gas being routed through the EGR cooler or valve. Manufacturers have indicated this catalyst reduces fouling of the cooler and/or valve, thereby prolonging the durability and performance of the EGR system. While manufacturers have argued that back to back tests comparing the emissions of a system with and without such a catalyst will show no measurable emission increase, they have acknowledged that a malfunction of the catalyst will eventually lead to higher emissions as the cooler and/or valve become fouled, reducing the effectiveness of the cooler or restricting flow through the system. Eventually, such fouling will cause an EGR cooler or flow fault to be detected but it is unclear how long higher emissions may be present or how much more rapidly a failed catalyst will cause subsequent failure of the cooler or valve. To avoid these excess emissions, the proposed amendments would require monitoring of EGR catalysts beginning with the 2013 model year. Staff believes that the current monitoring requirements would already require monitoring of this catalyst under the 'other emission control' section but discussions with manufacturers have indicated that this technology may also be phased out in the next few years as manufacturers determine such a part is not necessary.. While it has not generally been acceptable to add an emission control component and have it be unmonitored, staff believes a deviation from policy until the 2013 model year is appropriate for several reasons. Such reasons include failure of the catalyst does not immediately lead to an emission increase but rather a more rapid deterioration of another emission component, the other emission component (EGR cooler and/or EGR valve) is monitored and will eventually set a fault once its performance is compromised, and the component appears to be used by very few manufacturers in the interim but will not likely be used long term. Most manufacturers have systems that do not use this component and either do without it altogether, or in some limited cases, use the normal catalyst and/or PM filter in the exhaust to perform this function by putting the inlet to the EGR system further down the exhaust stream and after the catalyst or PM filter. In cases where such designs prevail, the additional leadtime until 2013 will allow manufacturers to transition to such designs.

Additional proposed changes to the EGR system monitoring requirements are discussed under section II.T. (Emission Control Strategies) below.

D. DIESEL BOOST PRESSURE CONTROL SYSTEM MONITORING

For diesel boost pressure control systems, staff is proposing changes to account for systems that are not equipped with variable geometry turbochargers (VGT) systems. Currently, only VGT systems are monitored for slow response failures (e.g., malfunctions that cause the VGT itself to take longer than expected to achieve the desired VGT position.). Discussions with manufacturers have identified that malfunctions that cause the system to take longer to achieve desired boost levels can affect emissions, regardless of the boost hardware architecture. Accordingly, staff is broadening the slow response malfunction criteria to apply to all boost systems, regardless of whether the system uses a VGT, and to make the criteria based on the response of the system to achieve the actual boost rather than on the response of one of the individual actuators to achieve a certain position. It should be noted that most manufacturers have indicated that slow response boost failures rarely could get bad enough that they would cause emissions to exceed the OBD threshold and thus, are subject only to a functional monitor. Further, most manufacturers are able to demonstrate that the under and over boost monitors meet the definition of a functional check for slow response by demonstrating they detect induced response failures with such diagnostics before emissions are too high. This proposed requirement, however, will ensure that any manufacturer who has a larger sensitivity to slow response boost malfunctions will be required to detect faults before emissions exceed the prescribed threshold levels.

Similar to the proposed amendments for EGR system monitoring, staff is also proposing amendments to the monitoring requirements that would attempt to clarify the requirements for various types of boost pressure control systems. Currently, the monitoring requirements were written with the premise that all systems would have direct feedback-control of boost pressure, as staff had believed that almost all manufacturers would use such systems. However, based on discussions with manufacturers as they review their plans for 2010 and later engines, the monitoring requirements needed to be modified to account for a broader range of systems. Examples include open loop boost pressure systems or control systems that technically use closed-loop control of other parameters such as fresh air flow or cylinder intake air concentration and control boost pressure to achieve the desired target instead of direct closed loop control of boost pressure. As detection of emission-related faults of these systems is important, regardless of whether or not they are directly feedback controlled, staff proposed amendments to the malfunction criteria for these monitors to indicate a fault tied to the "expected" boost pressure, rather than solely referring to the "commanded" boost pressure.

Additional proposed changes to the boost pressure control system monitoring requirements are discussed under section II.T. (Emission Control Strategies) below.

E. DIESEL NON-METHANE HYDROCARBON (NMHC) CONVERTING CATALYST MONITORING

The regulation currently requires diesel engine manufacturers to design the OBD system to detect an NMHC catalyst malfunction when the catalyst conversion capability decreases to the point that NMHC emissions exceed 2.5 times the applicable standard for 2010 model year engines. However, if a catalyst malfunction does not result in emissions exceeding this threshold, the regulation allows the manufacturer to detect a malfunction when the catalyst has no detectable amount of NMHC conversion capability. Monitoring of NMHC conversion performance is also required for catalyzed PM filters, with monitoring similarly required at 2.5 times the applicable standard or, if emissions cannot exceed that level, for complete failure of the NMHC-catalyzing function. The regulation also currently requires manufacturers to monitor the NMHC catalyst for its ability to perform other emission-related functions. Specifically, monitoring is required to ensure that the catalyst performance is sufficient to provide an exotherm necessary for PM filter regeneration and, if applicable, to generate a desired feedgas (e.g., nitrogen dioxide (N02)) to promote better performance in a downstream aftertreatment component (e.g., for higher NOx conversion efficiency in a selective catalytic reduction (SCR) system).

With respect to NMHC-converting catalyst monitoring, engine manufacturers are concerned that total failure of NMHC catalysts will push emissions over the threshold and force them to implement threshold monitors. Furthermore, they do not believe that there is any monitoring technology that can robustly detect anything other than a completely failed NMHC catalyst. Lastly, they believe the current requirement of determining and applying an adjusted IRAF when determining the emission level of a malfunctioning catalyst exacerbates this problem by requiring them to detect a less degraded catalyst. Accordingly, manufacturers have asked ARB to raise the threshold to 4.0 times the NMHC standard and remove the requirement to develop and apply an adjusted IRAF so that manufacturers would very likely only have to implement functional monitors.

Staff, however, does not agree with the manufacturers' assessment of the current monitoring technology, and is not proposing any changes to the current malfunction thresholds. Staff believes that there are currently feasible methods to perform threshold monitoring of the NMHC catalyst. For discerning a good from bad catalyst, manufacturers have primarily focused on whether the catalyst can generate a sufficient exotherm and have concluded that a catalyst is either able to produce a sufficient exotherm (and thus, is perfectly adequate) or it is unable to produce a sufficient exotherm (and thus, is completely failed). Manufacturers have concluded from such analysis that there is no level of catalyst degradation between perfectly adequate and completely failed and that an exotherm monitor can only discern those two states. However, in talking with suppliers and individual manufacturers, catalysts do indeed have intermediate levels of deterioration that cause increases in light-off temperature and lower conversion efficiencies. By looking more closely at the catalyst behavior during active regeneration (e.g., by investigating how much time and/or fuel is needed to generate an exotherm, tracking the actual temperature rise from the exotherm versus the expected, and using better temperature sensors), manufacturers may be able to better determine the characteristics exhibited as an NMHC catalyst degrades (even if it is still capable of eventually getting to a high enough exotherm to achieve regeneration of the PM filter). As an alternate approach, there are at least two light-duty manufacturers that are planning on monitoring the catalyst during a cold start. Often combined with an accelerated catalyst light-off strategy similar in concept to what many gasoline manufacturers use, this monitoring approach tracks the light-off and/or temperature rise characteristics to evaluate the catalyst during intrusive actions intended to bring the catalyst up to the desired temperature quickly after a cold start.

Along with improved monitoring approaches, manufacturers have the ability to reduce the emission impact associated with a malfunctioning catalyst. For example, engine-out NMHC emission levels have a direct impact on the emission levels from a malfunctioning NMHC catalyst. The lower the engine-out emissions, the lower the tailpipe emissions for a given level of degraded catalyst. In addition to looking into reducing engine-out emissions, manufacturers can also look into reducing emissions d.uring a regeneration event Manufacturers have generally indicated that without an NMHC catalyst, baseline tailpipe NMHC emissions are very close to the NMHC standard (still under in some cases, slightly over in others) and nowhere near the aBO malfunction criteria of 2.5 times the standard. However, when an active regeneration of the PM filter occurs and the NMHC catalyst is degraded or non-functional, emissions can be very high. Accordingly, when defining the level of degraded catalyst that reaches the aBO malfunction threshold (e.g., 2.5 times the standard), the emissions during the PM filter regeneration are the primary emission contributors. Because manufacturers are required to account for changes in regenOeration emissions in the form of an adjusted IRAF, the 'threshold' NMHC catalyst is almost exclusively defined by the impact on regeneration emissions. The more infrequent the regenerations or the smaller the emission increase during regeneration, the more tolerant the system is of a degraded catalyst before the aBO malfunction criterion is reached. Again, manufacturers have the ability to directly reduce the emission impact associated with a malfunctioning catalyst by minimizing emissions during a PM filter regeneration event Manufacturers that have less refined control strategies for regeneration (e.g.,' injecting fixed quantities of fuel regardless of the observed temperature riselreaction of the catalyst) will have higher associated emissions while those that more closely regulate the regeneration event can take quicker action to terminate or reduce fueling when the expected reaction does not occur. At least two manufacturers have taken this approach to be able to meet a lower tailpipe emission level with a degraded catalyst that their catalyst monitor is able to identify as a malfunction.

Similar to their argument for NMHC converting catalyst monitoring, manufacturers have also asked for the 2010 model year threshold to be raised from 2.5 to 4.0 times the standard for catalyzed PM filter NMHC conversion monitoring to ensure that only a functional check would be needed. Staff has been talking with suppliers and individual manufacturers regarding the use and monitoring of catalyzed PM filters. While there is no consistent trend in industry, many are looking at catalyzed PM filters and acknowledging that the incremental cost of a catalyzed PM filter is not insignificant As such, those that are using catalyzed PM filters are doing so because they are realizing actual benefits. Most have stated that it simply 'helps out' with regeneration without being able to quantify the actual impact Discussions with others indicate that the catalyzed coating leads to higher levels of passive regeneration at lower exhaust temperatures, helps convert hydrocarbon (HC) and carbon monoxide created during an active regeneration, and can help generate Na_2 feedgas for downstream SCR systems. Again, given the importance of these tasks and manufacturers' acknowledgment that they are spending extra money to have these functions, it is appropriate that monitoring be required. If the reasoning behind having the catalyzed coating is the impact on passive regeneration, then this function should be able to be monitored by looking at regeneration frequency or rate of soot loading increase under conditions where high levels of passive regeneration are expected. At least one heavy-duty manufacturer believes that there will be a detectable difference in active regeneration frequency between a PM filter with and without the catalyzed coating and is designing their 2010 monitor to detect this. However, staff acknowledges that manufacturers are scrambling to finish their systems for the 2010 model year and many are behind schedule on aBO development because the emission calibrations are not finalized. The success of the monitoring approaches outlined above may be highly dependent on the actual catalyst configuration, significance of the catalyst loading on the PM filter, and regeneration strategy (especially reliance on high levels of passive regeneration). Accordingly, staff is proposing to delay the monitoring requirements of the catalyst function of catalyzed PM filters until the 2013 model year to give manufacturers more time to refine their systems, optimize regeneration strategies, and better investigate the impacts of the catalyzed PM filter.

For monitoring of the NMHC catalysfs ability to generate a desired feedgas used to improve performance of a downstream aftertreatment component, manufacturers have indicated that insufficient knowledge exists about what property of the catalyst causes the desired feedgas and thus have argued that there is no feasible or known method to verify that such function is still properly operating. Further, manufacturers have indicated that the impact of such a failure is decreased efficiency of the downstream aftertreatment component (e.g., SCR system).. Accordingly, manufacturers have asked ARB to eliminate the requirement to directly verify the NMHC catalyst generates sufficient feedgas for other components and to instead rely on monitoring of the downstream component (e.g., SCR system) to detect a failure if the impact is large enough to cause emissions to exceed the OBD malfunction criteria.

However, the manufacturer's claim that they have insufficient knowledge about the mechanism of the catalyst that creates the desirable feedgas is not supported. Staff has met with various suppliers to the manufacturers who have indicated that they understand the properties of the catalyst extremely well and alter specific components to achieve the feedgas generation the manufacturers are asking for. In most cases, the catalyst is being used to oxidize nitric oxide (NO) to NOz to increase the relative NOz levels, which can help oxidize soot in a PM filter (leading to higher levels of passive regeneration of the PM filter or more effective active regenerations) and, perhaps more importantly, can improve NOx conversion efficiency in an SCR system. Using a catalyst to generate such a feedgasis not that new of a technology as there are even retrofit devices certified by ARB for use on older model year diesel engines that take advantage of these catalyst properties. Further, discussions with suppliers indicate that this catalyst function is likely to be the first to deteriorate and would·not be accompanied with a substantial change in the catalyst's HC conversion efficiency or ability to generate an exotherm. As such, staff believes that being able to determine whether the catalyst is still performing this function is essential and is concerned that a failure of this function will not likely be detected by the NMHC catalyst monitoring strategies mentioned above.

The manufacturers' proposal would require the failure of this function to be detected only if it alone causes the SCR system conversion efficiency to drop so far that it exceeds the OBD thresholds for the SCR system (approximately 2.5 to 3.0 times the standard). Staff does not believe this is an acceptable solution because, while failure of this NMHC catalyst property will lead to decreased SCR NOx conversion efficiency and likely higher tailpipe NOx levels, it is not expected to cause a large enough impact to exceed the SCR catalyst threshold. Under this scenario, this NMHC catalyst property could be completely non-functional, tailpipe emissions will be increased by some amount, and the system will continue to operate without any indication to the operator that a malfunction has occurred. Further, if the SCR system itself eventually degraded enough that the combined impact of the upstream catalyst and the SCR catalyst efficiency exceeded the threshold and illuminated the MIL, technicians would likely only replace the SCR catalyst components to extinguish the MIL. This repair sequence would result in essentially a partial repair-emissions would never be returned to the levels they were at when the upstream catalyst was also properly functioning. At this time, the most promising monitoring technology for verifying this function of the catalyst is some form of an SCR system NOx conversion efficiency evaluation to detect lower than expected conversion efficiencies in the absence of the proper feedgas. One heavy-duty manufacturer has indicated its intent to detect such a malfunction by evaluating the NOx conversion efficiency across the SCR system during specific operating conditions. If successful, this manufacturer would be able to detect a fault when this property of the NMHC catalyst was gone but the SCR system was still operating properly.

If the catalyst's ability to generate NO_2 also. has a significant impact on PM filter regeneration, another possible monitoring approach would involve evaluation of PM filter regeneration characteristics. In cases where the catalyst is used to promote high levels of passive regeneration, manufacturers may be able to identify a malfunction when backpressiJre or. other soot loading measures indicate much higher loading than expected if passive regeneration was working correctly. Given the importance of proper feedgas generation to PM filter regeneration and/or proper SCR system NOx conversion efficiency and the information from suppliers that this catalyst property will likely deteriorate first, staff is not proposing to adopt the changes suggested by the manufacturers. However, staff acknowledges that the monitoring approach of looking at SCR system conversion efficiency does ultimately rely on SCR system configuration and NOx sensor accuracy and is concerned that the monito"r resolution may be insufficient in the 2010 timeframe. Additionally, for monitoring approaches looking at PM filter regeneration, the ability to discern properly operating systems from " malfunctioning systems may be highly dependent on the manufacturer's catalyst configuration and regeneration strategy. Accordingly, staff is proposing to delay functional monitoring of proper feedgas generation until the 2013 model year. This additional leadtime should provide manufacturers the ability to better understand the catalyst properties used to generate the feedgas, optimize and refine catalyst configurations and PM filter regeneration strategies, and gain experience with NOx sensors and SCR systems to investigate areas where feedgas generation is expected to be high or have a substantial impact on conversion efficiency and focus on those regions for possible monitoring approaches.

Additionally, to be consistent with the recent OBD" regulation update, staff is proposing to add specific language detailing the requirements for manufacturers to functionally . monitor an NMHC-converting catalyst used to prevent ammonia slip downstream of an SCR system. Under the current regulation, all NMHC-converting catalysts have to be monitored but specific details were only provided for the most common types of catalysts such as catalysts used to generate an exotherm for PM filter regeneration or catalyzed PM filters. As has been traditionally done in the OBD regulatory updates, as new emission control technologies become more defined, staff adds more specific language to clarify the requirements that apply to that technology. This often removes the need for manufacturers to submit a monitoring plan (e.g., as is required in the 'other emission controls' section) and gives clear direction to manufacturers as to what is expected.

Staff is also proposing modifications to the emission thresholds manufacturers are required to calibrate NMHC catalyst monitors to. Currently, the HD OBD regulation requires manufacturers to detect an NMHC-converting catalyst malfunction before emissions exceed a specific NMHC emission threshold because staff thought that, in every case, NMHC emissions would be the dominant pollutant affected by a degraded NMHC catalyst system. However, as manufacturers finalize their designs for 2010, staff has observed a tremendous amount of variation in emission control solutions including many cases where the interactions of various emission controls and strategies cause previously unanticipated results. In some cases, a malfunction of a NMHC emission control component has caused a rather large increase in NOx emissions. As an example, a degraded NMHC catalyst can lead to more frequent or extended PM filter regeneration events. And, some manufacturers disable NOx controls during a PM filter regeneration event. Accordingly, more frequent and longer PM filter regeneration events lead to more operation with NOx controls disabled and significantly higher NOx emission levels. Thus, even though the root failure is of a component intended to reduce NMHC emissions, the in-use emissions impact may actually be dominated by NOx emissions. As the intent of OBO is to ensure malfunctions of emission components are detected before tailpipe emission levels of any criteria pollutant are too high, it would be inappropriate to allow excess emissions of one pollutant solely because the malfunctioning emission control is 'primarily' intended to control another pollutant. Thus, staff is proposing to require manufacturers to detect catalyst malfunctions before a specific NOx threshold is exceeded in addition to the currently-required NMHC threshold. Specifically, starting with the 2013 model year, manufacturers would be required to detect a fault before NMHC emissions exceeded 2.0 times the applicable standard or NOx emissions exceeded the applicable NOx standard by more than 0.2 g/bhp-hr, whichever occurs first. It is still expected in the vast majority of cases that the NMHC emission threshold will be the dominant factor when detecting malfunctioning NMHC converting catalyst systems. However, in the rare case that a manufacturer's particular design has other interactions or synergistic effects that cause NOx emissions to substantially increase, this change will ensure that a fault is detected before NOx emissions are substantially higher.

F. DIESEL OXIDES OF NITROGEN (NOx) CONVERTING CATALYST MONITORING

The regulation currently requires diesel manufacturers to monitor the NOx catalyst(s) for proper conversion capability and to detect a catalyst malfunction before NOx emissions exceed the applicable NOx standard by more than 0.3 g/bhp-hr for the 2010 model year. The regulation also requires engines equipped with SCR systems or other catalyst systems that utilize an active/intrusive reductant injection to monitor these systems for proper performance. Manufacturers have expressed concern that the current NOx sensor technology will not provide the accuracy at low concentration levels necessary for OBO monitoring of the SCR catalyst. According to manufacturers, a fresh production NOx sensor currently has a tolerance of +/- 6 parts-per-million (ppm) while an aged NOx sensor currently has a tolerance of +/- 15 ppm. Further, they indicated that the average NOx emissions over the federal test procedure (FTP) transient cycle would have to be roughly 20 ppm to meet the 0.2 g/bhp-hr NOx tailpipe standards for 2010 while concentrations would be roughly 50 ppm at the OBD threshold of 0.3 g/bhp-hr above the standard. Therefore, using an aged +/- 15 ppm NOx sensor to robustly discern a properly operating system at 20 ppm (that could read as high as 35 ppm) from a malfunctioning system at 50 ppm (that could read as low as 35 ppm) would not provide sufficient separation to be feasible. Based upon a paper assessment of the NOx sensor capability as an SCR monitoring device, manufacturers have indicated that to meet the 2010 model year requirements, an aged NOx sensor's accuracy would need to be about +/- 5 ppm, and that a sensor with such an accuracy will not be available in time to meet the 2010 requirements. Thus, manufacturers have asked staff to relax the OBO malfunction threshold for the 2010 model year to a level of 0.6 g/bhp-hr (or 60. ppm) above the NOx tailpipe standard instead of 0.3 g/bhp-hr (or 30 ppm) above the NOx tailpipe standard.

ARB is not convinced that the current NOx sensor capability necessitates raising the SCR catalyst monitor threshold as high as manufacturers have requested. . Manufacturers have not provided engineering test data from actual calibrations to support their assessment of SCR monitoring capability, even after staff sent specific requests for this supporting data, and have based their claims primarily on a paper assessment using 'average' concentrations over an entire emission test. Average concentrations generally are not very helpful in determining technical feasibility as an SCR catalyst diagnostic would typically be constrained to run under very specific operating conditions where the best separation between good and bad exists. It is expected that a degraded SCR catalyst would not lead to universally higher NOx emissions throughout the emission test but rather to larger increases during very specific conditions (e.g., accelerations, higher load cruises).and actual concentrations are only relevant during those specific conditions. Based on very limited data received, it appears that degraded catalysts do indeed affect emissions most in specific operating conditions where expected NOx concentrations are higher and current sensor accuracy is less of an issue. ARB does, however, believe that some interim relief is needed to address some remaining uncertainties with NOx sensor durability and separation at high mileage and is proposing to raise the OBO malfunction threshold to 0.4 g/bhp-hr (or 40 ppm) above the NOx tailpipe standard for the 2010 through 2012 model years (concurrently, this same threshold will also apply for 2010 through 2012 model year NOx sensor performance monitoring). Based on the manufacturers' over-simplified analysis, this would require discerning a 20 ppm system (reading as high as 35 ppm) from a 60 ppm system (reading as low as 45 ppm). As explained below, manufacturers should be able to be more selective when monitoring is conducted to provide even more separation than this.

In addition to improved NOx se.nsors not being available for 2010, some manufacturers have argued that the OBO malfunction threshold for SCR catalyst monitoring should be raised more than the proposed 0.4 g/bhp-hr above the NOx tailpipe standard due to the effects of the surrounding exhaust heat on the electronic NOx sensor module tolerance. Manufacturers have stated that the sensor supplier will only warrant an accuracy of +/- 18 ppm when NOx sensor module temperatures exceed an upper limit. Staff has considered this point but does not agree that the OBO malfunction threshold for SCR catalyst monitoring should be raised any higher for this reason. Staff believes most manufacturers will be able to design or configure an aftertreatment system to avoid exposing the electronic NOx sensor module to such excessive temperatures under the vast majority of vehicle operation and to keep the NOx sensor module within the supplier's specifications. During rare extreme conditions when high temperatures cannot be avoided (e.g. particulate matter filter regeneration), manufacturers can disable the SCR catalyst monitor in these limited regions by using parameters within the OBO system to identify these extreme .conditions. Staff considers it unacceptable to design a system that encounters these excessive temperatures in the majority of vehicle operation thereby preventing the SCR catalyst monitor from having a reasonable in-use monitoring frequency.

Despite some manufacturers' claims that improved NOx sensors are needed to monitor the SCR system, other manufacturers have identified different monitoring strategies that utilize current NOx sensor technology to successfully monitor the SCR catalyst. Most of these strategies rely upon monitoring the SCR catalyst only under normally occurring conditions where NOx concentrations are higher. Staff has been shown data indicating that sustained periods of operation above the 'average' 20 ppm NOx concentrations with a properly functioning SCR system are occurring during both the FTP transient cycle and the supplemental emission test (SET) cycle on engines designed to meet the 2010 NOx standard. Some manufacturers have provided data showing sustained periods of operation above 60 ppm NOx concentrations that naturally occur during the SET cycle, usually during transient conditions from high load to lower load conditions. At higher NOx concentrations (greater than 60 ppm), the accuracy of the NOx sensor is not as critical (e.g., an accuracy of +/- 15 ppm has less relative influence if you are measuring a concentration of 60 ppm instead of 20 ppm for good system) and can provide sufficient separation between a good catalyst and a threshold catalyst.

Manufacturers could design their SCR monitors to run when these higher NOx concentrations are either occurring naturally or created intrusively. Staff has data from a manufacturer that demonstrates the ability to intrusively increase the NOxoutput of an engine by decreasing exhaust gas recirculation (EGR) under specific engine operating conditions to run other emission-related diagnostics. Therefore, staff believes it is feasible to use the concept of intrusively increasing engine out NOx emissions and to calibrate an SCR catalyst monitor that will both be able to monitor the catalyst with currently available NOx sensors and be within the proposed OBO thresholds. An example of how this could be done is by defining specific engine operating conditions and intrusively reducing EGR flow to temporarily increase inlet (and outlet) SCR catalyst

NOx concentrations. While intrusive diagnostics that increase emissions are generally avoided, the negative emission impact of intentionally increasing NOx to the SCR catalyst could be minimized by appropriately increasing reductant injection dosing to the SCR catalyst such that properly operating systems still result in low SCR outlet NOx concentrations while malfunctioning systems would show larger relative outlet levels due to the decreased conversion efficiency and increased inlet levels.

In addition to monitoring only at higher NOx levels, alternative methods of monitoring the SCR catalyst conversion efficiency may be available. Staff believes it is feasible to intrusively perform SCR catalyst monitoring by temporarily disabling or altering reductant injection to optimize conditions for catalyst monitoring. Manufacturers have argued that they cannot afford to perform such intrusive strategies because of the negative emission consequence of reduced/disabled reductant injection. However, staff has data from an SCR system showing reductant injection being completely disabled temporarily with no adverse emission impact due to the reductant storage properties of an SCR catalyst. This data suggests that there may be a possibility to infer SCR catalyst·NOx conversion efficiency by measuring reductant storage capability if the two parameters can be correlated. Such a strategy would require disabling the dosing and watching for a reaction in the rear NOx sensor. If the sensor saw an increase in NOx soon after disablement, it would indicate poor reductant storage (and potentially correlate to poor NOx conversion efficiency). If the sensor did not see an increase in NOx after some amount of time, the system could conclude the catalyst was working correctly and resume reductant delivery. This strategy offers the potential to avoid any negative emission consequence during monitoring of the SCR catalyst while the catalyst is good by terminating the monitor before any NOx breakthrough has occurred.

Lastly, the HO OBO regulation requires manufacturers to detect a NOx converting catalyst malfunction before emissions exceed a specific NOx emission threshold. Originally, staff thought that, in every case, NOx emissions would be the dominant pollutant affected by a degraded NOx catalyst system such as SCR. However, as mentioned in section II.E. for NMHC converting catalysts, staff has observed a tremendous amount of variation in emission control solutions including many cases where the interactions of various emission controls and strategies cause previously unantiCipated results. As the intent of OBO is to ensure malfunctions of emission components are detected before tailpipe emission levels of any criteria pollutant are too high, it would be inappropriate to allow excess emissions of one pollutant solely because the malfunctioning emission control is 'primarily' intended to control another pollutant. Thus, staff is proposing to add language to ensure that NOx converting catalyst malfunctions are detected before NOx or NMHC emissions, whichever happens first, exceed specified levels. It is still expected in the vast majority of cases that the NOx emission threshold will be the dominant factor when detecting malfunctioning NOx converting catalyst systems like SCR. However, in the rare case that a manufacturer's particular design has other interactions or synergistic effects that cause NMHC emissions to substantially increase, this change will ensure that a fault is detected before NMHC emissions exceed 2.0 times the applicable standard. To ensure any manufacturer with such a rare interaction has sufficient leadtime to calibrate properly, the proposed NMHC threshold would not be applicable until the 2013 model year.

G. DIESEL NOx AOSORBER MONITORING

The HO OBO regulation currently requires manufacturers to detect NOx adsorber malfunctions before emissions exceeded a specific NOx threshold. Similar to the proposed NOx converting catalyst monitoring revisions mentioned above and for the same reasons, staff is also proposing to require manufacturers to detect NOx adsorber malfunctions before a specific NMHC threshold is exceeded in addition to the currently-required NOx threshold. Specifically, starting with the 2013 model year, manufacturers would be required to detect a fault before NOx emissions exceeded the applicable NOx standard by more than 0.2 g/bhp-hr or NMHC emissions exceeded 2.0 times the applicable standard.

Additionally, staff. is proposing language similar to what is currently required for NMHC and NOx converting catalyst monitoring regarding malfunction criteria determination with multiple adsorbers. Specifically, in order to determine the proper OBO malfunction threshold for the NOx adsorber, manufacturers would be required to progressively deteriorate or "age" the adsorber to the point where emissions exceed the malfunction threshold. The method used to age the adsorbers must be representative of real world adsorber deterioration Linder normal and malfunctioning operating conditions. For engines with aftertreatment systems that utilize multiple adsorbers, determining the OBO malfunction threshold becomes more complex since aging effects of the adsorber are dependent on many factors, including the locations of the adsorbers relative to the other aftertreatment technologies and the synergism between each component in the system. While a "one-size-fits-aU" aging process that accurately represents every possible aftertreatment configuration is ideal, the diesel aftertreatment system designs are not yet at a level of stabilization (Le., not yet limited in variation of configurations) to define such a process. Thus, until then, staff would require manufacturers to submit a system aging and monitoring plan to the Executive Officer for review and approval of the monitoring strategy, malfunction criteria, and aging process. Executive Officer approval would be based on the representativeness of the adsorber system aging to real world adsorber deterioration under normal and malfunctioning operating conditions, the effectiveness of the monitor to pinpoint the likely area of malfunction, and verification that each adsorber component is functioning as designed.

H. DIESEL PARTICULATE MATTER (PM) FILTER MONITORING

The heavy-duty OBO regulation currently requires the OBO system to identify malfunctions of the PM filter when the filtering capability degrades to a level such that tailpipe emissions exceed a specific threshold. For the 2010 through 2015 model year engines, the threshold is the highest of the following thresholds: 0.05 g/bhp-hr as measured from an applicable emission test cycle (Le., FTP or supplemental emission test (SET)) or the applicable standard plus 0.04 g/bhp-hr (e.g., 0.05 g/bhp-hrfor a standard of 0.01 g/bhp-hr). .

Heavy-duty engine manufacturers have expressed concern that the current threshold is too stringent and is not technically feasible for the 2010 model year time frame. They contend that the current status of technology cannot support such a threshold. When ARB originally adopted the current requirement in 2005, staff proposed that improved differential pressure sensors and refined soot-loading models should allow manufacturers to comply with the above thresholds by the 2010 model year. Manufacturers insist that current differential pressure sensors cannot measure pressures with the accuracy necessary to comply with the required thresholds in the given timeframe and that there are a number of uncontrolled variables that affect the accuracy of soot-loading models, such as a "lack of rigid control of fuel specifications" and the increased usage of biodiesel fuels that cannot be accounted for in the models. Additionally, part-to-part variability of PM filters increases the uncertainty of the pressure sensor correlation with the emission threshold. In order to achieve the current emission thresholds for PM filter monitoring, manufacturers believe PM sensors are necessary. However, these sensors are not expected to be available in the 2010 time frame.

ARB staff agrees that some relief is needed for these initial years of PM filter monitoring implementation based on discussions with manufacturers about their progress in meeting the monitoring requirements. Thus, staff is proposing to raise the PM filter threshold for the 2010 through the 2012 model year engines to 0.07 g/bhp-hr as measured from an applicable emission test cycle (Le., FTP or SET) or the applicable standard plus 0.06 g/bhp-hr (e.g., 0.07 g/bhp-hr for a standard of 0.01 g/bhp-hr). Staff believes the increase of the emission threshold by up to 40 percent will sufficiently address manufacturers' concerns on the technical feasibility of meeting the threshold. Two medium-duty diesel engines are already capable of detecting PM filter malfunctions below 0.07 g/bhp-hr and others are expected to meet these same levels soon. Additionally, two heavy-duty engine manufacturers have indicated that they are on track to detect malfunctions prior to PM emissions exceeding 0.05 g/bhp-hr but do not yet have final calibration data to conclusively demonstrate it.

Additionally, heavy-duty diesel manufacturers will have the added knowledge gained from three years of equipping engines with PM filters prior to introducing monitors in 2010 that comply with the 0.07 g/bhp-hr threshold. Staff projects that this additional experience should provide manufacturers the opportunity to further refine versions of the technology and components they currently use for the PM filter diagnostic such as soot loading models and differential pressure sensors,. In general, the diagnostics typically involve a comparison of the expected differential pressure derived from the soot-loading model and the actual measured differential pressure sensor across the PM filter. If the measured differential pressure is too small compared to the modeled differential pressure, a malfunctioning PM filter can be determined. However, if the soot loading model and/or the differential pressure sensor are not accurate, it is difficult to discern a good PM filter from a bad one because the differential pressures for the good and bad filters would overlap. As a result, only higher thresholds can be monitored with a crude soot loading model. With improvements to soot loading models and differential pressure sensors, staff believes that most heavy-duty manufacturers will be able to reliably identify malfunctioning PM filters at the proposed 0.07 g/bhp-hr PM threshold in the 2010 timeframe.

In addition to improving the monitoring stringency, more accurate soot loading models would allow manufacturers to operate their PM filter diagnostic more frequently than is currently possible with crude soot models. Under certain engine operating conditions such as driving with a clean PM filter (Le., a PM filter clear of soot) or low exhaustflow rates, it may be difficult to discern a good PM filter from a bad PM filter, especially with a crude soot model. To compensate for the shortcomings of their soot models, some manufacturers have proposed monitoring the PM filter only under high speeds and loads and only during a limited manufacturer-specified period following a PM filter regeneration event. As a result, in-use monitoring frequency may be low for such strategies and may have difficulty complying with the in-use monitoring frequency requirements. However, if a more accurate soot loading model is utilized, monitoring can be achieved at a variety of PM soot loads, thereby increasing the monitoring frequency of the diagnostic and potentially improving the separation between a malfunctioning and good PM filter. Improvements to differential pressure sensors will also have a similar positive effect on PM filter monitoring. Therefore, further refinement of soot-loading models and differential pressure sensors would reduce much of the diagnostic measurement variation manufacturers are concerned about and allow monitoring at the proposed 0.07 g/bhp-hr level under a variety of operating conditions that are encountered frequently during in-use driving.

ManUfacturers can also directly impact the level of emissions with a malfunctioning PM filter by varying engine out emissions. Directionally, the lower the engine out PM emissions, the lower the tailpipe PM level will be when a fault is detected. Staff has seen great variance in the levels of engine out pM level from manufacturers as they each seek to optimize in different areas. Unfortunately, some manufacturers have chosen to optimize for other factors with little to no consideration on diagnostic monitoring capability and, as a result, those manufacturers are struggling. Other manufacturers that did include OBD capability or impacts in the final emission solution and calibration appear to be able to detect malfunctions at much lower PM levels.

Other areas for improving the diagnostic's accuracy include reducing the manufacturer tolerances in the engine, reducing the part-to-part variability of the backpressure characteristics of the PM filters, and correcting for the backpressure variations of PM filters caused by manufacturing tolerances. Generally, any improvements to aspects that reduce the variation of PM output of the engine or the backpressure characteristics of the PM filter would reduce diagnostic error. Manufacturers could demand tighter tolerances from their suppliers to reduce the variation in these parts to improve the accuracy of the diagnostic. While deviations in back pressure are probably not critical for the durability or trapping performance of the PM filter, they likely will be critical for diagnostic purposes. Sizing of the PM filter itself also plays a role in the backpressure levels and manufacturers are expected to still be gaining experience from the field to define the optimum characteristics to improve monitoring capability.

Regarding manufacturer's concerns on fuel specification variation and increased usage of biodiesel fuels causing uncertainty in the soot loading models, staff agrees that consistent fuel quality is an important aspect in ensuring accurate modeling of the soot loading. However, diesel fuel quality in the United States is consistent in quality and will deliver consistent performance on diesel vehicles. In order to sell diesel fuel, fuel producers must demonstrate that various constituents of their candidate fuel meet certain specifications, including sulfur content, aromatics, and lubricity, and that tailpipe emissions from using the fuel on a known engine do not exceed emissions of that emitted from a reference fuel on the same engine. Additionally, ARB has a fuel enforcement program where fuel inspectors conduct frequent, unannounced inspections of refineries, service stations, distribution and storage facilities, and other facilities to ensure California diesel fuel is of a consistent quality. Lastly, staff acknowledges that biodiesel fuels have been shown to reduce exhaust PM emissions and thereby affect the accuracy of soot loading models if its usage is unaccounted for. However, staff believes that biodiesel usage is still very small in California (less than 0.1 %) and its effect on PM soot loading models is not significant in the more common forms available (Le., B2 or two percent biodiesel content). If higher blends of biodiesel fuel do affect the robustness of the PM filter diagnostics, manufacturers can continue to do what they do today and limit their usage by specifying limits on biodiesel fuels which may be safely used to avoid voiding the engine warranty on parts that can be damaged by its usage, such as the PM filter, fuel injectors, seals, and rubber gaskets. Further, the uncertainties introduced by fuels would have a larger impact on soot loading models as the soot loading increases towards full. However, most manufacturers constrain monitoring to the period shortly after a regeneration event. Even if manufacturers extend the interval and/or wait until some minimum amount of soot is accumulated to achieve better separation between a good and malfunctioning PM filter, it is expected that manufacturers would still limit the loading to the lowest 'soot loading levels where they can achieve robust monitoring and where the uncertainties introduced by low levels of fuel variation should have minimal impact.

As for PM sensors, staff agrees with industry that these sensors will not be commercially viable for the 2010 timeframe. However, PM sensor manufacturers are making progress and are continuing their development work towards developing a commercial product capable of meeting the 2013 model year PM filter thresholds. For' the 2010 modelyear, as mentioned above, considering that some medium-diesel' engine manufacturers are currently achieving the proposed 0.07 g/bhp-hr PM filter emission threshold without PM sensors for the 2007 model year, staff believes that heavy-duty diesel engine manufacturers should also be capable of meeting this threshold in the 2010 timeframe utilizing conventional technology (Le., PM filter soot modeling and differential pressure sensors).

In addition to the proposed amendment mentioned above, staff is also proposing changes to the malfunction criteria for PM filter frequent regeneration monitoring. Currently, the regulation requires manufacturers to indicate a frequent regeneration fault before emissions exceed 2.0 times the NMHC emission standards. However, in discussions with manufacturers and review of submitted emission data, NOx emissions have often increased significantly during PM filter regenerations. Depending on the manufacturer's strategy, some NOx emission controls may be temporarily disabled or otherwise scaled back during regeneration events leading to a substantial NOx increase. In some cases, it appears that NOx emissions may be more affected than NMHC emissions as more frequent or extended regeneration events leads to more frequent and longer periods of reduced NOx control. Thus, staff is proposing to require manufacturers to indicate a fault before emissions exceed 2.0 times the NMHC standards or the applicable NOx standard by more than 0.2 g/bhp-hr, whichever occurs first, starting with the 2013 model year.

Lastly, manufacturers have expressed concern about the current requirements for monitoring the NMHC conversion capability of catalyzed PM filters. Staff addressed this issue in section II. E (Diesel NMHC Converting Catalyst Monitoring) above.

I. DIESEL EXHAUST GAS SENSOR MONITORING

The HD OBD regulation currently details specific monitoring requirements for air-fuel ratio sensors and NOx sensors, while for other exhaust gas sensors such as PM sensors, manufacturers are required to submit a monitoring plan for ARB approval. PM sensors are less developed than NOx sensors, and thus, less is certain about the important characterJstics of PM sensors relative to their use in emission control or their proper use as monitoring devices. However, staff has had discussions with sensor suppliers about PM sensor development and is encouraged by the early findings. Further, staff has held discussions with these suppliers about the need for diagnostics, and staff expects that basic diagnostics such as circuit checks, out-of-range values, and heater functionality will be easily implemented. For sensor response or other such characteristics, manufacturers may need to implement strategies similar to those being developed for NOx sensors and may require intrusive operation to verify sensor readings or response during known exhaust concentration conditions (e.g., during deceleration events where fueling is shut-off). Thus, staff is proposing to require manufacturers to monitor the PM sensors to the same specific requirements as those currently required for NOx sensors.

J. GASOLINE FUEL SYSTEM MONITORING

An important part of the emission control system on gasoline vehicles is the fuel system. Proper delivery of fuel is essential to maintain stoichiometric operation, maximize catalytic converter efficiency, and minimize tail pipe emissions. As such, the OBD regulations have always required fuel system malfunctions to be detected when the fuel system cannot maintain emissions below a specific threshold (e.g., 1.5 times the standards).

Recent field testing of light- and medium-duty vehicles has revealed in-use fuel system-related malfunctions that OBD II systems generally cannot identify but which can cause emissions to exceed malfunction thresholds with no detection of a malfunction. ARB and manufacturers investigated this problem and found the 'cause to be cylinder-to-cylinder differences or imbalances in the air-fuel ratio that are not properly corrected by the fuel control system. As stated, this type of malfunction or system deterioration can have a significant impact on emissions. The imbalances can be caused by fuel injector variation, unequal airflow into the cylinders, or uneven EGR distribution across the cylinders. In many cases, the front oxygen sensor, which is located in the manifold collector and is used for feedback fuel control, does not equally sense all cylinders and may cause the feedback fuel control system to be blind or overly sensitive to specific cylinders. This can result in improper fuel system corrections (Le., the fuel system under-compensates or overcompensates for the imbalance) and higher emissions without detection of a malfunction.

As this failure mode was not previously identified in the OBD II regulation, staff recently amended the OBD II regulation to include detection of this malfunction, and is currently proposing the same amendments to the HD OBD regulation. The staff is proposing that manufacturers be required to detect an air-fuel cylinder imbalance in one or more cylinders that causes the fuel delivery system to be unable to maintain emissions below a specified emission level. To provide manufacturers sufficient leadtime to comply with the new requirements, staff is proposing a phase-in during the 2014-2016 modetyears with a malfunction threshold of 3.0 times the standards, with all engines required to meet the final threshold of 1.5 times the standards in the 2017 model year.

The staff is proposing a different phase-in schedule for vehicles equipped with certain types of EGR systems that have been found to be more prone to causing cylinder imbalance as the system deteriorates. The staff is proposing cylinder imbalance malfunctions be detected on all 2014 and subsequent model year engines equipped with EGR systems that have separate flow delivery passageways (internal or external) that deliver EGR flow to individual cylinders (e.g., an EGR system with individual . delivery pipes to each cylinder).

There are a number of monitoring strategies that may be used to detect cylinder imbalances.. Monitoring of these types of failures may be accomplished by evaluating the front and/or rear oxygen sensor signals. During in-use testing of vehicles with cylinder imbalance malfunctions by ARB staff, one vehicle had a cylinder imbalance caused by intake valve deposits. The valve deposits caused an EGR effect in that cylinder that resulted in a rich air-fuel ratio relative to the other cylinders. Coincidentally, the oxygen sensor was oversensitive to the malfunctioning cylinder and the fuel system overcompensated by leaning out all the cylinders yielding an overall lean bias for the engine. The lean bias caused NOx emissions to significantly exceed the emission standards. The vehicle manufacturer analyzed the vehicle using special engineering tools to obtain a high-speed signal from the oxygen sensors. With the high speed data, the manufacturer observed that front oxygen sensor signal was noisy (Le., there were rich spikes in the exhaust signal due the relatively rich air-fuel ratio in the cylinder that had the valve deposits). The noisy signa,! was an indicator that something was wrong with the system. Fuel system monitors generally use filtered or slower speed oxygen sensor signals to determine the average fuel system error caused by malfunctions that uniformly affect all cylinders. Therefore, typical fuel system monitors would not detect a noisy sensor as malfunctioning fuel system behavior. However, monitoring of the high-speed signal of the front sensor for this kind of behavior could be used to detect a cylinder imbalance fault. Additionally, the rear oxygen sensor signal also could show signs of cylinder imbalance. In the example discussed above, the rear oxygen sensor indicated a lean signal throughout the emission test cycle. However, depending on the fuel control strategy and the catalyst and sensor configuration, analysis of the rear sensor alone may not be sufficient for cylinder imbalance monitoring, nor would analysis of the rear oxygen sensor fuel control values be sufficient to cover all cases. (Monitoring of the downstream fuel control values will therefore remain a separate requirement in the regulation.)

Staff is also proposing additional language regarding engines that employ engine shutoff strategies (e.g., hybrid buses that shut off the engine at idle) that was not comprehended in the current regulation. The HO OBO regulation currently requires manufacturers to detect fuel system malfunctions where the system fails to enter closed-loop operation within a certain time after engine start, which does not specifically address .engines that can implement engine shutoff and restarts multiple times within the same driving cycle. Thus, staff is proposing to require manufacturers to detect fuel system malfunctions for these engines when the system fails to enter closed-loop operation within a certain time after every engine restart.

Lastly, a minor change was made to harmonize with the light- and medium-duty regulation regarding secondary oxygen sensor fuel system monitors. Specifically, an allowance was added for manufacturers to eliminate the use of similar conditions for such monitors upon demonstration that the system only operates in sufficiently constrained conditions that there is no technical need to use similar conditions to ensure robust detection of faults.

K. GASOLINE MISFIRE MONITORING

The staff is proposing to modify the gasoline misfire monitoring requirements in the HO aBO regulation to limit the monitoring of misfire during flare downs to just those occurring during positive torque conditions. Staff recently amended the OBO II regUlation with the same change due to manufacturers' arguments that, while there were no outside influences acting on the engine during the flare-down, the engine may be in negative torque and misfire monitoring accuracy could be affected.

The HO OBO regulation currently requires manufacturers to monitor for misfire from no later than the end of the second crankshaft revolution after engine start. Similar to the issue for gasoline fuel system monitoring above, the language does not specifically address engines that employ engine shutoff strategies (e.g., hybrid buses that shut off the engine at idle) and can restart the engine multiple times within the same driving cycle. Thus, staff is proposing to require manufacturers to monitor for misfire no later than the end of the second crankshaft revolution after every engine restart.

L. GASOLINE SECONDARY AIR SYSTEM MONITORING

Secondary air systems are used on vehicles to reduce cold start exhaust emissions and typically consist of an electric air pump, hoses, and a check va'lve(s} to deliver outside air to the exhaust system upstream of the catalytic converter(s}. The HO OBO regulation currently requires manufacturers to monitor the "air flow" delivered by the secondary air system and, in cases where there are more than one delivery hose (e.g., one to each side, or bank, of a V-6 engine), to verify that the proper amount of air is delivered through each hose. Industry, however, questioned the necessity of monitoring the air flow to each bank of the engine in cases where complete blockage of air delivery to one bank does not affect emissions. thus, the staff is proposing modified language to exempt detection of flow to both banks if the manufacturer can show that complete blockage of air delivery to one bank does not cause a measurable increase in emissions.

M. GASOLINE EVAPORATIVE SYSTEM MONITORING

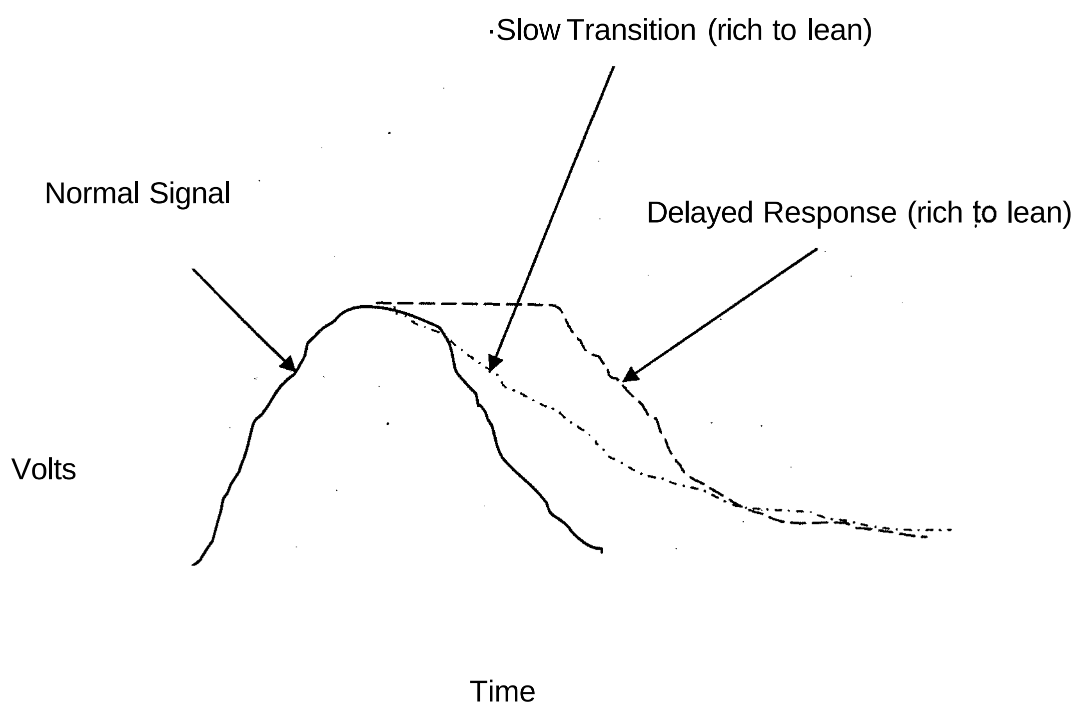
The HO 080 regulation currently requires monitoring of the complete evaporative . system for vapor leaks to the atmosphere as well as verification of proper function of the purge valve. Traditionally, vehicles have used a single purge path to purge vapor from the system to the engine. However, some newer engines, especially turbo-charged engines, have implemented two paths to ensure sufficient purge during boost operation. For vehicles that rely on the proper function of both paths to maintain in-use emission levels, the requirement has been clarified to ensure that both purge paths are monitored.

N. GASOLINE EXHAUST GAS SENSOR MONITORING

The HO OBO regulation currently details specific monitoring requirements for "exhaust gas sensors," with monitoring requirements split for exhaust gas sensors that are considered "primary" sensors versus "secondary" sensors. The OBO II regulation, by contrast, currently details specific monitoring requirements for oxygen sensors (conventional and wide-range or universal sensors), while manufacturers using other types of exhaust gas sensors (e.g., NOx sensors, PM sensors) are required to submit a monitoring plan for Executive Officer approval. Considering gasoline engines are generally not expected to utilize other exhaust gas sensors as much as oxygen sensors and to be consistent with the OBO II regulatory language, staff is proposing to modify the gasoline exhaust gas sensor monitoring language in the HO OBO regulation to detail specific requirements for oxygen sensors and require manufacturers to submit a plan for other exhaust gas sensors.

Additionally, as is currently required in the OBO II regulation, staff is proposing to clarify what is expected of manufacturers when developing response rate monitors for primary oxygen sensors. Specifically, manufacturers would be required to detect both asymmetric malfunctions (Le. faults that affect only the lean;.to-rich response rate or only the rich-to-Iean response rate) and symmetric malfunctions (Le., faults that equally affect both the lean-to-rich and rich-to-lean response rates). These response rate faults include faults that affect the response either by delaying the initial reaction of sensor to an exhaust gas change (e.g., "delayed" response) or by delaying the transition from a rich reading to a lean reading (or vice-versa) (e.g., "slow transition") (see Fig. 1 below). In previous years, while all light- and medium-duty manufacturers were currently capable of detecting each of these types of faults, not all of them had rigorously calibrated the monitors to ensure proper detection of the faults before emissions exceed 1.5 times the standards. Accordingly, staff recently amended the aBO II regulation, and is currently proposing for the HO aBO regulation, to identify the failure modes for response that should be considered by manufacturers in calibrating the response diagnostic. Under the proposal, manufacturers would be required to consider six different response fault conditions when determining the worst case failure mode necessary for calibration: asymmetric lean-to-rich delayed response, asymmetric rich-to-lean delayed response, asymmetric lean-to-rich slow transition, asymmetric rich-to-lean slow transition, symmetric delayed response, and symmetric slow transition. Manufacturers would be expected to determine an appropriate response monitor threshold(s) to ensure that all response failures are detected prior to exceeding 1.5 times the standards. Further, beginning in the 2013 model year, manufacturers would be required to submit data and/or documentation demonstrating that they have used a calibration method that ensures that these criteria have been satisfied.

Fig. 1: 02 Sensor Deterioration Sketch



Results from testing in-use light- and medium-duty gasoline vehicles by ARB staff have also reinforced the need for more rigorous monitoring of the secondary sensors used to monitor the catalyst for proper operation. For secondary oxygen sensors, the HO aBO regulation currently requires the diagnostic system to detect a fault, to the extent feasible, when the secondary oxygen sensor is no longer reliable for monitoring. Given the location of the sensor downstream of the catalyst, stringent monitoring of the sensor has been difficult to achieve or isolate from oth'er effects *(e.g.,* oxygen storage in the catalyst). Accordingly, staff had been accepting fairly simple "activity" diagnostiCS in light- and medium-duty aBO" vehicles that verify minimal operation of the sensor as acceptable monitoring techniques. Unfortunately, in-use vehicles with deteriorated secondary oxygen sensors and deteriorated catalysts were found to have high emissions' and no MIL illumination. Staff found that replacement of the secondary oxygen sensor resulted in ,the diagnostic system being able'to detect the malfunctioning catalyst and illuminate the MIL. Ideally, manufacturers' secondary oxygen sensor monitors should be able to detect and illuminate the MIL for this fault (Le., detect a malfunction for deteriorated sensors that cannot robustly detect a "threshold" catalyst). However, before the aBO" regulation was recently amended, very few manufacturers had monitors that met this ideal situation. Most monitors had a gap in the degree of sensor deterioration between where the sensor is no longer sufficient for catalyst monitoring and where the sensor itself can be detected as malfunctioning. Considering that catalyst fault codes are a significant percentage of the failures found in high-mileage cars in 11M programs, the staff believed the aBO" regulation needed to be modified to make manufacturers better understand what is expected of the secondary oxygen sensor monitors and to avoid problems like these in the future. Further, recent improvements in monitoring techniques for the rear sensor were identified that enable more stringent monitoring of the sensor as well as improved monitoring techniques for the catalyst monitor that are less sensitive to secondary sensor performance degradation.

Thus, staff recently amended the aBO " regulation to require better monitoring of the secondary sensors to ensure "sufficient" sensor performance for other monitors, and is currently proposing the same amendments for the HO aBO regulation. Specifically, the proposed amendments would require the aBO system be designed such that the worst-performing acceptable secondary sensor is able to detect the best-performing unacceptable system or component *(e.g.,* catalyst) that uses the secondary sensor for monitoring. In other words, in the case of the catalyst monitor, the worst-performing' secondary oxygen sensor that could "pass" the secondary sensor monitor should be able to detect a deteriorated catalyst that just barely "fails" the catalyst monitor (Le., a . catalyst deteriorated right to the threshold). If the aBO system is technically unable to meet this requirement, manufacturers would be required to submit a plan detailing how they will ultimately close the gap, and the proposed amendments would prescribe the minimum acceptable level of monitoring required of secondary oxygen sensors in the interim. Specifically, the aBO system would be required to detect a slow rich-to-Iean response malfunction of the sensor during a fuel shut-off event *(e.g.,* deceleration fuel cut event). This monitor would be required to monitor the response time during the following periods: (1) from a rich condition *(e.g.,* 0.7 Volts) at the start of fuel shut-off to a lean condition *(e.g.,* 0.1 Volts) expected during fuel shut-off conditions, and (2) the response time of the sensor in the intermediate sensor range *(e.g.,* from 0.55 Volts to 0.3 Volts). In order to develop a robust monitor, manufacturers would need to isolate the sensor response from catalyst effects and transport time as much as possible. Some manufacturers do not use fuel shut-off during deceleration to the degree or frequency that is necessary for the monitoring defined above. Therefore, in developing the proposed diagnostics, some manufacturers would have to make changes to their fuel control strategies to ensure that fuel shut-off is initiated from a rich condition (Le., a sensor voltage that is greater than voltages necessary to make the response time measurements defined above) and occurs with sufficient in-use frequency to meet the minimum required monitoring frequency specified in the regulation.

To allow time for manufacturers to make these changes across their product lines, the proposal would require all 2013 and subsequent model year engines to meet this requirement. The OBD system would be required to track and report the in-use monitoring frequency of this monitor starting with the 2013 model year. Additionally, prior to certification of 2013 model year engines, the manufacturers would be required to submit a comprehensive plan demonstrating the their efforts to minimize any gaps remaining between the worst-performing acceptable sensor and a "sufficienf' sensor.

O. COLD START EMISSION REDUCTION STRATEGY MONITORING

In order to meet the standards, manufacturers have to use emission control strategies to minimize emissions during and after a cold engine start. The vast majority of emissions from gasoline engines during an FTP emission test are generated during the short period after engine start before the catalytic converter "lights off' (Le., reaches the operating temperature where it begins to achieve high conversion efficiency). In order to minimize these cold start emissions, manufacturers use special strategies to maximize the heat transferred through the exhaust to the catalytic converter to accelerate light off. The most common elements of cold start strategies are modifications to engine speed and ignition timing. The idle speed is increased over the speed that is normally used, or is necessary, for a start-up. Increased idle speed increases exhaust mass flow. Ignition timing is also retarded from normal timing which makes the engine run less efficient/yo Retarded ignition timing increases the exhaust temperature and further increases exhaust mass flow. Combined, the two elements generate hotter exhaust temperatures and more thermal mass that can be used to accelerate the light off of the catalyst. Staff required the monitoring of these cold start . strategies in light- and medium-duty vehicles in 2002. The cold start monitoring requirements have been a difficult requirement for staff to administer. It requires a detailed disclosure by the manufacturers on how their cold start strategy works. At the same time, it requires an in depth understanding by both ARB staff and the manufacturers' staff of how malfunctions, drivers' actions, and vehicle operating conditions (e.g., fuel quality) can affect the proper execution of the cold start strategy.

In reviewing the cold start monitoring strategies that manufacturers implemented in the OBD II systems, the staff has concluded that, in some cases, the monitors did not sufficiently ensure that the cold start strategies are successfully executed. For example, some monitors evaluated the combined effects of idle speed and ignition timing and only detected a malfunction when both elements (Le., engine speed and ignition timing) of the emission reduction strategy have failed. The staff believes this is an inappropriate way to design the monitor because the aBO II system will not detect a malfunction until two failures have occurred. ather manufacturers have calibrated their monitors s.uch that a malfunction will not be detected until the performance of the cold start system has deteriorated beyond what is required for normal warmed-up engine operation. For example, most manufacturers require increased idle speed during cold start. Some manufacturers, however, have implemented malfunction thresholds for the cold start monitor that require the engine speed to be less than the normal warmed up idle speed for a malfunction to be detected. While such an approach does indeed verify that the engine starts and idles, it does not verify that some amount of increased idle speed was achieved during the cold start.

To address these issues, the staff amended to the cold start monitoring requirements in the aBO II regulation to ensure more consistent implementation of the requirements by all manufacturers. Specifically, the staff added language that described more specific malfunction criteria for the elements of the cold start monitoring strategy, requiring the aBO II system to detect a malfunction if either of two malfunction criteria is satisfied.

For the first malfunction criterion, the aBO II system is required to detect a cold start malfunction if any single commanded element of the cold start strategy does not properly respond to the commanded action while the cold start strategy is active. A cold start strategy element has proper cold start response if the following conditions are satisfied: (i) the element responds by a robustly detectable amount; (ii) the element responds in the direction of the desired command; and (iii) the magnitude of response is above and beyond what the element would achieve on start-up without the cold start strategy active. For example, if the cold start strategy commands a higher idle engine speed, a fault must be detected if there is no detectable amount of engine speed increase above what the system would achieve without the cold start strategy active. For elements involving spark timing (e.g., retarded spark timing), the·monitor may verify final *commanded* spark timing in lieu of verifying actual *delivered* spark timing.

For the second malfunction criterion, the aBO II system is required to detect a cold start malfunction when any failure or deterioration of the cold start emission reduction control strategy causes a vehicle's emissions to be equal to or above 1.5 times the applicable FTP standards. For this requirement, the aBO II system is required to either monitor all elements of the system as a whole (e.g., measuring air flow and modeling 'overall heat into the exhaust) or the individual elements (e.g., increased engine speed, commanded final spark timing) for failures that cause vehicle emissions to exceed the emission malfunction threshold.

Staff is currently proposing these same modifications to the gasoline cold start emission reduction strategy monitoring requirements in the HO aBO regulation. Additionally, the staff is requiring heavy-duty diesel engines to monitor for malfunctions of the cold start emission reduction strategies. While not yet prevalent in heavy-duty engines, some light-duty diesel manufacturers have implemented such strategies and-some heavy-duty manufacturers have indicated such strategi.es are being considered to reduce emissions shortly after engine start-up. The proposed amendments would ensure such strategies are monitored for proper operation when and if they are implemented.

P. ENGINE COOLING SYSTEM MONITORING,

The heavy-duty aBO regulation requires manufacturers to monitor cooling systems for malfunctions that affect emissions or other diagnostics. Engine manufacturers often modify engine operation strategies based on engine coolant temperature (ECT) and utilize it to enable other aBO diagnostics. Malfunctions resulting in improper engine temperature regulation may disable aBO diagnostics, reduce aBO monitoring frequency, cause changes in engine and emission control operation, and cause an increase in vehicle emissions. Therefore, ARB has required cooling systems to be monitored to detect malfunctions if either of the following occurs: (i) the ECT does not reach the highest temperature required by the aBO system to enable other diagnostics, or (ii) the ECT does not reach a warmed-up temperature within 20 degrees Fahrenheit of the engine manufacturer's nominal thermostat regulating temperature. Since engine manufacturers are responsible for designing their own aBO monitors, they have direct control over the first criteria by limiting how high they specify the enable temperature used for other monitors. Manufacturers that choose to design emission solutions that are less sensitive to temperature (or work effectively earlier in warm-up) and design diagnostics that are robust at lower warm-up temperatures can directly reduce the stringency of this monitor.

Nonetheless, engine manufacturers have expressed difficulty in meeting these requirements primarily because the engine may be used in a variety of vehicles and with various other devices that affect the warm-up of the engine. Other than the assurance that there is sufficient cooling capacity at peak engine loads, historically, few constraints have been placed on vehicle manufacturers (Le., truck builders) and thus,. there is significant variance in the engine warm-up characteristics in individual vehicles. Due to this variety, engine manufacturers have commented that they cannot properly . distinguish normal warm-up behavior from malfunctioning warm-up behavior. To address these concerns, manufacturers have proposed several modifications to the regulation they believe would make cooling system monitoring more feasible in the 2010 timeframe. One such request involves a change that would allow cooling system monitors to take longer to make pass or fail decisions, spanning many more trips than the two-trip strategy currently allowed for decision making. Specifically, manufacturers have asked permission to only illuminate the MIL if a fault is detected on six consecutive trips. Engine manufacturers believe a 6-in-a-row monitoring strategy will effectively filter out abnormal drive patterns or anomalies in vehicle operation that may cause the system to occasionally be delayed in warm-up or not warm-up, yet they would still eventually detect a fault for sys'tems with a true fault.

ARB staff disagrees with the engine manufacturers' request to use a longer statistical filter to detect faults because it does not adequately address the issue; these strategies simply allow for more time on less than sufficiently robust monitors hoping that false fails will not occur often enough or that the driver will not frequently or repeatedly engage in what they consider 'abnormal driving patterns.' A more appropriate solution is for engine manufacturers to better define enable conditions or the modeled coolant temperature to either account for or disable the monitor during such 'abnormal' driving conditions if an accurate pass/fail decision cannot be made: While this can result in less frequent monitoring and must be balanced with maintaining reasonable monitoring frequency under the breadth of conditions encountered in the real world, designing (or allowing) a monitor to run under conditions where it may make an incorrect decision is always inappropriate as it can lead to erroneous decisions in-use and undermine technician and vehicle operator confidence in the aBO system. Accordingly, staff will not be proposing a change to the currently required 2-in-a-row detection strategy.

Engine manufacturers have also requested that cooling system monitoring be disabled/desensitized on engine starts with ambient or starting temperatures below 60 degrees Fahrenheit. They believe this allowance will help reduce calibration burden and constrain monitoring to temperatures where truck cabin heat or other sources would be used minimally and would have less impact on delaying proper warm-up. The heavy-duty aBO regulation currently allows engine manufacturers, with Executive Officer approval, to use alternate malfunction criteria and/or monitoring conditions that are a function of temperature at engine start on engines that do not reach the temperatures specified in the malfunction criteria when the thermostat is functioning properly. Similarly, light- and medium-duty vehicles are given relief for engine starting temperatures below 50 degrees Fahrenheit and several engine manufacturers have used this provision for select vehicles (e.g., primarily vehicles with very large passenger compartments). ARB has recognized vehicle operation in California at temperatures below 50 degrees Fahrenheit is limited and accordingly, most ARB emission standards only apply down to 50 degrees Fahrenheit. However, the amount of vehicle activity in the temperature range from 50 to 60 degrees Fahrenheit is expected to be substantial in California, so monitoring to a less rigorous threshold in this temperature region could affect a substantial fraction of vehicle activity. As stated before, engine manufacturers have some control over the stringency of this monitor, as they have the ability to calibrate their aBO systems to use lower enable temperatures for appropriate monitors and still be robust in detecting faults. Thus, while ARB agrees that engine manufacturers should be allowed to desensitize the thermostat monitor on lower engine start temperatures, ARB is proposing to allow this on engine starts with temperatures below 50 degrees Fahrenheit, not 60 degrees Fahrenheit.

Citing the difficulty in accounting for heat sinks, engine manufacturers have also requested that cooling system monitoring be limited to detection of malfunctions in which the thermostat is fully stuck open, irrespective of what temperature is or is not achieved. Manufacturers feel that simply verifying the thermostat is not fully stuck open would greatly simplify the monitoring process and allow manufacturers to design for a range of applications, ensuring some minimum capability on all applications. ARB, however, disagrees and believes failures that prevent proper warm-up for emissions and diagnostics need to be detected regardless of the failure mode (e.g., fully stuck open, partially stuck open, leaking, opening too early).

Engine manufacturers would also be required to monitor for failures which cause the ECT to cool back down below diagnosticenablement temperatures after they have been reached (e.g. monitoring to ensure temperatures stay above thresholds after they are initially reached). In certain situations, an idling vehicle with a malfunctioning thermostat and low airflow across the engine bay can reach warmed-up temperatures and pass thermostat monitoring yet when the vehicle reaches higher speeds, additional cooling is introduced across the radiator and engine block, lowering the ECT below the temperature necessary for other aBO diagnostics. This situation could effectively disable all diagnostics that require off-idle operation without being detected as a cooling system fault as well as cause an increase in emissions in some instances (e.g., activation of low temperature AECOs that disable emission control functions, fall below optimal operating temperature windows for exhaust aftertreatment). The proposed revisions to the regulation include specific language identifying this malfunction and requiring monitoring for 2016 and subsequent model years. Staff has proposed longer leadtime for this specific requirement because of manufacturers' previously stated concerns that they have insufficient control over truck builders with regards to equipping the engine with devices that prolong warm-up or cool the engine back down. By waiting until 2016 model year, manufacturers will have time to implement aBO across all engines and truck builders will become more aware of the choices they make and their impacts on proper operation of.the aBO system. In some cases, this monitoring requirement could effectively impose design restrictions on the engine cooling system and force manufacturers to be more proscriptive in restricting what truck builders can and cannot add to an engine to remain in compliance. While this may be unfavorable, allowing truck builders to add equipment that effectively disables many aBO monitors and/or causes an engine to run below normal operating temperatures (and with an associated increase in emissions) is not an acceptable long term path for achieving and maintaining low emissions in-use. In some cases, a manufacturer may need to make design changes or include additional control strategies to ensure an engine stays above a minimum operating temperature under normal ambient conditions and the additional leadtime should allow manufacturers to investigate alternatives and/or implement such features. Further, as with other required thermostat monitoring, manufacturers will have the ability to constrain monitoring to operating conditions where they can robustly determine if the system is passing or failing and exclude conditions (e.g., very cold temperatures, very low speed driving) where such decisions cannot be made.

Engine manufacturers have also expressed interest in allowing vehicle manufacturers some ability to calibrate their own cooling system criteria in order to properly account for appropriate heat/work losses in the final vehicle configuration. In recognizing the difficulty of engine manufacturers to calibrate for every type of vehicle the engine is likely to be used in, ARB believes giving vehicle manufacturers some capability to select between various calibration parameters to best match the specific vehicle configuration would be a workable solution. This would allow the aBO system to be better optimized for the specific truck configuration while still allowing vehicle manufacturers a wide range of authority in what they add to the system and how it impacts vehicle warm-up. While ARB feels this is a reasonable approach, engine manufacturers will need to take appropriate actions to ensure vehicle manufacturers are given proper instruction on how to determine the proper calibration to select and are not allowed to just default to one that would be inappropriate. Further, engine manufacturers are ultimately held responsible for OBD compliance in-use and inappropriate selection by vehicle manufacturers could result in enforcement action against the engine manufacturer.

Q. CRANKCASE VENTILATION (CV) SYSTEM MONITORING

During the engine combustion process, some exhaust gases can escape past the pistons into the crankcase and subsequently to the atmosphere. The CV system is used to contain these exhaust gases (also known as "blow-by") and typically directs them to the intake to be. re-routed through the engine. The CV system generally consists of a crankcase vapor outlet hose (through which the exhaust gas isdirected from the crankcase to the intake ducting typically upstream of the compressor), and a CV valve to control the flow through the system. Many diesel systems also include a filter and/or oil separator to reduce the amount of oil and/or particulate matter that exits the CV system. As with CV systems on gasoline vehicles, staff believes the likely cause of CV system malfunctions and excess emissions is improper service or tampering of the CV system. These failures include misrouted or disconnected hoses, and missing or improperly installed valves, filters, or oil separators. 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.

For vehicles with diesel engines, the HD OBD regulation currently requires manufacturers to submit a plan for Executive Officer approval of the monitoring strategy, malfunction criteria, and monitoring conditions prior to introduction on a production vehicle. Executive Officer approval is based on the effectiveness of the monitoring strategy to monitor the performance of the CV system to the extent feasible with respect to the proposed malfunction criteria detailed in the current regulation, which essentially requires the OBD system to monitor for disconnections between the crankcase and the CV valve and between the CV valve and the intake ducting.

Instead of continuing to use the provision to require manufacturers to submit a monitoring plan for ARB approval, the staff is proposing to apply essentially the same monitoring requirements that are currently being required for gasoline vehicles and for light- and medium-duty diesel vehicles. Thus, the staff is proposing that manufacturers be required to monitor the CV system for disconnections between the crankcase and the CV valve and between the CV valve and the intake ducting. Regarding disconnection between the CV valve and the crankcase, detection would likely be significantly more difficult, and could require additional hardware such as a pressure switch to ensure flow in the system. However, in order to facilitate cost-effective compliance, the staff proposes to exempt manufacturers from detecting this type of disconnection if certain system design requirements are satisfied. Specifically, manufacturers can be exempted from monitoring in this area if the CV valve is fastened directly to the crankcase in a manner that makes technicians more likely to disconnect a monitored portion of the system (e.g., the line from the valve to the intake ducting provided this line is monitored)) during service or if disconnection of the CV valve results in a rapid loss of oil such that thevehicle operator is certain to respond and have the vehicle repaired. Staff believes that this would eliminate most of the disconnected hose and valve events because technicians who do not reconnect the intake ducting hose when the service procedure is completed will be alerted to a diagnostic fault or oil leak that will lead the technician back to the improperly assembled component.

Under the existing certification requirements for diesel engines, manufacturers are allowed to implement open CV·systems (i.e., systems that release crankcase vapors to the atmosphere without routing them to the intake ducting or to the exhaust upstream of the aftertreatment) if the manufacturer accounts for the crankcase emissions to the atmosphere in the tailpipe certification values. Such systems have additional risk for emission failures because a malfunctioning filter or oil' separator will result in much dirtier gases beingvented directly to atmosphere instead of being routed into the engine. For these systems, the proposal would still require manufacturers to submit.a monitoring plan for Executive Officer approval. The plan would be approved based on the effectiveness of the proposed monitor to detect disconnections and malfunctions in the system that prevent proper control of crankcase emissions (e.g., if the system is equipped with a filter to reduce crankca.se emissions to the atmosphere, the OBO system shall monitor the integrity of the filter).

In general, diesel engine manufacturers would be required to meet design requirements for most of system in lieu of actually monitoring many of the hoses for disconnection. Specifically, the proposed regulation would allow for an exemption for any portion of the system that is resistant to deterioration or accidental disconnection and not subject to disconnection during any of the manufacturer's repair procedures for non-CV system repair work. These safeguards should eliminate most of the disconnected or improperly connected hoses while allowing manufacturers to meet the requirements without adding any additional hardware solely to meetthe monitoring requirements. Where monitoring is required between the CV and the intake ducting, it is possible to use monitoring strategies similar to those used on gasoline vehicles. For example, if the components of the CV system are properly sized, a disconnected line will cause a large source of unmetered air to be inducted into the engine which can be detected by EGR or intake air mass flow rationality monitoring.

R. COMPREHENSIVE COMPONENT MONITORING

One of the most important elements of the OBO system is that it requires comprehensive monitoring of all electronic powertrain components or systems that either can affect emissions or are used as part of the OBO diagnostic strategy for another monitored component or system. This includes input components such as sensors and output components or systems such as valves, actuators, and solenoids. Monitoring of all these components is essential since their proper performance can be critical to the monitoring strategies of other components or systems.

However, as engines and vehicles have become increasingly sophisticated, there has been a proliferation of electronic components much beyond the traditional electronic powertrain components that existed when OBO was started. Many of these components are peripheral components not related to fuel or emission control of the engine. Yet, by the most stringent of interpretations, these ancillary components could be considered subject to OBD because they are powertrain-related and could affect emissions indirectly by increasing electrical demand.or load on the engine when malfunctioning.

In order to keep OBD systems containable and focused on identifying the powertrain components more directly related to fuel or emission control, the staff is proposing changes to the heavy-duty OBD regulation similar to those recently added to the OBD II regulation to exclude certain types of powertrain components. Specifically, the proposed changes would exclude components that are driven by the engine or can increase emissions only by increasing electrical demand or load on the engine and are not related to fuel or emission control. Examples of such excluded components could include electric power steering systems or intelligent vehicle charging systems.

Additionally, while hybrid powertrain components are subject to monitoring, the current regulation does not have very specific guidelines aimed at hybrid components, and some manufacturers have been unsure as to how to design their hybrid component diagnostics to be acceptable under the regulation. Ideally, the regulation would provide specific performance and diagnostic requirements for each and every hybrid component. Unfortunately, hybrids are still rapidly evolving .and neither the staff nor· manufacturers have developed sufficient experience to detail monitoring requirements for all hybrid components that would properly comprehend how they are used in all applications. Thus, the staff has proposed the inclusion of general guidelines specifying that monitoring would be required for (1) all components/systems used as part of the diagnostic strategy for other monitored component/systems, (2) all energy input devices to the electrical propulsion system, and (3) battery charging system performance, electric motor performance, and regenerative braking performance, and has added a provision that would require manufacturers to submit a monitoring plan for ARB's review and approval.

Manufacturers have expressed concerns about the specific requirement in the HD OBD regulation to monitor both the MIL and the wait-to-start lamp for circuit continuity malfunctions (e.g., burned out bulbs). Specifically, manufacturers have argued that, as engine builders/suppliers, they do not have control over the instrument panels and driver displays selected by truck builders in the final vehicle. In many of those systems, the warning lights are directly wired and controlled by the instrument panel itself, not the engine control unit (ECU), and it would require instrument panel changes and/or added hardware or software in the instrument panel to diagnose the lights and send that information back to the engine ECU. As another option, manufacturers would need to provide for and require that these warning lamps be directly hardwired to the engine ECU to ensure enough information is available to diagnose the circuits. Further, manufacturers have indicated a strong trend in industry to change from incandescent bulbs to light emitting diode (LED) technology for the warning lamps. Manufacturers have argued that LEDs are much less susceptible to burned out bulb failures, leaving only circuit faults to the LED as a likely failure mode. In some cases, the LEDs are directly attached to circuit boards, virtually eliminating any hardwiring. Lastly, one manufacturer has indicated that given the nature of an LEO and its extremely low current draw levels, certain failure modes within the LEO itself are not technically feasible to detect.

Staff's original intent for monitoring the wait-to-start lamp was different from the rationale for monitoring the MIL. For the wait-to-start lamp, monitoring has always been required in light-duty from the start of aBO II implementation. If this lamp does not function properly, a vehicle operator may crank the engine too soon, causing increased emissions from extended cranking or failed crank attempts before the engine is finally started. Further, if the lamp malfunctioned, the MIL would be illuminated to indicate the need forrepair. Based on the potential for direct emission impact, staff is not proposing any changes to the requirements for wait-to-start lamp monitoring. For MIL monitoring, however, the rationale for monitoring was to simplify roadside or other inspections of heavy-duty vehicles. Rather than requiring an inspector to shut off the engine and enter the vehicle cab to visually look for the proper function of the MIL (and record that observation somehow), the intent was the entire inspection could be automated and all necessary information could be downloaded electronically via a scan tool. However, the presence of a non-functional MIL does not necessarily need to be considered in a roadside type inspection. Unlike the wait-to-start lamp, a malfunction of the MIL by itself does not lead to a direct emission impact. And, unlike other malfunctions that result in MIL illumination, a malfunction of the MIL itself prevents the MIL from illuminating, thereby largely eliminating the chance for the driver to be alerted and take appropriate action. If other emission-related faults are present, the data downloaded at inspection will properly indicate the fault data and lead to correct pass/fail decisions. Given the minimal additional benefit for roadside inspection and the reduced opportunity for a driver to voluntarily notice and take corrective action for a failed MIL, staff is proposing to eliminate the requirement to monitor the MIL for circuit malfunctions in the HO aBO regulation.

Heavy-duty manufacturers have also expressed concern for potential monitoring of vehicle speed sensors located in the transmission. Manufacturers have indicated that the vehicle speed sensor may be needed to enable certain monitors, such as idle misfire monitoring. However, similar to the argument about the MIL and wait-to-start lamp monitoring, manufacturers have argued that, as engine builders/suppliers, they do not have control over the components in the transmission, including the vehicle speed sensor. Thus, manufacturers originally asked to be exempted from monitoring the vehicle speed sensor even though they would be using that sensor to enable other aBO monitors. After being told that would be unacceptable, manufacturers submitted an alternate plan that would including partial monitoring and MIL illumination for the vehicle speed sensor but would still require special handling as they wanted to exclude vehicle sensor failures from emission warranty, they wanted to exclude other transmission components from monitoring even though they were used to monitor the vehicle speed sensor itself, and they wanted to exclude disclosure and the review and approval process by ARB for these additional diagnostics. Staff, however, disagrees with manufacturers' proposal. Staff believes if the manufacturer uses the vehicle speed sensor signal from the transmission to enable an aBO monitor, the manufacturer must monitor the sensor as required under the comprehensive component monitoring requirements (including monitoring of components used to monitor the vehicle speed sensor itself, MIL illumination and proper fault handling upon fault detection, and disclosure of such diagnostics to ARB for review and approval). Further, the emission performance warranty is clear that all items that turn on the MIL are subject to emission warranty, and other provisions such as warranty reporting. Manufacturers have indicated that one transmission supplier in particular has informed them that they are prohibited from using information from their transmission for aBO purposes. Given that, there are still several options available to manufacturers including using alternate transmission suppliers (which will likely result in this transmission supplier reconsidering its position if its products are unable to be used with any heavy-duty engine). Other options including installing a dedicated vehicle speed sensor that is under the control of the engine manufacturer or using sourCes other than the transmission for vehicle speed information. Staff, however, still believes the best solution would be to have the transmission supplier provide a raw, undefaulted vehicle speed signal to the engine controller so that the engine controller could perform all of the necessary diagnostics. While this would still subject the vehicle speed sensor in the transmission to warranty requirements, this would avoid drawing other transmission components into the aBO system.

Additionally, for 2013 and subsequent model year heavy-duty engines, manufacturers would be required to monitor fuel control system components (e.g., injectors, fuel pumps) that have tolerance compensation features implemented in hardware or software during production or repair procedures. Examples of these include individually coded injector-to-injector tolerances and fuel pumps that use in-line resistors to correct for differences in fuel pump volume output. Some manufacturers have indicated they are currently using or are planning to use such components to achieve more consistent emission performance from cylinder to cylinder and would be reliant on proper assembly as well as on repair technicians to properly reprogram engine computers with the right coding upon fuel system component replacement in the field (e.g., a new injector). Staff is concerned that such systems are more prone to erroneous or incomplete repairs and will result in undetected increases in emission levels. Accordingly, monitoring of such systems will be required to ensure that mis-assembly, erron'eous programming, or incomplete repair procedures that result in incorrect adjustments being applied will be detected.

S. EMISSION-RELATED COMPONENT FAILURE MODES

The heavy-duty aBO regulation requires manufacturers to monitor "emission-related" components and systems that can either affect emissions or other aBO monitors. For major emission-related components or systems, functional monitors are generally required if a specific failure does not cause emissions to increase above the aBO emission threshold. For other emission-related input or output electronic components like sensors or valves, they are required to be monitored as completely as possible, regardless of the emission impact of individual failure modes of the component. This generally includes monitoring for circuitlout-of-range, rationality high and low, and functional faults.

Manufacturers have expressed concerns with these requirements. Specifically, while the regulation specifies the components and systems that are required to be monitored, it does not distinguish between. emission-related and non-emission-related "failure modes" of these components and systems. Manufacturers have indicated they should not have to monitor for specific failure modes of a component or system that do not impact emissions or other aBO monitors and believe the regulation language should be modified to allow manufacturers to be exempt from monitoring of these specific failure modes. For example, if a valve can only affect emissions when stuck closed, manufacturers argue they should not also have to detect stuck open failures.

ARB staff, however, disagrees.. Allowing regulation language that would exempt monitoring of specific failure modes would only lead to many more discussions and arguments between manufacturers and ARB staff regarding whether or not a specific failure mode does indeed affect emissions during any reasonable in-use driving condition. ane area of contention could be the specific driving conditions or driving cycle under which the emission impact of the specific failure mode should be evaluated. A failure mode that does not cause any emission increase during cruising conditions, for example, may cause a considerable increase in emissions during higher load driving. Manufacturers would have to run many test cycles to determine which driving conditions would indeed impact emissions. Additionally, considering the many applications one engine can be used in, manufacturers would need to determine if the failure mode that does not affect emissions in one application (e.g., a bus that mostly experiences city driving) could affect emissions in another application (e.g., trucks that run mostly on the freeways). Another area of contention could be the actual impact of the specific failure mode on other aBO monitors. For example, a manufacturer may consider a particular failure mode to be non-emission-related because, in addition to not resulting in any emission increase, the failure mode would not directly cause the disablement of any of the aBO monitors. However, this failure mode may indirectly affect another component of the vehicle such that certain enable conditions of other aBO monitors may be harder to meet (e.g., a failure mode of one component could indirectly slow down the increase of the engine coolant temperature, thereby delaying enablement of other monitors tied to engine coolant temperature). This would require a lot of analysis and testing on the part of the manufacturer and ARB staff to rule out all these indirect consequences and to consider which other aBO monitors may be affected. For the few failure modes that may fall under such an exemptio,n, the amount of workload required to determine if these failure modes are indeed exempt would be huge. It should also be noted that, under the current policy, manufacturers are not required to add any additional hardware just to accomplish monitoring of all failures-monitoring of all failures is limited to monitoring-that is technically feasible.

Thus, ARB is maintaining its current policy to require the complete monitoring of emission-related components and systems. A component that is experiencing a failure mode that does not have an emission impact or affect other aBO monitors is still clearly a malfunctioning component. If a repair technician sees an emission-related component experiencing this failure mode but with no MIL illuminated, this may cause confusion with the technician, which would undermine the confidence of the OBO system in the field. With the heavy-duty OBO regulation requiring the complete monitoring of these components, the extra workload to distinguish emission-related failure modes from non-emission-related failure modes will not be necessary and the confidence in OBO in the 'field will be sustained.

T. EMISSION CONTROL STRATEGIES

Based on recent meetings with manufacturers, staff has concerns that manufacturers are not designing OBO systems to monitor certain aspects of the emission control system, especially those that are not "specifically" identified in the regulation. The intent of OBO systems is to detect virtually any malfunction that leads to an emission increase yet staff is discovering some manufacturers have additional' emission controls or strategies that they have not readily disclosed to the OBO staff nor been considered when developing diagnostics. Staff is proposing amendments to reiterate and clarify that, if there is an emission control strategy being used by the engine, manufacturers should be monitoring this strategy for proper operation to the extent possible. Such monitoring should include faults that disable, prevent, or delay the strategy from properly operating and faults that cause the strategy to reach adaptive or authority limits and be unable to achieve the desired goal under conditions where it should be able to achieve them. In most cases, this will include monitoring ofinput components that are used to enable the strategy or as feedback for feed-forward information, output components that are controlled by the strategy to achieve the desired goal, and the overall function of the strategy itself.

In addition to proposed language in the other emission controls section and the comprehensive component sections for input and output components, staff proposed specific language for the EGR and boost monitors to further address this issue. The diesel EGR and boost pressure monitoring requirements inClude malfunction criteria tied to the system being unable to achieve proper closed loop control (e.g., not entering closed-loop control when it was expected to, reaching control limits when it should not have). These requirements could -be interpreted as only applying if the system has direct feedback control of EGR flow or boost pressure (e.g., to a target EGR flow or boost pressure level). However, as mentioned above in sections II.C. and 11.0. for diesel EGR and boost pressure control system monitoring, some manufacturers are using control systems with slightly different target parameters in lieu of EGR flow or boost pressure as staff originally anticipated (e.g., modify or control EGR flow not to achieve a target EGR flow rate but to achieve a target air-fuel ratio). Accordingly, these alternate systems should be similarly monitored for failures that affect proper closed loop operation. Staff is thus proposing to require manufacturers to submit a monitoring plan for ARB's review and approval. This would allow manufacturers and ARB staff to evaluate the technology and determine an appropriate level of monitoring that is both feasible and consistent with the closed-loop monitoring requirements for the EGR and boost pressure control systems and would ensure that manufacturers cannot avoid monitoring of critical emission control systems simply by creating a new control parameter name.

U. OTHER PROPOSED AMENDMENTS

Staff is proposing modifications to better define "continuous" monitoring for several monitors in the HO OBO regulation. Currently, the regulation defines "continuously" in the context of monitoring conditions for comprehensive component circuit and out-of-range monitors but not in the context of monitoring for other major monitors. Accordingly, this definition doesn't apply for monitors such as diesel fuel pressure control monitoring and EGR system feedback control monitoring, which are also required to be monitored "continuously." As these systems are typically continuously controlled, staff believed monitoring "continuously" was appropriate. However, staff acknowledges that there typically are conditions where control is not being done (e.g., shortly after engine start-up) and that there are conditions where robust monitoring could not be done (e.g., monitoring for too low EGR flow faults when EGR is commanded closed) and that continuous monitoring may not have been the most appropriate term. When used in the context of these monitors, staff intended for manufacturers to design the monitors to run virtually all the time except during conditions where robust fault detection is not possible. To avoid further confusion, staff modified the monitoring conditions requirement for these monitors to more explicitly state that.

III. **PROPOSED REVISIONS TO OBD II REGULATION**

At the request of medium-duty diesel manufacturers in order to maintain consistency between the HO OBO and OBO II diesel requirements, staff is proposing to carry over almost all of the proposed diesel-related changes mentioned above for the HO OBO regulation to the OBO II regulation, applying them to medium-duty diesel vehicles. The engines used in medium-duty diesel vehicles are often the same or similar to engines that also go in heavy-duty vehicles, are built and certified primarily by heavy-duty manufacturers, and often use the heavy-duty certification procedures as is currently allowed. Accordingly, the staff believes harmonization of the requirements is largely appropriate. The light- and medium-duty OBO II regulation is scheduled to begin a biennial review later this calendar year and further revisions for light-duty vehicles will be considered then. However, to avoid an interim mismatch in the requirements between the HO OBO regulation and the OBO II regulation, the changes that are applicable to medium-duty diesels are being proposed jointly. In some cases, the changes to medium-duty diesels involve clarification of requirements that are also applicable to light-duty diesels and will apply to both light- and medium:'duty. However, modifications to specific emission threshold values (e.g., the interim higher threshold values for some diesel monitors) are proposed only for medium-duty vehicles and will not be applied to light-duty diesels. Any revisions to light-duty diesel emission thresholds will be considered and broughtto the Board during the biennial review of the light-duty regulation scheduled to begin later this year. The specific proposed changes to the OBO II regulation can be found in Attachment B.

Additionally, staff is proposing one change to the gasoline monitoring requirements in the aBO II regulation concerning the phase-in schedule for primary oxygen sensor response rate monitoring data submission. Currently, manufacturers are required to submit data and/or engineering analysis to demonstrate that their oxygen sensor monitors are able to detect all asymmetric and symmetric response rate malfunctions with a phase-in starting with the 2010 model year. However, recent discussions with manufacturers indicate that more time is needed to meet this requirement. Thus, staff is delaying the start of the phase-in from the 2010 model year to the 2011 model year, with all vehicles required to meet this requirement for the 2013 and subsequent model years.

IV. PROPOSED REVISIONS TO HEAVY-DUTY OBD STANDARDIZATION REQUIREMENTS

A. REFERENCE DOCUMENTS

The staff is proposing amendments that would update the list of SAE and ISO documents that are incorporated by reference into the HD aBO regulation. As is common practice with technical standards, industry periodically updates the standards to add specification or clarity. The current HD aBO regulation incorporates the 2005 version of technical standard SAE J1939 and associated documents. The proposal would update the regulation to incorporate the most recently adopted versions of each applicable part of SAE J1939.[1] The proposed amendments would also incorporate the most recently adopted versions of several other SAE (Le.,. SAE J1930, J1979, J2012, and J2403) and ISO documents (Le., ISO 15765-4). Several other SAE standards are currently being prepared for ballot and adoption. As these documents are only updated every few years, staff will monitor the progress of adoption of these updates and include them in this rulemaking (through staff suggested changes presented at the Board Hearing) if they are adopted within time. Furthermore, the staff is proposing to incorporate two additional SAE technical standard documents to the HD aBO regulation. Specifically, the staff is proposing to add: (1) SAE J1699-3 - "aBO II Compliance Test Cases", May 2006; and (2) SAE J2534-1 - "Recommended Practice for Pass-Thru Vehicle Programming", December 2004. SAE J1699 and SAE J2534-1 are currently used by light- and medium-duty vehicle manufacturers for production engine/vehicle evaluation (PVE) testing of standardized requirements, and are expected to be used for PVE testing of heavy-duty engines (§197.1.1(1)(1)) that use the ISO 15765-4 protocol.

B. PERMANENT FAULT CODES

The HD aBO regulation currently requires the aBO system to store a "permanent" fault code for an emission-related fault in non-volatile memory that can only be erased if the

1 Staff had not yet obtained the SAE J1939 documents at the time this staff report was published. ARB will make these documents available as soon as it receives them, and will reference them and make them available for comment in a subsequent 15-Day Notice.

monitor responsible for setting that fault code has run and passed enough times to confirm that the fault is no longer present. These fault codes are intended to address fraudulent inspection issues where vehicle owners or technicia-ns could erase the emission-related fault information, including the fault codes, through a battery disconnection or by a scan tool command without repairing the fault.

There have been a number of questions as to how specifically the OBD system would erase a permanent fault code, specifically after a clearing of all other fault information (through a battery disconnection or a scan tool clear command) and for continuous monitors versus monitors subject to the minimum in-use performance ratio requirements (e.g., once-per-trip monitors). For monitors that are designed to run continuously, including monitors that must wait until similar conditions are satisfied (e.g., misfire and fuel system monitors), there has been uncertainty about when a permanent fault code should be cleared since a continuously running monitor makes multiple pass/fail decisions throughout the driving cycle. Further, for monitors requiring similar conditions to be satisfied prior to extinguishing a MIL, there has been uncertainty since there is no requirement to store similar conditions in NVRAM along with the permanent fault code and thus, no way to know if similar conditions have been satisfied or not. Recently adopted language in the OBD II regulation requiring implementation of permanent fault codes included language that clarified the protocol under which the fault codes could be erased to ensure consistent implementation by all manufacturers and consistent methods for repair technicians to prepare vehicles for re-inspection by clearing permanent fault codes, and staff is currently proposing for the same-amendments for - the HD OBD regulation. The proposed amendments would require that the permanent fault code be erased only after the vehicle has been operated on a driving cycle in which both the monitor has run and passed without any indication of a malfunction and the criteria similar to those for a general denominator (§1971.1 (d)(4.3.2)(B)) have been satisfied (with the exception that the general denominator conditions require ambient temperatures above 20 degrees Fahrenheit or below 8000 feet in elevation). This would ensure that the vehicle has been operated for a sufficient period of time to reasonably detect a recurrence of the malfunction but does not unnecessarily delay erasure of permanent fault codes. By eliminating the dependency on ambient temperature and altitude, the driving conditions can easily be met throughout California and the nation, regardless of location or seasonal temperatures. Further, in the special case of erasing a permanent fault code for a monitor that uses similar conditions following a code clear event, this eliminates the need for manufacturers to store similar conditions in NVRAM and actually prohibits manufacturers from using similar conditions to erase the permanent fault code. While this creates the possibility that a permanent fault code may be erased before the vehicle encounters similar conditions to those in which the malfunction was originally detected, this is a reasonable compromise since generic scan tools are not capable of reading similar conditions information, and repair technicians would be unable to determine how to operate the vehicle to erase a - permanent fault code - a situation that would be unacceptable for inspection programs.

C. ACCESS TO ADDITIONAL DATA THROUGH A GENERIC SCAN TOOL

Currently, manufacturers are required to report certain "real-time" data parameters in a format that a generic scan tool can process and read so technicians can access the data for trouble-shooting malfunctions. In recent years, feedback from technicians in . the field has identified the need for additional parameters to be made available by the OBD system to assist them in effective repair. Thus, the proposed amendments define some additional parameters (data stream andfreeze frame values) that manufacturers would be required to report. These additional parameters would include values related to PM filter regeneration (e.g., average distances between r.egeneration events), EGR temperature, reductant level, and NOx adsorber regeneration and deSOx status. While the proposed data parameters would generally be used by technicians to assist them in repairs, some of the data could also used to facilitate inspection programs and compliance or enforcement testing by ARB staff. It is also expected that continued improvement and development in the in-use emission testing procedures and equipment currently being established for heavy-duty engines may identify the need for additional standardized parameters and/or modifications to proposed parameters that can be incorporated during a future regulatory revision.

D. EMISSION-RELATED TEST RESULTS

The heavy-duty OBD regulation currently requires a large number of monitors to report the test results of the most recent monitoring event. Some manufacturers have questioned the necessity of requiring continuous monitors to store test results, since the test results technicians will read from a scan tool will not reflect the most recent monitoring event anyways. Staff has reviewed the monitors subject to reporting test results and has identified and proposed language to exclude test results for several monitors related to feedback control. However, the proposed amendments do not remove the requirement to report results for continuous monitors. While staff recognizes that there will be a lag between decisions being made and those that the technician is currently looking at, the results could still be a benefit when diagnosing intermittent malfunctions. Such malfunctions may be present long enough for technicians to see them or, more likely, current scan tools will be able to continuously update test results and log them so a technician could scroll through the data to look for anomalies. Some manufacturers also indicated that for many of the continuous monitors, such as fuel pressure, a technician might be better served by watching the instantaneous fuel pressure rather than periodically updated test results. However, . manufacturers often use complicated algorithms to determine if a system is passing or failing (e.g., integrated pressure error above and beyond a variable level of expected deviation from the commanded pressure) that would not be discernible to a technician visually observing instantaneous fuel pressure. Outputting the results that are already being calculated internally in the computer should be a trivial task for software designers and could provide tangible benefits to repair technicians.

E. IDENTIFICATION AND VERIFICATION NUMBERS

The HD OBD regulation currently requires OBD systems to support parameters identifying the current software "version" or calibration (CAL 10) and an internal calculated result to verify the integrity of the software (calibration verification number (CVN)). These two parameters are intended to be used to help verify that valid software is installed in the on-board computer and that the software has not been corrupted or tampered. As various states around the nation have begun to collect these data on OBD II vehicles, further revisions were found to be necessary based on feedback from the field to facilitate the usage of these parameters in inspection programs. Thus, staff recently adopted changes to the CAL ID and CVN requirements in the OBD II regulation, and is currently proposing similar amendments to the requirements in the HD OBD regulation. First, staff is proposing to require all engines to respond with an equal number of CAL IDs and CVNs and in the same order such that off-board equipment could match up each CAL ID with its corresponding CVN. Further, manufacturers are required to either design the engines to respond with a single CAL ID and CVN combination for each on-board computer or to respond with them in a fixed order of importance (from most critical for proper emission control to least critical). These two changes will allow reasonable size databases to be established to gather and use the CAL ID and CVN data in inspection programs. Lastly, the regulation currently requires the CAL ID and CVN information to be reported in a "standardized electronic format", but with no information on what the standardized format is. Staff recently developed such a standardized template and will be sending it outto industry in an ARB mail-out and is proposing to bring amendments to the Board at the hearing to specifically refer to this mail-out in the regulation. This will provide a uniform format to receive the data from all manufacturers and facilitate further testing to incorporate usage of the data. Lastly, regarding CVN and CAL ID, a clarification was made by removing the word 'reprogrammable' from the language. When originally adopted in the light-duty OBD II regulation, CVN was only required on reprogrammable computers. Subsequent revisions required CVN for all computers but the old language for reprogrammable was never removed and mistakenly included in the HD OBD regulation. To avoid further confusion, the term is being removed so that there is no conflict with the following sentence which requires CVN in every emission or diagnostic-critical computer.

Staff is also proposing two additional pieces of information be made available from the HD OBD system to a scan tool. Specifically, as was previously adopted for light- and medium-duty vehicles, staff is proposing that 2013 and subsequent OBD systems support a function that associates a name or function with each electronic control unit (ECU) that responds to a generic scan tool. This ECU name function provides technicians with additional valuable information by allowing a scan tool to not only report data or fault information but tell the technician which ECU is reporting the data (e.g., engine controller, transmission controller). For some faults, diagnosis and repair can be greatly expedited by isolating which ECU is reporting the fault information especially in cases where data from a single component is used by several ECUs. Secondly, the proposed amendments include a requirement for the HD OBD system to report engine serial number (ESN) starting in the 2013 model year. Discussions with manufacturers and ARB staff from enforcement, roadside testing, and other sections has indicated that ESN is commonly used by industry to identify specific engine characteristics or configurations and is used by field inspectors when performing roadside inspections. As this parameter appears to already be supported and available in all engines, adding a requirement that it be available to generic scan tools should be a trivial change and will allow easier automated collection of data and identification of the engine.

F. EMISSION-INCREASING AUXILIARY EMISSION CONTROL DEVICE (EI-AECD) . TRACKING

An additional important item relative to the effectiveness of diesel emission controls in-.use is the usage of auxiliary emission control devices (AECDs). TypiGally, AECDs consist of alternate control strategies or actions taken by the engine controller for purposes of engine, engine component, or emission control component protection or durability. In some cases, activation of an AECD has been justified by the manufacturer as needed to protect the engine and it can result in substantial emission increases while the AECD is activated. AECDs have been an essential part of the certification process and the subject of numerous mail-outs and guidance by U.S. EPA and ARB to help ensure consistent interpretation and equity in usage among all manufacturers. Approval usually involves lengthy review and considerable scrutiny by ARB staff to try and understand the complex algorithms and strategies used by various manufacturers and additionally relies on data supplied by manufacturers as to the expected occurrence/operation of these items in-use. However, such data are often based on the operation of one or two trucks for a few hours of operation and are not likely to be representative of the extreme variances in engine duty cycles and vehicle operator habits that the diesel engines are exposed to in the real world. Further, the complicated algorithms and calculations used by manufacturers to activate such strategies are not easily decipherable nor comparable from one manufacturer to another, making consistent policy decisions and equity among all manufacturers extremely difficult, if not impossible, to achieve.

To help alleviate this issue, the OBD II regulation was recently amended to require the on-board computer on light-and medium-duty diesel vehicles to keep track of cumulative time that a subset of these AECDs is active - the staff is now proposing similar requirements for the HD OBD regulation.. Specifically, the proposed language would require tracking of AECDs that cause an emission increase (Le., emission increasing AECDs or EI-AECDs) on 2013 and subsequent model year diesel engines. Further, the proposed language would only require tracking of EI-AECDs that are . justified by the manufacturer as needed for engine protection. Additionally, the proposal would include a provision for some AECDs to be approved as not-to-exceed deficiencies and for any such AECDs to be automatically excluded from being considered an EI-AECD. In the rare instance (if any) that there is an EI-AECD that is justified as needed for engine protection but it actually is comprised of no sensed, calculated, or measured value and no corresponding commanded action by the on-board computer to act differently as a result, it would also be excluded from being tracked as an EI-AECD. Lastly, AECDs that are only invoked solely due to any of the following conditions would be excluded from being considered and EI-AECD: (1) operation of the vehicle above 8000 feet in elevation; (2) ambient temperature; (3) while the engine is warming up and cannot be reactivated once the engine has warmed up in the same driving cycle; (4) failure detection (storage of a fault code) by the OBD system; (5) execution of an OBD monitor; or (6) execution of an infrequent regeneration event.

For those strategies that meet all the requirements above to be considered an EI-AECD, the on-board computer would be required to log cumulative time each one is active and update the stored counter at the end of each driving cycle with the total cumulative time during the driving cycle. Further, each EI-AECD would be counted and reported separately (EI-AECD #1, etc.). ARB staff would be able to use this data to confirm or refute previous assumptions about expected frequency of occurrence in-use and use the data to support modifications to future model year applications and better ensure equityamong all manufacturers. This data will also help ARB staff identify "frail" engine designs that are under-designed relative to their competitors and inappropriately relying on EI-AECD activation to protect the under-designed system.

Manufacturers have raised several concerns regarding this required tracking including technical concerns, confidentiality concerns, and the inappropriateness of including such a requirement in the OBD regulations. Regarding technical concerns, manufacturers have argued that determination of which AECDs are emission-increasing will require additional emission testing time. However, as was done with the same requirements in the OBD II regulation, staff has defined emission-increasing as reducing the emission control system effectiveness and thus, made the determination based on engineering analysis, not any emission test data. Industry has also argued that many EI-AECDs have varied levels of emission increase and they are not simple on/off switches, thereby complicating the counting process and making no distinction between items with a large emission impact and those with only a minor emission impact. To address this, staff split tracking of each EI-AECD that is not a simple on-off decision into two separate timers to separately track time spent with "mild" EI-AECD activation (defined as action taken up to 75 percent of the maximum action that particular EI-AECD can take) and "severe" EI-AECD activation (defined as action taken from 75 to 100 percent of the maximum action that particular EI-AECD can take). As an example, an EI-AECD that progressively derates and eventually shuts off EGR when the engine overheats would be tracked in the "mild" timer for time spent commanding EGR derating of 1 to 75 percent and tracked in the "severe" timer for time spent commanding EGR derating of 75 to 100 percent (fully closed). For EI-AECDs where it is harder to determine the 75 percent point (e.g., strategies that activate two different actions of varying levels), manufacturers would be required to present a plan for tracking the timers for ARB approval to ensure that the action that has the most impact on emissions is accurately accounted for.

Manufacturers have also expressed concern about the complexity of tracking two EI-AECDs that may be overlapping and both commanding action. After further discussion with individual manufacturers about how their strategies were structured, staff modified the proposal to require independent tracking of each unique EI-AECDs (defined as a combination of parameter used to trigger the action, state/value of the parameter that actually triggers the action, and commanded action) and not require the software to decipher which of the overlapping EI-AECDs was actually having the bigger impact and only accumulate time in that counter. Additional modifications are also being proposed to further clarify how different types of EI-AECDs are required to be tracked.

Regarding confidentiality, manufacturers have indicated that their algorithms and strategies that comprise their EI-AECDs are extremely confidential and they do not want their competitors to know the details. Manufacturers have indicated that they believe staff's proposal would provide competitors with more detail of their EI-AECDs and make reverse-engineering easier. Staff's proposal, however, does not provide any additional information to make it easier to reverse-engineer a competitor's strategies nor does it provide any detail about the strategies or algorithms used. The only data staff's proposal would make available is cumulative time an engine is operated with a specific numbered EI-AECD active (e.g., EI-AECD #6). Only the certifying manufacturer and ARB would know for any particular engine what strategy or algorithm a particular EI-AECD corresponded to. Further, since the cumulative time data is only updated at the end of a drive cycle, a competitor could only ascertain that, at some previous time in the operation of this engine, a particular EI-AECD was activated a cumulative amount of time. The data would not indicate at what specific time(s) during any previous drive cycles the EI-AECD was active, whether it was active for one long period or many short bursts of time, or the severity of the action (or even what action) was taken during the EI-AECD activation. As can be done today, a manufacturer would be better served emission testing the engine, identifying real time spikes in emissions, and analyzing the engine operating conditions where the spikes actually occurred to reverse engineer his competitor's products rather than looking at data that does not tell him when the actual activation may have occurred. Lastly, given that the only items of discussion here are EI-AECDs justified by the need to protect the engine, a manufacturer's desire for confidentiality can be motivated by only one concern-that it is currently activating an EI-AECD (and thus, protecting its engine) during conditions that its competitors are not (and thus, not equally protecting their engine) thereby giving the manufacturer a competitive advantage in engine durability. By definition, this means that the manufacturer is activating its EI-AECDs more often (in conditions where its competitors are not). But this is also some of the very same inequity that ARB staff struggle to eliminate in certification in cases where a manufacturer is overly conservative in concluding engine "protection" is necessary and/or staff use to distinguish a "frail" engine design relative to competitors' engines.

G. SERVICE INFORMAT!ON REQUIREMENTS

The heavy-dUty OBD regulation currently contains requirements for service information that heavy-duty manufacturers are required to make available to the repair industry, which were not included in the stand-alone service information regulation, Cal. Code Regs., title 13, section 1969, at the time the heavy-duty OBD regulation was adopted in 2005. Thus, the heavy-duty OBD regulation currently details requirements for heavy-duty manufacturers to provide basic information including OBD monitor descriptions, information necessary to execute each monitor (e.g., enable conditions), and information on how to interpret the test data accessed from the on-board computer. Additionally, it requires manufacturers to make available repair procedures for OBD faults that either only require the use of a generic scan tool or require the use of a non-generic scan tool as long as they make information available to the aftermarket scan tool industry to manufacture their own tools to perform the same functions. Furthermore, it includes language that clarifies that the stand-alone service information regulation, to the extent it is effective and operative, supersedes any redundant service information requirement in the heavy"auty aBO regulation. In 2006, section 1969 was updated to include aBO information manufacturers are required to make available for heavy-duty vehicles, including requirements to make available to independent service facilities service tools to access the aBO information. Thus, the heavy-duty industry has requested that the service information requirements in the heavy-duty aBO regulation be deleted. "

However, the updated detailed requirements in section 1969 only apply to 2013 and subsequent model year heavy-duty engines, while enhanced aBO systems are required on some 2010 through 2012 model year heavy-duty engines under the heavy-duty aBO regulation. For model years prior to 2013, section 1969 only requires heavy-duty manufacturers to make available information and tools they already currently provide to dealers and independent facilities. Thus, since heavy-duty manufacturers currently do not provide information regarding manufacturing of scan tools to perform the same functions as the non-generic scan tools, staff interpreted the requirements in section 1969 as saying heavy-duty manufacturers are not obligated to provide this information for the 2010 through 2012 model year engines. Accordingly, section 1969 is not redundant to the service information requirements of the heavy-duty aBO regulation and does not automatically supersede it. Further, with such a position, manufacturers could provide access only for their authorized dealers to the heavy-duty aBO fault information and deny access to all independent repair facilities. Given the intent of the heavy-duty aBO system is to achieve early identification of the presence of a malfunction and prompt repair, it would be inappropriate to allow manufacturers to restrict access only to authorized dealer facilities. Therefore, ARB staff is not deleting the current service information "requirements in the regulation as manufacturers suggested to prevent this problem for 2010 through 2012 model year heavy-duty engines with aBO systems. These requirements are important to prevent the heavy-duty aBO program from getting off to a bad start. If repairs of OBO-related malfunctions can only be done by dealers (and not independent service facilities) during these first few years of heavy-duty aBO implementation, the overall intent of the program will be undermined and it could jeopardize the future acceptance of the system by the repair industry.

Though staff is not deleting the service information requirements, it agrees that some clarification is needed in what exactly is required for the 2010 through 2012 model years. There have been different interpretations among engine manufacturers about the language in section 1969. As stated above, while a few (including ARB staff) believe the language only requires manufacturers to sell tools they "currently" make available to the aftermarket (which would not include tools that perform aBO-related diagnosis), some engine manufacturers believe that the language requires the manufacturers to sell their diagnostic tools that perform the aBO and emission-telated diagnosis and repairs to the aftermarket industry during this timeframe. Since the original intent of ARB's keeping the service information language was so that the aftermarket repair industry has a means to repair engines with HO aBO detected faults, staff agrees that this intent would be satisfied if manufacturers are indeed required to sell their tools to non-dealer repair facilities during this timeframe (which most of industry already says they are required to do). Thus, staff modified the service information language in the HO aBO regulation to make sale of a manufacturer's service tool to non-dealers a clear option for compliance.

V. PROPOSED REVISIONS TO HEAVY-DUTY OeD DEMONSTRATION TESTING REQUIREMENTS

Manufacturers are required to design and calibrate the aBO system to detect some malfunctions before specific emission thresholds are exceeded at any time within the full useful life of the engine. Depending on the size of the heavy-duty vehicle, the useful life can be 110,000 miles, 185,000 miles, or 435,000 miles.. The current regulation requires manufacturers to conduct emission demonstration testing prior to certification to ensure that the systems are indeed able to detect faults before the thresholds are exceeded. And, to ensure the emission thresholds are not exceeded for the full useful life, ideally, the manufacturers would age the whole system (Le., the engine and all emission controls) to full useful life and then verify the calibration for each fault is correct. However, ARB recognizes that manufacturers have limited experien.ce, resources, and time to age the engine, engine emission controls, and aftertreatment to fulll,lsefullife priorto certification, especially for engines subject to a 435,000 mile useful life. Additionally, manufacturers have traditionally claimed that engines and engine components deteriorate very little based on past experience, and that this trend is expected to continue. ARB, therefore, compromised in 2005 by allowing manufacturers to simply 'break-in' the engine and engine components by aging for 125 hours while requiring aging of only the aftertreatment to full useful life for demonstration tests. Further, since aging to accumulate the full mileage is time consuming, ARB also allows manufacturers to develop and use accelerated aging processes to simulate full useful life aging. Manufacturers would ideally develop and validate these processes with actual aged parts and are required to have these processes approved by ARB after a thorough review.

Even with ARB's compromise on the. aging requirements, the manufacturers assert that they will not be able to create full useful life aged aftertreatment components or develop an accelerated aging process for the aftertreatment in time for the 2010 model year. Manufacturers cite the lack of time and experience in developing such a process and validating it with real data and the lack of experience with the new aftertreatment components in the field. Therefore, the manufacturers instead proposed a phase-in schedule that would allow for less rigorous aging to lower mileage goals in the initial years of implementation. Specifically, for the 2010 through 2012 model years, an engine manufacturer would age the aftertreatment to the level used to satisfy ARB certification requirements for determining the deterioration factor, whatever that intermediate mileage level for each manufacturer may be. For the 2013 through 2015 model years, an engine manufacturer would age the aftertreatment up to 185,000 miles. And finally, for the 2016 and subsequent model years, an engine manufacturer would age the aftertreatment to the current requirement of full useful life. Additionally, the manufacturers proposed that the scope of the aftertreatment aging be limited to 'key components' only, specifically the diesel oxidation catalyst, diesel particulate filter, NOx aftertreatment catalyst, oxygen sensors, and NOx sensors. The manufacturers' proposal also retained the requirement that the engine only be 'broken-in' with 125 hours and aging only be required of the aftertreatment.

After discussing engine manufacturers' progress towards meeting the 2010 emission standards and OBO implementation, ARB recognized that manufacturers are further behind than anticipated. Thus, ARB agrees that interim relief is appropriate to allow manufacturers to build up the knowledge and field experience with these new components to understand the extent of deterioration during useful life. However, staff does not believe the schedule or scope of the manufacturers' proposal really provides the necessary incremental steps towards a long term solution. The changes proposed by staff below are intended to focus on a successful long term solution and require manufacturers to meet interim requirements that are logical steps in the process.

While this discussion is specific to the allowed aging during demonstration testing, it is important to remember that manufacturers are liable in-use for proper detection of faults before the OBO emission thresholds are exceeded at any time during the useful life. If manufacturers do not properly account for all the synergistic effects and total system deterioration that occurs during useful life, they risk non-compliance and recall, fines, or other remedial action. Thus, from ARB's perspective, even for OBO monitor calibration purposes (not just demonstration testing), manufacturers need to (and are required and expected to) account for full useful life deterioration and base their calibration efforts on that. As is commonly done within the light-duty vehicle community, manufacturers are expected to develop engineering shortcuts and procedures to account for this full useful life performance. However, to be successful, these procedures have to accurately represent in-use deterioration and overall system performance. The only way a manufacturer can be sure that its procedure accurately represents in-use performance is to validate the systems (engine, engine component, and aftertreatment) created by their engineering procedures against actual full useful life (e.g., high mileage) systems.

Based on discussions with manufacturers and suppliers as they are progressing towards finalizing 2010 model year system designs, ARB is especially concerned about engine (and component) deterioration and its synergetic effects with the aftertreatment. Despite manufacturers' previous assertions that diesel engines and components deteriorate very little, ARB has ·seen fairly dramatic changes in diesel engines with control strategies and new components (including new EGR systems, EGR coolers, fuel injection system changes, turbo component changes, etc.) that operate in much more varied control points (e.g. near partial homogeneous charge compression ignition type operation with heavy EGR, tight air-fuel ratio control in specific regions). In light of such complicated system architecture and control strategies, previous conventions and knowledge about diesel engine and component deterioration no longer seem applicable.

Until experience is gained with high mileage evaluations and real world experience, it would be inappropriate to assume past deterioration characteristics will continue on these new systems. With this perspective, an engine aged for 125 hours (which is currently required by the OBD regulation) would not likely be representative of one at full useful life, so calibration or demonstration testing with such an engine would not provide assurance of OBD compliance throughout useful life. Additionally, manufacturers appear to *have* insufficient experience and knowledge to be able to accurately account for or predict the cumulative aging.effects of the total system by simply aging a few "key" components of the aftertreatment (as manufacturers *have* proposed). ARB believes the only long term solution to get compliance assurance is to require manufacturers to generate high mileage systems and/or to collect and use data from real world high mileage systems to develop and *validate* accelerated aging procedures for the entire system (Le., the engine, engine components, and aftertreatment system).

Thus, while agreeing that interim relief with lower aging mileage goals is appropriate, ARB is proposing to *revise* the requirements with a phase-in schedule containing higher interim goals than those proposed by the manufacturers. Additionally, for the reasons stated *above,* ARB *believes* that total system aging (engine plus the aftertreatment system) mu.st be considered and is revising the requirements to achieve that in the long term.

For the 2010 to 2012 model years, the proposed changes would continue to allow the use of an engine aged for 125 hours. *However,* in lieu of requiring the aftertreatment system to be aged and validated as representative of full useful 'life, the changes would allow manufacturers to only age the individual aftertreatment components (e.g., PM filter, oxidation catalyst) and exhaust gas sensors (e.g., NOx, lambda sensors) to the manufacturer's best estimates of useful life without the rigors of validation that would normally be required for ARB to approve the system as representative of full useful life. In discussions with manufacturers and suppliers, it appears fairly straightforward for manufacturers, in consultation with their suppliers, to identify the key aging mechanism (e.g., time at or *above* specific temperatures), to calculate expected operation *over* useful life in those key conditions, 'and to develop an accelerated aging process to condense that aging into a reasonable timeframe. Where these approaches fall short is in validation to real world operation that the estimates of expected operation were correct and/or whether other component deterioration altered the outcome. *However,* the manufacturer's responsibility to *validate* the accelerated aging process would be *waived* for these model years.

In exchange for the relaxed requirements, a manufacturer would be required to collect and report in-use data from 2010 or later model year engines operated in the real world. The data collected would be from engines and systems operated for approximately 18 months or longer and with mileages equal to the full useful life for engines subject to 110,000 or 185,000 mile useful life and at least 185;000 miles for engines subject to 435,000 mile useful life. Such data collection by manufacturers would require *removing* real world aged systems (engine and aftertreatment) from vehicles, installing the systems on engine dynamometers, running various emission tests to quantify the system deterioration, and reporting the data to ARB late in the 2011 calendar year. For 2013 to 2015 model year engines subject to 110,000 or 185,000 mile useful life, a manufacturer would be required to use the knowledge gained from the collected data to modify (if needed) and validate its accelerated aging processes for ARB's approval. For 2013 to 2015 model year engines subject to 435,000 mile useful life, a manufacturer would also be required to use the collected data to validate and/or modify the accelerated aging procedure used in 2010 to better equate to real world deterioration, however, the manufacturer would still be allowed to use its best estimates for full useful life aging as the collected data would only allow validation up to 185,000 miles and not to the full useful life of 435,000 miles.

For engines subject to 435,000 mile useful life, manufacturers would additionally be required to collect data from 2010 or newer model year real world aged systems with mileage equal to 435,000 miles and report the data to ARB in the 2014 calendar year. Identical to the data collected at 185,000 miles, the manufacturer would be required to obtain high mileage systems, perform various emission tests to quantify and understand the deterioration, and incorporate that knowledge to refine and validate its accelerated aging procedures to be representative of full useful life and used for certification of 2016 and subsequent model year systems.

The following table summarizes the proposed requirements.

Table I: Phase-in aging data requirement schedule for engine and aftertreatment

Year	Aging data required at certification for accelerated aging: Engine	Aging data required at certification for accelerated aging: Aftertreatment
2010-2012 model year	125 hours aging	Accelerated aged to best estimates of full useful life on aftertreatment components.
Report in-use data in 2011	-18 months (for light and medium HDDE, full useful life, for heavy HDDE,185,OOO+ miles) real world aging data on 2010 model'year engines	
2013-2015 model year	For light and medium HDDE: accelerated aging to full useful life validated with real world aging data. For heavy HDDE: Best estimates for accelerated aging to full useful life incorporating 185,000 real world aging data	
Report in-use data in 2014	435,000 mile full useful life real world aging data on 2010 or later model year engines	
2016 model year and after	Accelerated aging to full useful life validated with real world aging data	

Manufacturers had requested that ARB adopt the same propose.d procedures that U.S. EPA is currently developing for determining deterioration factors (DFs) in lieu of staff's proposal. Specifically, U.S. EPA's plan would require manufacturers to do partial aging of the engines (Le., not require aging to full-useful life) and extrapolation of the emission data to determine the projected emission levels at full useful life. While partial aging may be appropriate for determining the likely emission levels of non-malfunctioning engines at useful life, it is not appropriate for projecting emission levels of engines with emission-related malfunctions. As previously stated, manufacturers are liable in-use for proper detection of faults before the OBD emission thresholds are exceeded at any time during the full useful life. To accurately determine how high emissions will be when a malfunction occurs, the performance level of the engine and aftertreatment system aged to full useful life must be taken into consideration. For example, to accurately calibrate an EGR system monitor to the emission threshold, the manufacturer must know how much of the increased engine-out NOx emissions caused by a malfunctioning EGR system is going to be cleaned up by the downstream SCR system at full useful life. This determination cannot be "extrapolated" by implanting a fault at low mileage and measuring the reaction of a low mileage SCR system. Accordingly, staff has rejected the manufacturers' suggestion to mimic EPA's DF determination process and continue down the path of requiring manufacturers to develop validated rapid aging procedures to simulate full useful life aging.

In addition to the aging requirements, staff is also proposing modifications to the malfunction simulation methods. Currently, the regulation allows manufacturers to electronically simulate malfunctions (e.g., use of an external sir:nulator) but does not allow them to make modifications to the electronic control unit (on-board computer) except for a few limited monitors. In general, staff has severely limited the use of internal computer modifications because it results in special software (non-production intent) to run the demonstration tests and increases the risk that the system will perform differently with the special software than it would with the actual production intent software. However, given the wide variety of technologies and strategies being implemented by diesel manufacturers, staff believes there may be additional cases that arise where it is not technically feasible or very expensive, difficult, and resource-intensive to implant faults through hardware or an external simulator. Accordingly, the proposal includes a provision for manufacturers to request and receive ARB approval to use internal computer modifications for additional monitors upon demonstration or analysis that it is infeasible or disproportionally difficult and resource intensive to implant the fault externally. Further, the proposal clarifies that, in cases where a manufacturer elects to electronically simulate a fault through an external simulator or internal computer modifications, the manufacturer must demonstrate that the failure characteristics produced by the simulation are equivalent to an induced hardware failure. This ensures that manufacturers are calibrating and designing the monitor to detect failures that are related to actual hardware malfunctions and not purely theoretical or idealized simulations of a fault.

Staff is also proposing modifications concerning the actual testing process. The current requirements were primarily copied from the test procedure for light-duty vehicles, however, recent discussions with manufacturers have revealed some fundamental differences in how heavy-duty emission tests are run. Unlike light-duty, the heavy-duty test procedure does not include a 'preconditioning' cyclethe day before the emission test. To be consistent with the 'current heavy-duty test procedures and to eliminate unnecessary extra testing, the proposed amendments would eliminate the preconditioning cycle and require manufacturers to implant the fault and immediately perform the emission test. Further, because the previous test procedures anticipated the use of a preconditioning cycle, the procedure expected that the fault would be detected once during the preconditioning cycle and a second time during the first engine start of the emission test. In conjunction with eliminating the preconditioning, the language was modified to expect the fault to be first detected on the first engine start of the emission test and detected'a second time during the. second engine start of the emission test. The proposed language does still allow a manufacturer to request approval to use preconditioning cycles if technically justified to stabilize the emission control system. While manufacturers have not yet identified a need for this provision, it will be in place in case future emisison controls require such stabilization.

Lastly, staff is also proposing modifications to the data collected during demonstration testing. The current regulatory language requires specific fault information (Le., time after start when the MIL illuminated, fault code(s), freeze frame information, test results) to be collected. Staff is proposing that manufacturers also be required to collect other OBO electronic information as well, including readiness status, current data stream values, CAL 10, CVN, VIN, in-use performance ratios, and engine run time tracking data. Furthermore, staff is also proposing that manufacture'rs be required to collect all the test data immediately prior to or after each engine shut-down, such as at the end of the preconditioning cycle (if used), cold start FTP cycle, and warm start FTP cycle. By analyzing this data when reviewing the demonstration test results, staff will be able to better understand the scenario of events and.ensure that the standardized data is outputting expected values during the test sequence. Historically, in testing done at ARB's facility, review of such data has identified many other small issues and .having this data at the time of certification would allow identified issues to be corrected sooner.

VI. PROPOSED REVISIONS TO HEAVY·DUTYOBD CERTIFICATION REQUIREMENTS

A. CERTIFICAnON ApPLICATION

Based on the staffs review of manufacturers' OBO II applications in the past years, minor changes are being proposed to the HO OBO certification submittal requirements to expedite the OBO review and approval process. Specifically, the proposed amendments would require some information, including a checklist, the summary table, and misfire monitor disablement data, to be submitted in a standardized format that will be detailed in a future ARB mail-out to facilitate consistent and quick review by staff (the specific mail-out number will be made available at the Board Hearing and as part of the subsequent 15-day changes to the regulations). Staff is also proposing to require manufacturers to submit data supporting their infrequent regeneration adjustment factors and information regarding EI-AECOs: Lastly, the staff is also proposing to require manufacturers to include a cover letter with each OBO application identifying the deficiencies and concerns (if any eXist) that apply to the equivalent engine family or OBO group in the previous model year and the changes and/or resolution of each concern or deficiency for the current model year. This'would allow the ARB staff to spend less time determining if past problems have been corrected.

B. IN-USE COMPLIANCE TESTING

As a condition for certification, manufacturers would be required to perform in-use compliance testing on their own engines. The actual procedures are detailed in the proposed enforcement regulation (§1971.5) and would require manufacturers to procure actual in-use engines, at roughly 75 percent of full useful life mileage, and perform a series of engine dynamometer emission tests to confirm the OBO system will detect faults at the emission levels specified in the HO aBO regulation (§1971.1). ARB has previously adopted similar requirements for manufacturers to do their own in-use compliance testing. This includes the "CAP 2000" program .adopted for light-duty vehicles that sets forth in-use compliance requirements and procedures in the test procedures incorporated by Cal. Code Regs., title 13, section 1961 and requires manufacturers to procure in-use vehicles, at various mileages, and perform emission tests to verify compliance with the tailpipe standards established in section 1961. It also includes the heavy-duty on-road manufacturer in-use compliance testing program in test procedures incorporated by Cal. Code Regs., title 13 sections 1956.1 and 1956.8 that requires manufacturers to procure .in-use vehicles, equip them with emission measurement devices, and collect emission data to verify compliance with the not-to-exceed (NTE) tailpipe standards established in sections 1956.1 and 1956.8. Cal. Code Regs., title 13, section 2438 establishes a manufaCturer in-use testing program for large spark-ignition engines with greater than 1.0 Liter displacement. Similar to what is proposed for HO aBO compliance, this program requires manufacturers to procure a number of in-use engines with a minimum mileage, perform emission tests to verify compliance with the established tailpipe standards, perform further testing if initial tested engines fail, and ultimately, generate sufficient data to determine if the engines do not comply and if remedial action is warranted. Another similar program exists for spark-ignition engines used in personal watercraft and outboard marine engines in Cal. Code Regs., title 13, section 2444.1 and requires manufacturers to procure in-use engines and perform emission testing to verify compliance with the established emission standards. Further, in the HO aBO (§1971.1(1» and the aBO" (§1968.2(j) regulations, manufacturers are also required to do other forms of production vehicle or engine evaluation testing to confirm various elements of their aBO systems comply with the certification standards and procedures established within the regulations themselves.

In all of the above examples, the requirements are indeed mandatory requirements that apply to the manufacturers of applicable vehicles and engines. EMA has argued that the heavy-duty in-use compliar1ce program is not a valid confirmation of ARB's authority to adopt similar requirements for HO aBO compliance because manufacturers agreed to do such testing during discussions and settlements in 1998 that ended with consent decrees to resolve engines produced in the 1990's that allowed the engines to comply with emission limits under certification conditions but caused significantly higher Nax .emissions during highway driving. However, not all engine manufacturers were part of the settlements and consent decrees yet all manufacturers are now required to do the in-use compliance testing. In any case, this and the other programs cited above are not optional requirements or voluntary agreements entered into by the manufacturers with ARB. It is both consistent with past and current practice of ARB to have manufacturers do some form of self-testing for verifying compliance with adopted standards.

VII. PROPOSED REVISIONS TO HEAVY-DUTY OBD STANDARDIZED METHOD TO MEASURE REAL WORLD MONITORING PERFORMANCE

Currently, the HO aBD regulation requires manufacturers to track monitor performance by counting the number of monitoring events and the number of driving events. The number of monitoring events is defined as the numerator and the number of driving events is defined as the denominator. The ratio of these two numbers is referred to as the monitoring frequency and provides an indication of how often the monitor is operating relative to vehicle operation. It is important to note that the denominator is a measure of vehicle activity, not a measure of "monitoring opportunities". The regulation requires manufacturers"to design monitors that meet a minimum acceptable ratio, currently set at 0.1 for 2013 and subsequent model year engines.

The current requirement for incrementing the general denominator is:

1.) minimum engine run time of 10 minutes;
2.) minimum of 5 minutes, cumulatively, of vehicle operation atvehicle speeds greater than 25 miles-per-hour (mph) for gasoline engines or calculated load greater than 15 percent for diesel engines; and .
3.) at least one continuous idle for a minimum of 30 seconds encountered; and the above three conditions met while:
4.) ambient temperature above 20 degrees Fahrenheit and
5.) altitude of </= 8000 feet.

Industry has expressed concerns that some monitors may not execute on the denominator drive cycle defined above and, therefore, some vehicles may exhibit poor in-use ratios. However, industry has erroneouslyreached the conclusion that the denominator represents a drive cycle during which all monitors must be executed. On the contrary, manufacturers are not required to design monitors to execute during the denominator drive cycle but are required to design robust monitors that perform frequently in-use. Monitors are designed to run when specific engine operating conditions are met-not when a specific drive cycle is met-and the occurrence of those conditions happens independent of whether a denominator drive cycle is met. For.example, a case may exist where a monitor never executes on the denominator cycle but the minimum in-use frequency ratio may still be satisfied because the monitor executes frequently on other drive cycles. The purpose of the denominator is not to provide industry with a drive cycle by which to run all monitors but to provide ARB with a measure of vehicle activity.

Additionally, industry has requested changes in the definition of the denominator drive cycle. When the HD OBD regulation was adopted in 2005, diesel engine manufacturers indicated that they did not always have access to vehicle speed and thus, could not determine when a vehicle had spent five cumulative minutes above 25 mph. As an alternative, they proposed, and ARB accepted, five minutes above 15 percent engine load for diesel engines. At this time, however, diesel engine manufacturers have now indicated that 15 percent engine load is not a consistent indicator from engine to engine, since it could be satisfied ·at idle on some engines while it is satisfied with operation somewhere above 25 mph on other engines. Diesel engine manufacturers now propose greater than 50 percent calculated load for five cumulative minutes in lieu of greater than 15 percent for five cumulative minutes. Further, for those engines that do have access to vehicle speed, industry has requested permission to alternatively use the gasoline engine parameter of greater than 25 mph for five cumulative minutes on diesel engines in lieu of the greater than 15 percent load.

Regarding the denominator drive cycle, ARB's objective is to provide a common definition because manufacturers will be held to the same minimum in-use frequency ratio based on this definition and the use of different definitions would lead to inequity among manufacturers. Under the current regulation, while gasoline and diesel engines do not use the same definition, all diesels are required to use a consistent definition and all gasoline are required to use a consistent definition. This consistency among similar engines is imperative to ensure equivalent stringency in requirements among manufacturers and must be maintained. However, staff agrees that the 15 percent engine load criterion is inappropriate as a consistent measure of engine work or vehicle activity. To address industry's concern and maintain commonality, staff is proposing to change this definition to exclude the calculated load parameter and instead include five cumulative minutes of engine speed at or above 1150 rpm for diesel engines. Staff believes 1150 revolutions-per-minute (rpm) represents an engine speed above idle in virtually all engines and is a positive indicator that the engine is being used to do work (e.g., move the vehicle, operate a substantial power take-off unit). Many engines have-peak torque that occurs at 1200 rpm and above and most manufacturers' engines are subject to the not-to-exceed emission standard at engine speeds above 1150 to 1200 rpm. And, whenever the engine is doing work, it is vital that the emission controls are working properly so basing an in-use monitoring frequency relative to how often the engine is being used to do work is appropriate. Further, all manufacturers have access to engine speed and could accurately determine when this criteria was satisfied. With the 2010 model year production fast approaching, however, staff believes some lead time is necessary a'nd is allowing 2010 through 2012 model year diesel engines to use the 15 percent calculated load criterion. Additionally, to maintain consistency of the denominator definition and equality among manufacturers, staff does not agree with manufacturers' request to optionally use the vehicle speed criterion in lieu of the engine speed or load criterion.

In addition to the proposed changes to-the general denominator definition above, staff is proposing a separate denominator for PM filter monitoring. Currently, the regUlation allows manufacturers to submit proposed criteria for incrementing the PM filter monitor denominator for ARB approval. Since the adoption of the requirement, staff has gained enough knowledge from discussions with engine manufacturers to propose specific criteria for the PM filter monitor, which engine manufacturers have indicated will most likely be tied to PM filter regeneration events. Thus, in addition to meeting the general denominator on at least one driving cycle, staff is proposing that the PM filter denominator be incremented after 750 minutes of cumulative engine run time. The basis for 750 minutes is calculated starting from a 300-500 mile interval that industry has indicated is typical of distance between PM filter regenerations and assuming an average vehicle speed of 40 mph (500 miles *140* mph =12.5 hours =750 minutes).

The proposed revised definition for the general rate-based denominator for diesel engines is:

,1.) minimum engine run time of 10 minutes;

2.) minimum of 5 minutes, cumulatively, of engine operation with engine speed at or above 1150 rpm; and
3.) at least one continuous idle for a minimum of 30 seconds encountered; and the above three conditions met while:· .
4.) ambient temperature above 20 degrees Fahrenheit and
5.) altitude of</= 8000 feet.

The proposed definition for the PM filter rate-based denominator is:

1.) minimum of 750 minutes of cumulative engine run time since the last time the PM filter denominator was incremented and
2.) meeting the above requirements for the general denominator on at least one driving cycle.

For the PM filter denominator, the proposed language also provides clarification regarding tracking the. order of events when determining the criteria have been met. Specifically, the language identifies methods to first identify on a particular key start if a general denominator has been satisfied and subsequently to then determine if the cumulative engine run time has been satisfied. The language also provides direction to manufacturers on when the cumulative engine run time counter must be restarted.

Staff is also proposing to modify the definition of "idle" operation (which is also referred to in the permanent fault code erasure requirements and the standardization tracking requirements of the regulation). "Idle" operation is currently defined as conditions where vehicle speed is less than or equal to one mph, among other criteria. As indicated above, some manufacturers have indicated that their engines do not utilize vehicle speed information and thus, cannot sense vehicle speed. They further indicated that engine speed is an acceptable surrogate to use to determine idle operation. Thus, ARB is proposing to define idle operation as conditions where, among other criteria, either the vehicle speed is less than or equal to one mph or engine speed is less than or equal to 200 rpm above the normal warmed-up idle speed.

VIII. PROPOSED REVISIONS TO OBD II REGULATION

At the request of medium-duty diesel manufacturers in order to maintain consistency between the HO aBO and aBO II diesel requirements, staff is proposing to carry over almost all of the proposed diesel-related changes mentioned above for the HO aBO regulation to the aBO II regulation, applying them to light- and medium-duty diesel vehicles. The only difference between what would be proposed for light-duty diesel vehicles versus medium-duty diesel vehicles is that any of the proposed changes related to modification of the specific malfunction emission threshold values would only apply to the medium-duty diesel vehicles. The specific proposed changes to the aBO II regulation can be found in Attachment B.

Additionally, staff is proposing one change to the gasoline monitoring requirements in the aBO II regulation concerning the phase-in schedule for primary oxygen sensor response rate monitoring data submission. Currently, manufacturers are required to submit data and/or engineering analysis to demonstrate that their oxygen sensor monitors are able to detect all asymmetric and symmetric response rate malfunctions with a phase-in starting with the 2010 model year. However, recent discussions with manufacturers indicate that more time is needed to meet this requirement. Thus, staff is delaying the start of the phase-in from the 2010 model year to the 2011 model year, with all vehicles required to meet this requirement for the 2013 and subsequent model years.

IX. **PROPOSED** HEAVY-DUTY **OBD ENFORCEMENT REGULATION**

A. OVERVIEW

The staff is proposing that the Board adopt a comprehensive in-use enforcement protocol that applies specifically to the HO aBO requirements (Cal Code Regs., title 13, §1971.1), pursuant to the Board's general and specific authority to adopt procedures that ensure compliance.[2] The proposed HO aBO enforcement provisions would help ensure the effectiveness of the HO aBO regulation and the underlying more stringent emission standards that have been adopted for 2010 and subsequent model year heavy dutY engines. Among other things, the staff is proposing procedures for the in-use testing of HO aBO systems installed on heavy-dutY engines. The proposal would further provide the Executive Officer with authority to order engine manufacturers to take remedial action when in-use testing indicates that an HO aBO system within an identified engine class does not meet the certification requirements of Cal. Code Regs., title 13, section 1971.1.

The staff believes that specific HO aBO enforcement provisions are necessary to better address and identify the special circumstances involved in in-use testing and remedying identified nonconformities with HD aBO systems. Past experience in light-and medium-dutY revealed that the general enforcement procedures (Cal. Code Regs., title 13, §2111-2135), which were s'pecifically adopted to enforce noncompliance with tailpipe and evaporative emission standards, do not allow for effective enforcement of aBO requirements and standards. The general enforcement procedures do not neatly apply to aBO regulations for two main reasons. First, the aBO regulations include both emission standards and other non-emission-related requirements, such as test procedures and standardization requirements. Second, aBO systems are comprehensive and exceedingly complex; and, consequently, in-use enforcement of aBO systems involVes a myriad of issues that do not arise in the enforcement of tailpipe and evaporative emission standards. Over time, it became apparent that the simplified general enforcement approach used for tailpipe noncompliance did not adequately address the unique issues involved in the in-use operation of aBO systems.

In 2002, the Board adopted stand-alone specific enforcement procedures for the aBO II requirements (codified at Cal. Code Regs., title 13, §1968.5). Since adoption of the

2 Health and Safety Code, se.ctions 39600, 39601, 43013(b), 43018,43102,43104, and 43105.,

enforcement regulation, ARB has applied its detailed protocols in addressing OBO /I noncompliance. In general, the procedures provide for straight-forward evaluation and remediation (where necessary) of complex, OBO /I-specific in-use issues. The detailed protocols have also provided clear direction to manufacturers as to the procurement, testing, sampling, and evaluation criteria that ARB staff uses to determine compliance with the OBO /I requirements and has eliminated many uncertainties for manufacturers related to the procedures that ARB will follow in carrying out enforcement and the criteria ARB will use. in determining compliance and appropriate. corrective action. Further discussion about the need for an OBO specific enforcement procedure can be found in the staff report for the 2002 OBO II Board hearing available at ARB's website (http://www.arb.ca.gov/msprog/obdprog/pastregs.htm) and incorporated by reference.

Ouring the 2005 HO OBO rulemaking process, staff indicated its intent to return to the Board with a proposal to adopt similar independent enforcement provisions for HO OBO. To that end, staff is now proposing adoption of section 1971.5, which would establish enforcement procedures and requirements for heavy-duty engines with HO OBO systems. It is ARB staff's goal that the regulation becomes effective prior to implementation of HO OBO system requirements, which commence with the 2010 model year.

The proposed HO enforcement procedures are similar in comprehensiveness to those currently required for light-duty and medium-duty vehicles under the OBO /I regulation. Both regulations include performance testing of emission.,related monitors, downloading of data of in-use performance monitoring ratios, and evaluation of other OBO requirements (e.g., diagnostic connector location, communication protocol standards, MIL illumination protocol, etc.). But there are distinct differences,primarily because heavy-duty engines"are certified on engine dynamometers and the testing of emission-related monitors on HO OBO systems will require the removal of engines from in-use vehicles for testing. Accordingly, the proposed regulation provides that, in addition to ARB-initiated enforcement testing, engine manufacturers will be responsible for compliance self-testing of OBO systems to ensure that the systems in-use actually meet certification requirements.

One of the reasons manufacturer self-testing is necessary is because of the uniqueness of engine dynamometer testing. Unlike chassis dynamometer testing of the complete vehicle as is done in light-duty and can easily be replicated by ARB; manufacturers, and independent laboratories, engine dynamometer set-up and testing differs for each engine and involves the use of custom parts, modifications, ·and configurations. Because the engine is removed from the vehicle, various inputs and outputs to the engine control computer must be generated to simulate operation in a vehicle. Further, many engine components especially heat exchangers like the radiator, charge air cooler, and EGR cooler that rely on outside airflow (that would occur through the front of the engine compartment while driving on the road) must be removed ahd simulated because there is no comparable source of outside airflow in the test cell. Such simulations vary from manufacturer to manufacturer and engine model to engine model because they must duplicate the performance applicable to ·those components for that particular engine in a specific vehicle type. Some manufacturers have also indicated that certain software functions or features within the engine control unit must be disabled during engine dynamometer testing to prevent abnormal operation due to specific engine dynamics that occur during testing and disablement of such features requires manufacturer-specific tools and hardware to implement. Without intimate knowledge of all the individual component specifications and input and output signals, not to mention custom hardware and software to replace the removed components, or tremendous reliance on the voluntary cooperation and resources of the engine manufacturer, successful engine dynamometer testing is very difficult to perform. Engine manufacturers, who routinely perform engine dynamometer testing of their own engines, including testing for research, development, and tailpipe certification,have, by definition, the knowledge and equipment necessary to perform engine dynamometer testing.

B. THE NEED FOR HD aBO-SPECIFIC ENFORCEMENT PROCEDURES

The staff believes that specific HD aBO enforcement provisions are necessary to better address and identify the special circumstances involved in in-use testing and remedying identified nonconformities with HD aBO systems. As stated, experience with aBO II has revealed that the existing general enforcement procedures, which were specifically adopted to enforce noncompliance with tailpipe and evaporative emission standards, do not allow for effective enforcement of aBO requirements and standards. For example, the adoption of aBO II-specific enforcement provisions helped clarify that a manufacturer 'cannot escape liability for failing to comply with the aBO II standards and requirements by demonstrating that vehicles with the nonconforming aBO II system, on average, comply with certification standards for tailpipe and evaporative emissions. The aBO II emission standards and requirements serve very different purposes from the tailpipe and evaporative emission standards, arid compliance with the latter two standards should not excuse noncompliance with the former.

As with aBO II, to allow a heavy-duty engine manufacturer to overcome the need to remedy a nonconforming HD aBO system by showing that the failure would not result in the engine class, on average, to fail to conform to the tailpipe emission standards would undermine the purpose and intent of the HD OBD requirements. In adopting the HD aBO regulation, the Board specifically determined that functional aBO systems were necessary and should be equipped on all heavy-duty engines in the future. In so determining, the Board found that functional aBO systems are a vital complement to the success of the ARB's heavy-duty engine emission reduction programs. The HD aBO system is intended to insure that 2010 and subsequent model year engines meet the adopted tailpipe emission standards in-use. The HD aBO systems are there to ensure that forecasted emission reductions will be achieved, and the proposed enforcement provisions are necessary to ensure that the adopted HD aBO requirements are fully effective in-use.

C. AUTHORITY TO ADOPT ENFORCEMENT PROCEDURES

Depending upon the nature of the nonconformity of the HO aBO system and the circumstances surrounding the nonconformity, recall may be an appropriate remedy. Health and Safety Code section 43105 authorizes the Executive afficer to order recalls, if a manufacturer has violated emission standards or test procedures and has failed to take corrective action. The HO aBO regulation, Cal. Code Regs., section 1971.1, establishes both emission standards and test procedures for certification to those standards. The ARB expressly adopted the HO aBO regulation pursuant to authority granted by the Legislature to adopt and implement emission standards and test procedures under the Health and Safety Code.[3] In 2000, in adopting Senate Bill 1146, the Legislature expressly recognized ARB's authority to adopt aBO regulations, finding that aBO requirements are emission standards, stating:

> Recent emission standards adopted and implemented by the State Air Resources board for motor vehicles manufactured after 1993 have resulted in the development by vehicle manufacturers of "on board diagnostic computers" that interface with the many component parts of a vehicle's emission control system. (Stats. 2000, Ch. 1077, Sec. 1; emphasis added.)

Similarly, in granting California a waiver of federal preemption for the aBO II regulation, pursuant to section 209(b) of the federal Clean Air Act, the U.S. Environmental Protection Agency (U.S. EPA) expressly found that the requirements of the California aBO II regulation were emission standards, stating.

> aBO requirements appear to be closer in their application and effect to standards than to enforcement procedures: they establish specific levels of emissions that beyond which the MIL must be illuminated and fault codes be stored; they create direct requirements on the manner inwhich manufacturers build their vehicles; the aBO II requirements set forth how a vehicle must operate at time of certification and in use, and not how the state would ensure that the vehicle is operating properly as is typical of an accompanying enforcement procedure.

Beyond being emission standards, the HO aBO regulation sets forth specific test procedures that manufacturers must follow to assure certification and compliance to the established standards. Accordingly, Health and Safety Code section 43105 expressly authorizes the ARB to adopt regulations regarding corrective actions, including recall, that the Board may take for violations of the aBO II emission standards and the test . procedures established to certify vehicles to those standards.

In addition to the express authority of Health and Safety Code section 43105 to adopt enforcement procedures, the Board has unmistakable implied authority to adopt such regulations. The general powers granted to the Board in Health and Safety Code section 39600 provide that the Board shall do such acts as may be necessary for the proper execution of the powers and duties granted to it. The aBO II requirements were

3 See Health and Safety Code §§ 43013, 43018, 43101, 43104, and 43105.

adopted pursuant to general authority granted under sections 43013,43018, and 43101 among others. Specifically, sections 43013(a) and 43101 authorize the Board to adopt and implement motor vehicle emission standards. And section 43018 directs the Board to take whatever actions are necessary, cost-effective, and technologically feasible in order to achieve specific emission reductions, including the adoption of standards and regulations that will result in, among other things, reductions in motor vehicle in-use emissions through improvements in emission system durability and performance.

Although the Legislature did not expressly authorize the adoption and implementation of aBO II requirements, the Legislature recently gave its imprimatur to the regulation.[4] Having implicitly authorized the Board to adopt the aBO II regulations in furtherance of the Board's mission, it cannot reasonably be argued that the Legislature has not also entrusted the Board with authority to properly enforce the adopted standards and test procedures to ensure complian·ce.[5]

Such authority would extend to the requirements discussed below that require manufacturers to self-test HO aBO emission threshold monitors so long as those requirements do not impose a significant economic burden on manufacturers and are cost-effective. As stated manufacturers are in the best position,with specialized knowledge of how they tested engines for certification on the dynamometer and convenient access to the engin.e parts that enable accurate testing, to perform such self-testing. As explained below in the economic cost section, the enforcement self-testing provisions would not impose an excessive economic burden on manufacturers, and effective and accurate dynamometer testing that ensure that aBO systems work correctly and that forecasted emission reductions are achieved is unquestionably cost-effective.

O. SUMMARY OF THE HO aBO COMPLIANCE/ENFORCEMENT REGULATION

1. General

. The main differences between the aBO II enforcement procedures and those proposed here for HO aBO involve non-compliance related to monitors exceeding the aBO emission malfunction thresholds (e.g., verifying that the fault is detected before emissions exceed 2.0 times the applicable tailpipe standard). The differences include the criteria that would need to be met for ARB to assume non-compliance and require further enforcement testing, and the specific testing procedures that would need to be carried out. For light-duty enforcement under the aBO II regulation, the enforcement protocol relied heavily on well established vehicle procurement, screening, and testing procedures used for tailpipe emission compliance testing. No such detailed protocol exists for heavy-duty aBO testing. To a large extent, the proposed procurement and selection process parallels the recently established procedures that EPA, ARB, and

4 See section 43105.5(a)(4), Stats. 2000, Ch. 1077, Sec. 4; see also Sec. 1.
5 See *California Drive-In Restaurant Ass'n* v. *Clark* (1943) 22 Cal.2d 287, 302 [140 P.2d 657], "the authority of an administrative board or officer, ... to adopt reasonable rules and regulations, which are deemed necessary to the due and efficient exercise of the powers expressly granted, cannot be questioned."

manufacturers agreed to for the manufacturer self-testing for tailpipe emission compliance using portable emission measurement systems.

The proposed regulation provides that ARB may conduct enforcement testing for emission threshold noncompliance by procuring engines from in-use vehicles and testing them on an engine dynamometer in accordance with the procurement, selection, and testing criteria noted above. ARB, however, has very limited experience with such testing and no existing facilities capable of conducting such-testing of heavy-duty engines. To address this issue, the proposed regulation would also require manufacturers to· perform self-testing for compliance on a limited number of engines each year.

For each engine tested by the manufacturer; if the faults are detected prior to the prescribed emission levels being exceeded, the testing is completed. However, if initial testing indicates that the system fails to detect one or more faults before emissions exceed the emission thresholds of Cal. Code Regs., section 1971.1, the manufacturer would be required to procure, select, and test four more engines from the same engine family for that specific monitor. And, if two or more of the additional four engines fail, an additional five more engines are to be procured for testing of the failing monitor. At *most*, a manufacturer would have to test 10 engines from the same engine family. For both testing done by ARB and by the manufacturer, the monitor would be jUdged noncompliant if five or more of the 10 tested engines failed to detect the fault before the appropriate emission threshold is exceeded.

Manufacturers have argued that it is inappropriate to require them to do their own compliance testing and that ARB has no authority to require them to do testing·beyond certification. As previously indicated, staff disagrees as ARB clearly has authority to adopt test procedures, including in-use compliance testing, as part of the certification process to ensure that its regulations are met and there is no restriction that such procedures are limited to items that are conducted prior to certification. Further, ARB clearly has authority to adopt enforcement regulations and procedures to be used on engines and vehicles after certification and there is no restriction that these procedures be carried out exclusively by ARB.

Staff did consider alternatives to the manufacturer self-testing element and to the engine dynamometer testing. Staff looked into various methods to contract out for and perform engine dynamometer testing. However, as noted above, engine dynamometer testing requires very detailed knowledge about the engine and often requires custom equipment or parts created by the manufaCturer themselves to successfully conduct a test (e.g., water to air coolers to simulate on-vehicle air-to-aOir coolers, simulations of vehicle or transmission outputs to enable the engine to operate over the required speed and load regions).· Engine manufacturers are uniquely qualified to test their own engines at a substantial economic savings relative to anyone else. Staff investigated methods to develop a 'screening' test of some sort using portable emission measurement systems (PEMS) which would allow testing while the engine is still in the vehicle. If such a method could identify whether an engine would likely pass or fail, then only engines that are more likely to fail could be sent on to engine dynamometer based testing for the ultimate compliance decision. Unfortunately, several complications were encountered that, at this time, render such a screening test infeasible. Staff has' discussed this with industry and has indicated it is still open to suggestions that evolve in the future. And, because the first engines won't need to be tested until 2013 calendar year, there is significant time between now and then for more ideas to surface and be considered during a future biennial review. Should such an idea surface and need to be used before a future biennial review can incorporate it, language is included in section , 1971.5 to allow the Executive Officer to accept alternative testing procedures upon the manufacturer demonstrating they will' provide an equivalently robust determination as to the compliance of the OBO system on the engine.

2. ARB Conducted Testing

The structure of the proposed regulation is similar in many respects to the OBO II enforcement regulation, especially as it applies to the testing of OBOsystems that would occur while the engine is installed in the vehicle. Under the proposed regulation, the ARB staff could elect to periodically evaluate engines from any certified engine class. It would be directly responsible for enforcement testing of all HO OBO requirements other than the testing of emission-related monitors, which require engine dynamometer testing. For example, ARB staff would conduct enforcement for testing of in-use performance monitoring ratios and other non-emission-threshold related requirements. For such non-emission related testing, the protocols that the ARB would use would closely follow the OBO II protocols for procuring, testing, and determining compliance of OBO systems. Additionally, ARB could e,lect to conduct testing on emission-threshold monitors that require engine dynamometer testing at an independent laboratory or at an ARB facility, but such testing is expected to be limited due to the difficulties in conducting such testing and lack of an ARB testing facility.

The proposed procedures set forth detailed provisions on how ARB will conduct testing, including, among other things, how the staff would initially determine the scope of engines (the engine class) to be tested, the number of engines to be tested (Le., the size of the test sample group), and the type of testing to be conducted. As indicated, ARB enforcement testing would be grouped into three different categories depending on the nature of the OBO II noncompliance issue to be tested. Specifically, the protocol proposes that separate guidelines and procedures be followed for in-use performance ratio testing, "other" HD OBO testing, and testing of emission-related threshold monitors.

For OBO ratio testing, ARB staff would collect data from a test sample group of 30 engines that have been properly procured and selected. In determining compliance with other requirements that do not require emission testing, the staff would determine, on a case by case basis, the number of engines needed to ensure that the results of such testing may be reasonably inferred to the engine class. The determination would be based upon the nature of the nonconformance and the scope of the engine class. The test sample group could be as few as two test engines. For OBO emission testing, the ARB staff would follow the provisions of Cal. Code Regs., title 13, section 2137 regarding test sample size. In accordance with section 2137, the staff would test 10 engines that have been properly procured and selected.

The ratio testing procedures would be used when the in-use monitor performance is tested for compliance with the minimum acceptable. in-use monitor performance' requirements (Le., does the monitor run often enough?). In cases where the monitor being tested has a ratio that is required to be tracked and reported to a scan tool in standardized manner, the actual ratio testing of procured vehicles would be a rather expeditious and straightforward process. The "testing" of the 30-plus engines would be as simple as electronically downloading the stored data from the engines with a diagnostic tool (e.g., an aBO scan tool).

For testing of monitors that are required to meet the ratio but are not required to track the data in the on-board computer or report it in a standardized manner, the process would be lengthier and slightly more involved. In these cases, rather than downloading information stored in the on-board computer, each test engine would be equipped with instrumentation that would record and collect engine activity data and diagnostic activity. Each test vehicle would then be returned to the vehicle operator for accumulation of data. After collection of sufficient data (the.same amount of data as required for the ratios that are tracked and reported), the data would be analyzed to determine the ratio for the. tested monitor for each engine. This method is directly analogous to that used for the ratios that are required to be tracked and reported in the on-board computer by effectively tracking and reporting the ratio in an "off-board" computer (Le., the instrumentation attached to the engine).

Testing of HO aBO requirements other than rate-based monitoring or emission testing would be determined on a case-by-case basis because of the myriad of different requirements included in this residual category and the many nuances of the complex systems that they regulate that may affect some aspects of the system performance. Given this complexity, it is impossible to predict every possible permutation or noncompliance that might occur.in the future. As such, it is impossible to prescribe exact test procedures that will adequately address every possible noncompliance scenario. For example, a problem could be as simple as a system not complying with the MIL display requirements (e.g., using an incorrect symbol or wording instead of the required engine symbol on the dashboard light). The noncompliance would likely be confirmed by using a visual examination of the procured vehicles. an the other hand, the problem could be complex such as the inability of the HO aBO system to properly detect malfunctioning thermostats that cause the engine to warm up too slowly. Such a. malfunction could cause a vehicle to have increased emissions and/or cause the disablement of other diagnostics. In contrast to the first example, testing could not be conducted to confirm .noncompliance by performing a visual inspection but would require implanting of a faulty thermostat and operation of the vehicle in various ambient and driving conditions to ensure the manufacturers' disclosed monitoring conditions have been satisfied, all while recording results and data with an off-board tool. Accordingly, for the "other" HO aBO testing category, the proposed regulation defines general guidelines to be followed by the staff when conducting testing in this area. The Executive Officer would have discretion to determine, on a case-by-case basis, the most appropriate procedures for selection and testing of vehicles based on the nature of the noncompliance and the projected number of affected engines. The Executive Officer would be required to provide notice of the selection and testing procedures to the manufacturer of the engines subject to such testing (see discussion below).

The HO aBO emission testing procedures would be used when the measurement of tailpipe emission levels relative to the tailpipe emission standards is essential to determining system compliance. Emission testing for HO aBO compliance is comprised of two distinct parts: (1) emission testing in accordance with the test procedures used by the Executive Officer for in-use. testing of compliance with tailpipe emission standards in accordance with Cal. Code Regs., title 13, sections 2138 and 2139; and (2) on-road and/or dynamometer testing with the engine being operated in a manner that reasonably ensures that all of the monitoring conditions disclosed in the manufacturer's certification application for the tested monitor are encountered. The latter testing will be conducted to determine the MIL illumination point and the former testing will be conducted to determine the tailpipe emission level at the MIL illumination point. Together, these two parts of testing are necessary to determine if the MIL illuminates prior to exceeding the tailpipe emission levels as required in the HO aBO regulation. As stated, HO aBO emission-threshold monitoring requires engine dynamometer testing. For all such testing, the staff must implant a malfunction into the engine and then determine if the HO aBO system properly detects the malfunction at the required tailpipe emission levels.

Like the aBO II regulation, the proposed HO aBO reguJation sets forth the decision criteria that the Executive Officer would use to determine if a system is noncompliant for each type of testing. For example, for HO aBO minimum in-use monitoring frequency testing, the system would be noncompliant if the average in-use performance of the sample engines is below a critical ratio that indicates the average ratio for the entire engine class is below the required minimum in-use monitor performance ratio of 0.100 set forth in Cal. Code Regs., title 13, section 1971.1 (d)(3). For 2016 and subsequent model year engines, engines would be considered noncompliant with the in-use performance ratio requirement if either 66 percent or more of the 3D-engine test sample had a ratio of less than 0.100 or the average of the ratios in the test sample was less than a critical ratio of 0.088. This critical ratio was calculated using the same method discussed in Appendix V'of the 2002 aBO II Staff Report referenced above to provide statistical confidence that the results derived from the 3D-engine sample represent the actual in-use performance of the affected engines.

And, for the "other" testing category, the system would be determined to be noncompliant if 30 percent or more of the sample engines fail to meet the same requirement that falls within the residual-testing category. This criterion is consistent with the criterion set forth in the existing tailpipe emission enforcement procedures, which provides that a test group or sub-group of vehicles shall be considered nonconforming when a specific emission-related failure occurred in three or more test

· vehicles from a sample that includes a minimum of 10 in-use vehicles. The staff believes that use of the definitive 30 percent criterion is preferabJe to the use of the term "substantial number of a class or category of vehicles that ...experience a failure of the same emission-related component. ..", that is used in the definition of nonconformity in the existing enforcement procedures.[6] The specific percentage will provide clear notice to all parties of what is expected for compliance with the regulations.

For HO OBO emission testing, the regulation specifies that the system would be determined to be noncompliant if 50 percent or more of the tested sample engines are unable to properly detect a malfunction and illuminate the MIL before tailpipe emissions exceed the malfunction criteria thresholds set forth in Cal. Code Regs., title 13, section 1971.1 (e) and (f). Further details of the emission testing are provided in section IX. 0.4. below .

If any of the above testing indicates that the HO OBO system is suspected of being noncompliant, the Executive Officer would be required to provide the manufacturer with a notice of the test results. The proposed regulation would require that such notice include all relevant supporting information that the Executive Officer relied upon in making his or her determination of nonconformance of the HO OBO system.

Manufacturers would have the opportunity to respond to the preliminary notice and present test results and other data that they believe rebut the preliminary findings of noncompliance. Upon consideration of the information submitted by the manufacturer, the Executive Officer may decide to perform additional in-use testing if necessary. The Executive Officer would consider all information submitted by the manufacturer in ultimately determining whether an HO OBO system is nonconforming.

Lastly, the Executive Officer would be required to issue a notice of final determination to the manufacturer as to whether the HO OBO system is nonconforming. If the Executive Officer finds the HO OBO system to be nonconforming, the regulation would require the notice to set forth the factual bases for the determination. After receiving the notice of noncompliance from the Executive Officer, a manufacturer would have 45 days to elect to conduct an influenced recall and repair of the affected vehicles. If the manufacturer were to take no action, the Executive Officer could order the manufacturer to take appropriate remedial action scaled to the level of noncompliance. The proposed regulation sets forth a detailed set of factors that the Executive Officer would consider in determining the appropriate remedy. Three distinct categories of remedial action are identified in the regulation and are discussed in section 4 below.

3. Manufacturer Self-Conducted Compliance Testing

Cal. Code Regs., title 13, section 1971.1, would require as a condition for certification that manufacturers conduct compliance testing of in-use engines to ensure that production engines in-use continue to meet the HO OBO requirements. The requirements for compliance testing are set forth as part of Cal. Code Regs., title 13,

6 Cal. Code Regs., title 13, section 2112(h)

section 1971.5, and are discussed immediately below. ARB may use the results of such testing to determine if enforcement remedial action is necessary. A summary of the compliance test procedures that manufacturers would be required to follow is provided below.

Specifically, manufacturers would be required to perform enforcement testing on one to three engine families per year, depending on the size of the manufacturer. For each engine family, manufacturers would be required to procure a single representative in-use engine with approximately 75 percent of full useful life mileage and remove it from the vehicle for engine dynamometer testing. For each tested engine, the manufacturer would run the same sequence of tests ARB would run-testing each threshold component one after the other and determining the emission level at which the fault is detected. Given the mileage for procurement, such testing would occur approximately three years after introduction of the engine into the marketplace so 2010 model year engines would first be tested in 2013 calendar year.

Under the proposed procedures, an engine manufacturer would be required to submit a listing to the Executive Officer of all of the engine families and engine ratings within each family that have been certified for each model year. The Executive Officer would then select the engine family(ies) and the specific engine rating within the engine family(ies) that the manufacturer shall use as a test engine for the test sample group to provide emission test compliance data. For the 2010 model year, a manufacturer would be required to provide emission test data of a test engine from the OBD parent rating. In 2013 and subsequent model years, the number of test engines that a manufacturer would be required to provide emission test data from would depend upon'the number of engine families that it certified in any model year: if from one to five engine families were certified, the manufacturer would be required to provide data from one engine rating; six to ten certified engine families would require data from two engine ratings; and eleven or more certified engine families would require data from three engine ratings. The Executive Officer could waive the requirement for submittal of data of one or more of the test engines if data have been previously submitted for all of the engine ratings.

In selecting the test sample group, the engine manufacturer would be required to follow the same criteria that ARB would follow in conducting enforcement testing. Within three calendar years after the model year of the engine (e.g., by the end of calendar year 2013 for a 2010 model year engine), the engine manufacturer would be required to complete compliance testing of the emission threshold monitors of the test engine. Prior to conducting any testing, the engine manufacturer would be required to replace components'monitored by the OBD system with components that are sufficiently deteriorated or simulated to cause malfunctions that exceed the malfunction criteria established in Cal. Code Regs., title 13, sections 1971.1 (e) through (g) in a properly operating system. The engine manufacturer would not be required to use-components deteriorated or simulated to represent failure modes that could not have been foreseen to occur by the manufacturer.

After the test engine(s) has been selected and procured, engine manufacturers would need to perform emission testing for all applicable components/systems according to the certification demonstration testing requirements of Cal. Code Regs., title 13, sections 1971.1 (i)(3) and (i)(4), unless a manufacturer obtains approval from the Executive Officer to deviate from the procedures for the purpose of compliance testing. If the initial testing on the originally selected test engine indicates that the OBO system properly illuminates the MIL for all component/system monitors before emissions exceed the malfunction criteria defined in title 13, CCR sections 1971.1(e) through (g), no further testing is required.

However, if the results of the OBO emission tests indicate that the OBO system does not properly illuminate the MIL for one or more of the component/system monitor(s) before emissions exceed the malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1 (e) through (g), the engine manufacturer would need to conduct further testing on an additional four engines from the same engine rating and engine family as the test engine. The engine manufacturer would only be required to test the component/system monitor(s) for which the OBO emission test results exceeded the malfunction criteria specified in the HO OBO requirements. If the results indicate that the OBO system properly illuminates the MIL for the tested component/system monitor(s) before emissions exceed the malfunction criteria, on three or more of the additional test engines, the no further testing is required. If,. however, two or more of the engines failed the second round of testing, the manufacturer would be required to test five more engines. At the conclusion of testing, if five or more of the ten total tested engines failed, the Executive Officer would make a determination that the engine family is noncompliant.

Under the proposed compliance/enforcement testing procedures, manufacturers would be required to allow ARB personnel access to any facility where a manufacturer performs any work related to procurement, selection, or testing and any facility where documents relating to the above are located. Among other things, ARB staff would be allowed to inspect and monitor work performed at these facilities, including the right to verify correlation or calibration of test equipment, inspect and photograph any part or aspect of the tested engine(s) and any components added to the engine(s) in conjunction with testing. ARB personnel would also have the right to inspect and make copies of any such records, designs, or other documents related to a tested engine and its testing.

Within 30 days after completing testing of the initial engine, the manufacturer would be required to submit a report of the results of the testing as well as a detailed description of the conducted testing to the Executive Officer. If testing of additional engines is required, the manufacturer would have six months to complete the testing "and would need to submit an additional report within 30 days of completing the additional testing.

After the engine manufacturer has conducted testing pursuant to sections (c)(3) and (c)(4) and the Executive Officer has received the test results pursuant to section (c)(6) as described above, the Executive Officer shall make a finding of nonconformance of the OBO system in the engine class using the same criteria that is used in ARB-conducted enforcement testing. The Executive Officer would provide the manufacturer of his or her compliance determination. In thecase of a finding of noncompliance, the Executive would follow the procedures similar to that previously described for ARB-conducted notices.

4. Remedial Action

A. Introduction

After notification of noncompliance from the Executive Officer, a manufacturer would have 45 days to elect to conduct an influenced recall and repair of the affected engines. If the manufacturer takes no action, the Executive Officer could order the manufacturer to take appropriate remedial action scaled to the level of noncompliance. The regulation would set forth a detailed set of factors that the Executive Officer would consider in determining the appropriate remedy.

The proposed regulation would provide for the recall of effectively nonfunctional HO OBO systems because the existence of such a noncomplying system effectively defeats the purposes and objectives of.the HO OBO program and potentially undermines the emission reduction benefits that have been projected from recently adopted tailpipe standards for heavy-duty engines. It has been the long-standing position of the ARB that it is necessary to repair or replace such nonconforming systems because they are not capable of detecting future malfunctions of the engine's emission control systems and that this would likely lead to future emission increases.[7] This position is consistent with the Senate Committee on Environment and Public Works when considering federal adoption of onboard diagnostic regulations.[8]

7 See e.g., Manufacturers Advisory Correspondence No. 87-06 (July 1,1987), in which the ARB stated.

> A recall ... would be appropriate based on ... the underlying defect identified by the aBO system even where the vehicles could pass the FTP, assuming a substantial number of vehicles in the -class or category being tested contained that defect.

8 P.L. 101-549, Clean Air Act Amendments of 1989, S.Rep. 101-228, 101[51] Cong.,Ist Sess.1989, 1990 U.S.C.CAN. 33855, 1989 WL 2326970 et seq. , in which the Committee reported:

> The amended section 202 of the [CM] authorizes the Administrator to promUlgate regulations for [emission control diagnostics (ECD)]. Existing section 207(c) of the [CM] provides for recall of vehicles which do not conform to the regulations adopted under section 202, thus proViding clear authority for the Administrator to recall classes or categories of vehicles determined to have malfunctioning ECO systems during their full useful life. This authority will enable EPA to ensure that the emission components and the ECO system operate properly. A vehicle will be recalled or repaired if, during the useful life of the vehicle, the ECO system itself is broken or malfunctions such that it would no longer be able to serve its intended function of alerting the vehicle operator to the need for emission related maintenance and properly storing such information for subsequent retrieval by inspection or maintenance personnel. The ECO system is intended to alert the operator to the need for maintenance which may head off further emission deterioration or damage to the emission control system. Therefore, the Administrator may order a recall and a

It is beyond dispute that as heavy-duty engines age and accumulate high mileage, their emission control systems deteriorate, increasingly malfunction, and cause emissions to increase. No one knows or can accurately predict how well emission control systems of , different manufacturers will work 10, 20, or more years from now. This is especially true when heavy-duty engines are being required to meet increasingly stringent emission ' standards, requiring new and complex technologies to be utilized.

B. Mandatory Recall

The staff is proposing that the most seriously design-flawed nonconforming HO aBO systems discovered as part of manufacturer compliance testing or ARB enforcement testing be subject to mandatory recall. See Table 1 below. Under Cal. Code Regs., section 1971.5(d)(3) of the proposed regulation, the Executive Officer would be required to order the recall of HO aBO systems that have at least one major monitor that performs so egregiously that it cannot effectively detect malfunctions or cannot be validly tested in a roadside inspection or fleet self-inspection. The ARB adopted the HO aBO requirements to address this problem and, specifically, to provide assurance that when malfunctions in emission control systems do occur, they will be expeditiously discovered and repaired. To properly perform these objectives, the HO aBO system itself must be functional and capable of detecting malfunctions when they occur. To minimize potential emission increases in future years,it is imperative that the identified, effectively nonfunctional aBO systems be recalled and repaired at the time noncompliance of the systems is discovered. Monitors that perform at levels significantly below the established criteria thresholds in-use run the risk of undermining the potential ben,efits of the HO aBO program. The ARB staff has concluded that systems that operate below these levels are essenti,ally nonfunctional and need to be repaired or replaced.

By specifying minimum performance levels, below which' a system would be considered nonfunctional and in need of recall, the Executive Officer would be providing manufacturers with clear notice and direction as to what the ARB considers to be a totally unacceptable system. With such knowledge, manufacturers can better plan and design their product lines and perform necessary internal testing to assure proper , performance of the HO aBO systems that they manufacture and distribute. The minimum performance levels that would be established by the regulation for recall are fair and reasonable. The levels have been set so as to provide a liberal margin of error that distinguishes between a monitor that fails to meet the threshold levels required for . proper detection of malfunctions and a monitor that performs so poorly that it cannot be considered functional. .The proposed criteria for mandatory recall are summarized in Table 1 below.

repair of the ECO system in cases wherever there is systematic misdiagnosis, even if the vehicle is passing emission standards, either by not alerting the operator to the need for necessary repair or by flagging a repair which is not necessary.

Table 1: HO oeo Enforcement RegUlation Mandatory Recall Criteria

		2010-2012		2013-2015			2016-2018		2019
		parent'l	child [*2]	previous 2010-2012 phase-in engine family	parent	child	previous child from 2013-2015	all others	all engines
Tailpipe Level	< aBO threshold	pass	nla	pass	pass	nla	pass	pass	pass
	> OBD threshold and < 2x aBO threshold	pass	nla	pass	pass	nfa	pass	fail (except PM filter monitor)	fail
	> 2x and < 3x aBO threshold	fail	nfa	fail	fail	nla	fail	fail, mandatory recall (except PM filter monitor)	fail, mandatory recall
	> 3x aBO threshold	fail	nla	fail, mandatory recall	fail, mandatory recall	nfa	fail, mandatory recall	fail, mandatory recall	fail, mandatory recall
	Applicable standard (FTPorSET)	Manufacturer determined at cert	nfa	Manufacturer determined at cert	Manufacturer determined at cert	nla	Whichever is actual worst case	Whichever is actual worst case	Whichever is actual worst case
	Recall Liability	no mandatory	nla	mandatory at >3x aBO threshold	mandatory at >3x aBO threshold	nfa	mandatory at >3xOBO threshold	mandatory at >2x aBO threshold (3x for PM filter monitor)	mandatory at>2x aBO threshold
Ratios'	> 0.100 ratio in reg'	nfa	nla	pass	pass	pass	pass	pass	pass
	>0.05 and < 0.100	nla	n(a	pass	pass	pass	fail	fail	fail
	>0.033 and < 0.05	nfa	nfa	fail	fail	fail	fail	fail	fail
	< 0.033	nfa	'nfa	fail	fail	fail'	fail, mandatory recall	fail, mandatory recall	fail, mandatory recall
	Recall Liability	nla	nla	no mandatory	no mandatory	no mandatory	<0.033	<0.033	<0.033

Note: "2x aBO threshold" does not mean 2x standard. E.g., if aBO threshold is 2.5x std, 2x aBO threshold is 2x (2.5x std) = 5.0x std

[1] "Parent" in this table refers to a specific engine rating within an engine family that is required to be fully compliant with HO aBO

[*2] "Child" in this table refers to the other engine ratings within an engine family that are allowed to "carry over" calibrations from the parent engine and are not required to be fully compliant with HO aBO

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C. Discretionary Remedial Action

The proposed regulation also provides the Executive Officer with discretionary authority to order remedial action when he or she finds a HO OBO system to be nonconforming for reasons other than those requiring mandatory recall. The Executive Officer would have discretion to order a graduating scale of remedies. In determining appropriate remedial action, the Executive Officer would consider all relevant circumstances surrounding the existence and discovery of the nonconformity, including the factors specifically set forth in section 1971.5(d)(4)(B). For example, in cases where the nonconformity is limited, the HO OBO system is largely functional, and the manufacturer has voluntarily identified the nonconformity, the Executive Officer would have authority to order a lesser form of remedial action, comparable to a deficiency. In the most serious cases, where the Executive Officer determines that the HO OBO system, when considered in its totality, is unacceptably ineffective, he or she would have discretion to order the recall of the nonconforming systems.

O. Monetary Penalties

Pursuant to authority granted under the Health and Safety Code,[9] the Executive Officer would be able to seek monetary penalties against a manufacturer for a nonconforming HO OBO system on a case by case basis. In determining whether to seek penalties, the Executive Officer would consider all relevant circumstances, including, but not limited to, the factors set forth in Cal. Code Regs., title 13, section 1971.5(d)(5).

E. Notice to Manufacturer of Remedial Order and Availability of Public Hearing

The proposed regulation requires the Executive Officer to notify the manufacturer of the ordered remedial action and/or his or her intent to seek monetary penalties in an administrative or civil court. The notice would be required to include a description of each class of vehicles or engines covered by remedial action and the factual basis for the determination. The notice would further provide a date at least 45 days from the date of receipt of such notice for the manufacturer to submit a plan outlining how it proposes to comply with the remedial order or to request a public hearing to consider the merits of the ordered remedial action.

F. Requirements for Implementing Remedial Action

The proposed regulation sets forth requirements and procedures to be followed by the manufacturer in implementing either a voluntary, influenced, or ordered remedial action. Among other things, the regulation would establish specific provisions requiring manufacturers to establish remedial action plans, provide notice to owners of heavy-duty vehicles and engines affected by the remedial action, and maintain and make available specific information regarding the remedial action. The proposed requirements and procedures are identical to the requirements of the OBO II enforcement regulation and similar, but not identical, to those required for tailpipe

[9] See Health and Safety Code, sections 43016,43154,43211-43212.

enforcement remedial actions in Cal. Code Regs., title 13, sections 2113 - 2121 and sections 2123 - 2132.[10] As with the existing enforcement provisions, the proposed requirements for implementing remedial action provide c1e.ar directions to a manufacturer subject to a remedial action on its obligations and responsibilities in carrying out a remedial action campaign. This should ensure effective and expeditious implementation of proposed remedial action plans and compliance with the HO OBO requirements. The proposed requirements should also ensure that all manufacturers follow consistent reporting requirements that allow forfull and effective monitoring of the remedial action campaign by the ARB.

Having determined the need for specific enforcement procedures, it makes sense that the requirements and procedures for implementing HO OBO-related remedial actions should be included within the self-contained HO OBO enforcement procedures. This follows closely with the procedures for remedial action that manufacturers must follow under the OBO II enforcement procedures. Having a single regulation with all HO OBO enforcement provisions should prove helpful and convenient to both affected manufacturers and ARB staff. The result should be a clearer, more readily understandable document.

G. Penalties for Failing to Comply with the Requirements of Section 1971.5(e)

The staff is proposing a provision that would make it clear that a manufacturer could be sUbject to penalties, in addition to any penalties that could be assessed for HO OBO nonconformance, for failing to comply with the proposed requirements for imple"menting remedial action. Such failures would be considered a violation of the Health and Safety Code and would subject the manufacturer to penalties prescribed under Health and Safety Code section 43016. The ability to assess monetary penalties should encourage compliance with the requirements for implementing recali actions and result in thorough and timely implementation of both voluntary and ordered remedial action campaigns.

10 The proposal includes a requirement that manufacturers subject to an HD OBD recall be required to report on the progress of the remedial action campaign by submitting reports for eight consecutive quarters. See section 1971.5(e)(6)(B). Although the eight consecutive quarter requirement differs from the reporting requirements of Cal. Code Regs., title 13, sections 2119(a) and 2133(c), the proposal is in fact consistent with ARB practice. See "Voluntary and Influenced Recall Recordkeeping and Reporting," MAC #96-08, July 26,1996. Similarly, the proposed reporting requirements require manufacturers subject to vehicle recall to provide the ARB with a list of data elements and designated positions in the submitted reports that indicate all vehicles or engines subject to the recall that have not as yet been corrected. Although not expressly set forth in the existing recall reporting requirements, the information required under the proposed provision has a long-standing ARB requirement and is consistent with OBD II enforcement. See "Revision to Mail-Out 91-13 (Implementation of Air Resources Board's (ARB) and Department of Motor Vehicles' Registration Renewal/Recall Tie-In Program), Mail-Out 91-19, April 10, 1991.

E. INTERIM IN-USE RELIEF

With this proposed adoption, staff is also proposing to delete section 1971.1 (m) of the HO OBO regulation, which detailed intermediate in-use compliance standards, as these criteria would be incorporated into the proposed stand-alone HO OBO enforcement regulation. These criteria provide interim relief by phasing in enforcement liability for manufacturers over the first years of HO OBO implementation. These criteria included higher interim ih-use compliance standards for HO OBO monitors that are calibrated to specific emission thresholds as weH as relaxed criteria for the minimum in-use . frequency. This interim'relief provides manufacturers with extra margin to fine-tune their calibration techniques and to gain experience with in-use operation, without imposing an excessive level of risk for mistakes.

Under the existing regulation, an OBO monitor in 2010 through 2015 model year engines will be considered compliant (and not sUbject to enforcement action) unless emissions exceed twice the OBD threshold without detection of a fault. Additionally, the number of engines subject to liability in these years is limited. For example, for 2010 through 2012 model years, manufacturers will only be liable for the highest sales volume engine rating (e.g., a specific rated power variant) within the one engine family that is required to have an OBO system. Other engine ratings within that engine family are not subject to liability even though they may fail to detect a fault at the specified emission threshold. For 2013 through 2015 model years, all engine ratings within this original OBO engine family are potentially liable if they fail to meet the emission thresholds: Further, a limited number of engine ratings in other engine families are subject to liability for in-use noncompliance in the 2013 model year. Emission threshold liability for all in-use engines does not become effective until the 2016 model year.

F. RESPONSIBLE PARTY

Under the proposed enforcement procedures, the engine manufacturer that is the certifying party would be the responsible party for all in-use compliance' and enforcement actions. In this role, the engine manufacturer would be ARB's sole point of contact for any noncompliance identified during in-use or enforcement testing. In cases where remedial"action will be required(e.g., recall), the certifying party would be responsible for coordinating any actions to remediate the noncompliance (e.g., coordination with truck builders to contact vehicle owners or to provide service networks to conduct the recall work). To protect themselves, it is expected that engine manufacturers would require engine purchasers to sign indemnity clauses or other agreements to abide by the build specifications applicable to the engine and to bear ultimate financial responsibility ·for noncompliance caused by the engine purchaser.

X. ANALYSIS OF ENVIRONMENTAL IMPACTS AND ENVIRONMENTAL JUSTICE ISSUES

As stated, the proposed HO OBO andOBO II requirements and enforcement procedures help ensure that forecasted emission reduction benefits from adopted light-, medium-, and heavy-duty,engine emission standards programs are achieved. Given the substantial shortfall in emission reductions still needed to attain the National and State Ambient Air Quality Standards and the difficulty in identifying further sources of cost-effective emission reductions, it is vital that the emission reductions projected for the light-, medium-, and heavy-duty vehicle programs be achieved. The OBO regulations are necessary to accomplish this goal, achieving these emission benefits in two distinct ways. First, to avoid customer dissatisfaction that may be caused by frequent illumination of the MIL because of emission-related malfunctions, it is anticipated that the manufacturers will produce increasingly durable, more robust emission-related components. Second, by alerting vehicle operators of emission-related malfunctions and providing precise information to the service industry for identifying and repairing detected malfunctions, emission systems will be quickly repaired. The benefits of the regulations become increasingly important as certification levels become more and more stringent and as a single malfunction has an increasingly greater impact relative to certification levels.

Regarding the HO aBO regulation, the proposed amendments are not expected to significantly alter previously calculated emission benefits or findings. Though the proposed amendments for diesel engines would delay the starting implementation date of a few emission threshold monitoring requirements and would allow higher interim malfunction emission thresholds for some monitors, the staff believes these short term interim delays and higher thresholds are necessary considering the diesel emission control technologies involved are new and evolving and have never previously existed on diesel engines.

For reference, during'the 2005 HO OBO regulatOry process, lifetime cumulative emission reductions attributable to the HO OBO program, on a per engine basis, were calculated to be 81 pounds of ROG, 5,735 pounds of NOx, and 24 pounds of PM. Oetails ofthe methodology can be found in the 2005 HO OBO staff report. However, staff has recalculated the benefits using the latest emission inventory models. The estimated emission benefits from HO OBO are significantly different from the 2005 estimates due primarily to a recent update of the base emission inventory model (EMFAC). EMFAC was updated with new data for heavy-duty vehicle miles traveled and emission rates. In addition, an error wasfound in the 2005 estimates that resulted in an overestimation of the NOx and ROG benefits. As a result, the lifetime cumulative emission reductions for HD OBO, on a per engine basis calculated with the most recent version of EMFAC, are'165 pounds of ROG, 2000 pounds of NOx, and 14 pounds of PM.

With this rulemaking, the primary amendments apply to the HO OBO regulation. As stated earlier, changes are also being made to the light- and medium-duty OBO II regulation to harmonize the medium-duty diesel requirements with the heavy-duty diesel requirements. The changes to the OBO II regulation, for both gasoline and diesel, are minor and are not expected to significantly alter previously calculated emission benefits or findings.

For reference, during the 2002 OBO II regulatory update, staff calculate'd a combined benefit for OBO II and LEV II of 57 tons per day of ROG + NOx in the South Coast Air Basin alone. Details of the methodology can be found in the 2002 OBO II staff report. Given the substantial shortfall in emission reductions still needed to attain the National and State Ambient Air Quality Standards and the difficulty in identifying further sources of cost-effective emission reductions, it is vital that the emission reductions projected for the LEV II program be achieved. The proposed OBO II regulatory revisions apply almost exclusively to LEV II vehicles and better ensure these vehicles will continue to operate at the expected emission levels, a necessary step towards achieving this goal.

Having identified that the proposed amendments to the regulations will not result in any adverse environmental impacts but rather will help ensure that measurable emission benefits are achieved both statewide and in the South Coast Air Basin, the amendments should not adversely impact any community in the State, especially low-income or minority communities.

XI. COST IMPACT OF THE PROPOSED REQUIREMENTS

A. COST OF THE PROPOSED REQUIREMENTS

For HO OBO, like the modifications to the OBO II program, the revisions to the regulation (§1971.1) consist primarily of interim relief and clarification of existing requirements. As such, the previously calculated cost estimate is still applicable. However, ARB staff has performed a comprehensive cost analysis of the proposed HO OBO enforcement program to add to the previous estimate. The goal of this analysis is to estimate the "learned-out" costs of the program to a heavy-duty engine purchaser for a "typical" engine. The analysis estimates the incremental costs of implementing the HO OBO enforcement regulation for a "hypothetical" larger-than-average engine manufacturer. The hypothetical engine manufacturer is projected to include eight engine families and five ratings per engine family. In contrast, the "average" engine manufacturer according to U.S. EPA's data of 2004 heavy-duty engines includes 6.5 engine families and five ratings per engine family. To determine the average sales number of the hypothetical manufacturer, the staff took the national sales numbers for the top nine engine manufacturers and determined a composite average value of 72,440. This number was rounded to 72,000 in the analysis.

The various types of costs that are addressed in this analysis are variable costs, support costs, investment recovery costs, capital recovery costs, and truck/coach builder costs. Results of the analysis from the 2005 staff report indicate the learned-out costs per engine to comply with the proposed HO OBO regulation (§1971.1) would be $132.39 for diesel engines and $35.04 for gasoline engines. As note above, since the proposed modifications to the regulation consist mainly of threshold modifications for diesel engines to provide compliance relief, the previous cost estimates should still apply. In the very limited cases where a new monitor is required (e.g., cylinder air-fuel imbalance), lead time is provided to allow manufacturers to implement necessary changes in conjunction with scheduled vehicle upgrades. None of the new monitoring requirements should require any additional hardware for monitoring. It is projected that only software modifications will be required to comply witb the any of the new requirements. .

B. COSTS OF THE HO aBO ENFORCEMENT PROGRAM

As described in section IX, staff is proposing the adoption of Cal. Code Regs., title 13, section 1971.5 which would establish enforcement procedures and requirements for heavy-duty aBO systems. Costs were estimated utilizing the same methodology and assumptions as described above for the HO OBD regulation (Le., costs were based on a hypothetical larger-than average engine manufacturer). Additionally, costs were only estimated for diesel engines since the costs for testing diesel engines are significantly higher than gasoline engines .due to the cost of the engine and the associated aftertreatment components. Results of the analysis indicate the learned-out incremental retail costs to incorporate the proposed HO aBO enforcement regulation would be $1.97 per engine. Therefore, the estimated combined costs ofthe HO aBO regulation and the proposed HO aBO enforcement regulation are $134.36 per heavy-duty diesel engine and $37.01 per gasoline engine. Details of the cost.analysis methodology are described in the heavy-duty aBO staff report of July 2005. The primary costs associated with the enforcement regulation are for the provisions that require 'self-testing' by the manufacturer at a rate of one to three engines per year, depending on the size of the manufacturer (two per year has been assumed for this cost analysis). The primary assumptions used include a cost of $23,150 per engine in procurement related expenses and just over $80,000 per engine in testing costs. Staff talked with manufacturers, EPA, and independent laboratories that perform such procurement and testing in developing these estimates. Tables'1 and·2 below summarize the results of. the cost analysis when spread out across all engines produced by a manufacturer.

Table 1: Incremental Consumer Cost of HDDE

		1971.1 Costs (in dollars)	1971.5 Costs (in dollars)	Total HO aBO Costs (in dollars)
Variable costs	Component	$37.18	$0.00	$37.18
	Assembly	$0.68	$0.00	$0.68
	Warranty	$1.64	$0.00	$1.64
	Shipping	$1.20	$0.00	$1.20
Support costs	Research	$22.49	$0.00	$22.49
	Engineering Support	$0.14	$0.08	$0.22
	Legal	$0.35	$0.00	$0.35
	Administrative	$2.08	$0.16	$2.24
Investment	Mach. & equipment	$0.00	$0.00	$0.00
recovery costs	Assembly plant changes	$0.00	$0.00	$0.00
	DevelopmentlTesting	$57.34	$1.59	$58.93
Capital recovery (a)		$7.39	$0.11	$7.50
Truck/Coach Builder costs	Cost of capital recovery (b)	$1.91	$0.03	$1.94
Total cost		$132.39	$1.97	$134.36

(a) Cost of capital recovery was calculated at 6% ofthe total incremental costs.

(b) Cost of capital recovery was calculated at 6%. Engines are assumed to remain in inventory for 3 months.

Table 2: Incremental Consumer Cost of HDGE

		1971.1 Costs (in dollars)	1971SCosts (in dollars)	Total HO aBO Costs (in dollars)
Variable costs	Component	$30.00	$0.00	$30.00
	Assembly	$0.20	$0.00	$0.20
	Warranty	$0.07	$0.00	$0.07
	Shipping	$0.60	$0.00	$0.60
Support costs	Research	$0.75	$0.00	$0.75
	Engineering Support	$0.00	$0.08	$0.08
	Legal	$0.00	$0.00	$0.00
	Administrative	$0.00	$0.16	$0.16
Investment	Mach. & equipment	$0.00	$0.00	$0.00
recovery costs	Assembly plant changes	$0.00	$0.00	$0.00
	DevelopmentlTesting	$0.96	$1.59	$2.55
Capital recovery (a)		$1.95	$0.11	$2.06
Truck/Coach Builder costs	Cost of capital recovery (b)	$0.51	$0.03	$0.54
Total·cost		$35.04	$1.97	$37.01

(a) Cost of capital recovery was calculated at 6% of the total incremental costs.

(b) Cost of capital recovery was calculated at 6%. Engines are assumed to remain in inventory for 3 months.

C. COST EFFECTIVENESS OF THE PROPOSED REQUIREMENTS

Based on the emission benefit analysis and the additional cost numbers identified above, the cost effectiveness of the aBO regulation was re-calculated. For the cost estimation, it was assumed that half of the cost was for PM emission benefit and the other half was for ROG+NOx benefit. Accordingly, the per engine cost to implement aBO ($134) was added to the per engine repair cost ($496) (from the cost an.alysis in the 2005 HO aBO Staff Report) for a total cost of $630 per engine. Splitting that in half, $315 was attributed to PM benefit for a cost-effectiveness of $22.50 per pound of PM. The other half of the cost was attributed to ROG+NOx benefit for a cost-effectiveness of $0.15 per pound of ROG+NOx. Both values compare favorably with the cost-effectiveness of other, recently adopted regulations.

As noted above, the proposed light-duty and medium-duty aBO II regulation revisions are not expected to add any significant cost to gasoline or diesel vehicles nor change any previously calculated emission benefits. Accordingly, the cost-effectiveness numbers calculated from the 2002 regulation update are still applicable. For reference, in 2002 staff calculated two separate cost-analyses for aBO II systems. The first covered the useful life period of the vehicle (typically the first 120,000 miles) and combined with the LEV II program, was $2.18 per pound of RaG + NOx reduced. The second analysis,was for the second phase of the vehicle's life, from 120,000 to 230,000 miles, when increased reliance on aBO II·is necessary to maintain low in-use vehicle emissions.' That. cost effectiveness was calculated to be $4.57 per pound of RaG + NOx reduced. The methodologies for both analyses were detailed in the 2002 aBO II staff report, which is incorporated by reference herein (a copy of which may be found at http://www.arb.ca.gov/regact/obd02/obd02.htm).

XII. ECONOMIC IMPACT ANALYSIS

Overall, the proposed amendments to the HO aBO and aBO II regulation are expected to have a negligible impact on the profitability of heavy-duty engine manufacturers and automobile manufacturers. It is anticipated that the proposed amendments would result in negligible costs to heavy-duty vehicle manufacturers. For light- and medium-duty vehicles, the manufacturers are large and mostly located outside of California with the exception of the New United Motor Manufacturing, Inc. (NUMMI), which is a joint venture between Toyota Motor Corporation and General Motors Corporation. The proposed changes involve minimal development and verification of software above what is already incorporated into HO aBO and aBO II systems. Staff believes, therefore, that the proposed requirements would cause no noticeable adverse impact in California employment, business status, and competitiveness.

A. LEGAL REQUIREMENTS

Section 11346.3 of the Government Code requires State agencies to. assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative regulation. Section 43101 of the Health and Safety Code similarly requires that the Board consider the impact of adopted standards on the California economy. This ,assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination, or creation, and the ability of California business to compete.

B. AFFECTED BUSINESSES AND POTENTIAL IMPACTS

Any business involved in manufacturing, purchasing, or servicing passenger cars, light-duty trucks, medium-duty vehicles, and heavy-duty engines and vehicles could be affected by the proposed amendments. Also affected are businesses that supply parts for these vehicles.

There are 21 heavy-duty engine manufacturers, none of which is located in California. Of these businesses, two of the engine manufacturing companies are assumed to be "small businesses" (Le., selling less than 150 engines per year based on California certification data). There are approximately 8 major heavy-duty vehicle manufacturers, but staff has been unable to obtain an estimation of the total number of vehicle manufacturers that manufacture and sell heavy-duty vehicles in California. Thus, staff is unable to determine how many of these companies are located in California and how many are considered "small businesses." However, the cost related to vehicle manufacturers is determined to be negligible based on the minor effects these regulatory provisions might have on their operations.

California accounts for only a small share of total nationwide light- and medium-duty motor vehicle and parts manufacturing. There are 34 companies worldwide that manufacture California-certified light- and medium-duty vehicles and heavy-duty gasoline engines. As stated, only one motor vehicle manufacturing plant is located in California, the NUMMI facility.

C. POTENTIAL IMPACTS ON VEHICLE OPERATORS

For heavy-duty engines and vehicles, the proposed amendments would provide OBO information and encourage manufacturers to build more durable engines, which would result in the need for fewer repairs and savings for vehicle owners. However, OBO is expected to detect malfunctions that may otherwise have gone undetected (and thus, unrepaired) by the vehicle owner. A single additional repair was estimated to occur on approximately two-thirds of the'trucks over a 21 year lifetime as a result of OBO at an ,average cost of $741 per repair. This is a conservative cost estimate, since OBO will potentially result in savings by catching problems early before they adversely affect other components and systems in the engine. The proposed amendments are anticipated to have a negligible impact on new vehicle' prices, since the calculated increase in retail price of an engine to meet OBO is less than one percent of the retail cost of the engine and less than 0.2 percent of the retail cost of a heavy-duty vehicle.

For light- and medium-duty veHicles, the proposed amendments would provide improved OBO /I information and encourage manufacturers to build more durable vehicles, which should result in the need for fewer vehicle repairs and savings for consumers. The proposed changes involve minimal development and verification of software above what is already incorporated into OBO II systems. Additionally, because manufacturers would be provided sufficient lead time to incorporate the minimal proposed changes, incorporation and verification of the revised OBO II software would be accomplished during the regular design process at virtually no additional cost. Any additional engineering resources needed to comply with the proposed program would be small, and when spread over severa1 years of vehicle production, these costs would be negligible. Thus, the proposed amendments are anticipated to have a negligible impact on manufacturer costs and new vehicle prices.

O. POTENTIAL IMPACTS ON BUSINESS COMPETITIVENESS

The proposed amendments are not expected to adversely impact the ability of California businesses to compete with businesses in other states as the proposed standards are anticipated to have only a negligible impact on retail prices of new engines and vehicles. Additionally, U.S. EPA adopted federal OBO II and heavy-duty OBO requirements that are harmonized with those of ARB. Therefore, any increase in costs will al.so be experienced by non-California businesses due to federal requirements. Thus, any price increases of light-, medium-, and heavy-duty vehicles are not expected to dampen the demand for these vehicles in California relative to other states, since price increases would be the same nationwide.

E. POTENTIAL IMPACTS ON EMPLOYMENT

The proposed amendments are not expected'to cause a noticeable change in California employment because California accounts for only a small share of motor vehicle, heavy-duty engine, and parts manufacturing employment, and the .minimal additional work done by heavy-duty vehicle manufacturers can be done with existing staff.

However, some jobs may be created at heavy-duty engine manufacturing companies. Currently, heavy-duty engine manufacturers lack significant experience in designing and implementing OBO systems on heavy-duty engines. This may result in additional jobs for programmers and engineers.

F. POTENTIAL IMPACT ON BUSINESS CREATION, ELIMINATION, OR EXPANSION

The proposed amendments are not expected to affect business creation, elimination or expansion.

REFERENCES

Below is a list of documents and other information that the ARB staff relied upon in developing the Staff Report.

1) Staff Report: Initial Statement of Reasons (ISOR): Technical Status and Revisions to Malfunction and Diagnostic .System Requirements for 2004 and SUbsequent Model Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II), March 8,2002.

2) Staff Report: Initial Statement of Reasons (ISOR): "Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model Year Heavy-Duty Engines (HD OBD)," June 3, 2005.

3) Staff Report: Initial Statement of Reasons (ISOR): "Technical Status and Revisions to Malfunction and Diagnostic System Requirements for Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II) and the Emission Warranty Regulation," August 11, 2006

Below is a list of documents newly incorporated by reference in the HD OBD and OBD II regulations.

1) EMFAC2007

2) EMFAC 2007 Technical Memo "EMFAC Modeling Change Technical Memo," September 13, 2006

3) International Standards Organization (ISO) 15765-4:2005 "Road Vehicles - Diagnostics on Controller Area Network (CAN) - Part 4: Requirements for emission-related systems," January 2005.

4) Society of Automotive Engineers (SAE) J1930 "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms - Equivalent to ISOITR 15031-2," October 2008.

5) SAE J1978 "OBD II Scan Tool- Equivalent to ISO/DIS 15031-4:December 14, 2001," April 2002.

6) SAE J1979 "E/E Diagnostic Test Modes," May 2007.

7) SAE J2012 "Diagnostic Trouble Code Definitions," December 2007.

8) SAE J2403 "Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature," August 2007.

9) SAE J1939 consisting of:

J1939 Recommended Practice for.a Serial Control and Communications Vehicle Network, March 2009;
J1939/1 Recommended Practice for Control and Communications Network for On-Highway Equipment, September 2000;
J1939/11 Physical Layer, 250K bits/s, Twisted Shielded Pair, September 2006;
J1939/13 Off-Board Diagnostic Connector, March 2004; .
J1939/15 Reduced Physical Layer, 250K bits/sec, UN-Shielded Twisted Pair· (UTP), August 2008;
J1939/21 Data Link Layer, December 2006;
J1939/31 Network Layer, April 2004;
J1939/71 Vehicle Application Layer (Through February 2008), January 2009;
J1939/73 Application Layer-Diagnostics, September 2006;
J1939/81 Network Management, May 2003; and
J1939/84 OBD Communications Compliance Test Cases For Heavy Duty Components and Vehicles, December 2008.

10)SAE J1699-3 - "aBO II Compliance Test Cases", May 2006.

11) SAE J2534-1 - "Recommended Practice for Pass-Thru Vehicle Programming", . December 2004.

APPENDIX I

The following tables were used to support the cost estimates in Section·XI. "Cost Impact of the Proposed Requirements" of the Staff Report.

Manufacturer Self Testing Cost of Heavy..duty OBO Enforcement (Engineering Support)

Staff	Number of Staff (person yrs.)	Staff Cost (a) (in dollars)	Testing and Equipment Costs (d) (in dollars)	Cost/vehicle(c) (dollars/veh.)
Test Cell Technician	0.13	$13,000	$262,662	$0.64
			Total	$0.64

Legal and Administrative costs

	No. of Staff required	Number of years	Staff cost (in dollars)	Cost/vehicle (c) (dollars/vehicle)
Administrative	0.15	3	67,500	0.16
			Total	0.16

(a) Development cost includes personnel, overhead and other miscellaneous costs at a total rate of $150klyr for an engineer and $100klyr for a technician.
(b) Testing Costs includes Labor Costs for Technicians needed to staff the Tests
(c) Staff cost has been distributed over 72,000 engines per year for a total of 3 years.
(d) Equipment costs have been distributed over 72,000 engines per year for a total of 3 years

Incremental Consumer **Cost of HOV OBO Enforcement Testing**

		HDV (in dollars)
Variable .costs	Component	$0.00
	Assembly	$0.00.
	Warranty	$0.00
	Shipping	$0.00
Support costs	Research	$0.00
	Engineering Support	$0.06
	Legal	$0.00
	Administrative	$0.16
Investment recovery costs	Mach. & equipment	$0.00
	Assembly plant changes	$0.00
	DevelopmentITesting	$1.22
Capital recovery (a)		$0.09
Truck/Coach Builder costs	Cost of capital recovery (b) .	$0.02
Total cost		$1.55

(a) Cost of capital recovery was calculated at 6% of the total incremental costs.
(b) Cost of capital recovery was calculated at 6%. Engines are assumed to remain in inventory for 3 months.

Long term CO$ts

rea	description	#of engine families	**phase 1 test number**	**phase 1 test percentage**	**phase 2 test number**	**phase 2 test percentage**	**phase 3 test number**	**phase 3 test percentage**	sets of test hardware per enaine familv
1971.5 (c)	manufacturer self testing	8	2	1	4	0.1	5	0.05	1

cost per test hardware	#of faults to be tested	Engine dyno test cell hours	Engine removal from Truck	New engine install into truck	Engine Install	FTP/SET test Phase 1	FTP/SET test Phases 2 &3	Erigine uninstall	Procurement Cost per engine including aftertreatment
$21,488	16.3	130.4	1500	1500	2460	80196	9840	2460	$23,150

Technician Manhours to run test - Phase 1	Technician Manhours to run test - Phase 2 and 3	cost per tech PY	Hourly cost per tech	Equipment! test costs	PY costs	Total
130.4	5	$100,000	$ 50	$ 262,662	$ 13,043	$275,705

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Parts Cost

Task Description	2016 Emissions/OBD Component List	New Part Cost	L.imit Part Cost
Fuel System			
fuel system injection quantity low/high	Injector	$200	$1,000
fuel system pressure low/high	Rail Pressure Sensor	$200	$1,000
fuel system iniection timing advance/retard	Iniector	$200	$1,000
Misfire Monitor		$0	$0
Air Handling			
VGT Underboostloverboostlslow response	VGT Actuator	$500	$2,500
CAC Undercooling	Charge Air Cooler	$25	$125
EGR			
EGR low/high flow	,EGR Valve Actuator	$500	$2,500
EGR Undercooling	EGRCooier	$25	$125
Oxidation Catalvst			
NMHC cat conversion efficiency	oxidation catalvst	$1,000	$5,000
SCR Catalyst			
SCR NOx cat conversion efficiency	SCR Catalyst	$2,000	$10,000
SCR,reductant iniection performance	Urea Iniector	$300	$1,500
PM Filter			
PM filter leak/missing substrate	PM Filter	$5,000	$6,000
PM filter regeneration frequent	PM Filter	$5,000	$6,000
PM filter regeneration incomplete	PM Filter	$5,000	$0
NMHC conversion of catalyst	oxidation catalyst	$1,000	$5,000
Active injection (in exhaust) (in-cylinder no cost)	computer mod to post ini	$0	$0
NOxSensors			
NOx sensor performance	NOx sensor	$75	$375
NOx sensor offset	NOx sensor	$75	$375
NOx sensor monitoring capability	NOx sensor	$75	$375
Sensor Heaters			
Sensor heater performance	computer mods to induce fault	$0	$0
ECT SensorlThermostat			
t-stat monitor warm-up oerformance		$20	$100
Total			1$42,9751

ATTACHMENT A

California Code of Regulations, Title 13, section 1971.1, On-Board Diagnostic System Requirements for" 2010 and Subsequent Model-Year Heavy-Duty Engines (HD OBD)

Set forth below are proposed amendments to California Code of Regulations, Title 13, §1971.1. The proposed amendments are shown in single underline to indicate additions and single strikeout to indicate deletions.

Table of Contents

§1971.1. On-Board Diagnostic System Requirements--2010 and Subsequent Model-Year Heavy-Duty Engines

(a) *PURPOSE*

The purpose of this regulation is to establish emission standards and other requirements for onboard diagnostic systems (OBO systems) that are installed on 2010 and subsequent model-year engines certified for sale in heavy-duty applications in California. The OBO systems, through the use of an onboard computer(s), shall monitor emission systems in-use for the actual life of the engine and shall be capable of detecting malfunctions of the monitored emission systems, illuminating a malfunction indicator light (MIL) to notify the vehicle operator of detected malfunctions, and storing fault codes identifying the detected malfunctions.

(b) *APPLICABILITY*

Except as specified in section (d)(7) and elsewhere in this regulation (title 13, CCR section 1971.1), all 2010 and subsequent model-year heavy-duty engines shall be equipped with an OBO system that has been certified by the Executive Officer as and shall meeting all applicable requirements of this regulation (title 13, CCR section 1971.1).[1]

(c) *DEFINITIONS*

"Actual life" refers to the entire period that an engine is operated on public roads in California up to the time an engine is retired from use.

"Applicable standards" refers to the specific exhaust emission standards or family emission limits (FEL), including the Federal Test Procedure (FTP) and Supplemental Emission Test (SET) standards, to which the engine is certified.

"Base fuel schedule" refers to the fuel calibration schedule programmed into the Powertrain Control Module or programmable read-only memory (PROM) when manufactured or when updated by some off-board source, prior to any learned on-board correction.

"Auxiliary Emission Control Device (AECD)" refers to any approved AECO (as defined by 40 Code of Federal Regulations (CFR) 86.082-2 and 86.094-2).

"Emission Increasing Auxiliary Emission Control Device (EI-AECD)" refers to any approved AECO that reduces the effectiveness of the emission control system 'under conditions which may reasonably be expected to be encountered in normal vehicle operation and use; and the need for the AECO is justified in terms of protecting the vehicle against damage or accident. An AECO that is certified as an NTE deficiency shall not be considered an EI-AECO. An AECO that does not sense, measure, or calculate any parameter or command or trigger any action, algorithm, or alternate strategy shall not be considered an EI-AECO. An AECO that is activated solely due to any of the following conditions shall not be considered an EI-AECO: (1) operation of the vehicle above 8000 feet in elevation; (2) ambient temperature; (3) when the engine is warming up and is not reactivated once the engine has warmed up in the same driving cycle; (4) failure detection (storage of a fault code) by the OBO system; (5) execution of an aBO monitor; or (6) execution of an infrequent regeneration event.

1 Unless otherwise noted, all section references refer to section 1971.1 of title 13,CCR.

"Calculated load value" refers to the percent of engine capacity being used and is defined in Society of Automotive Engineers (SAE) J1979 "E/E Diagnostic Test Modes Equivalent to ISOIDIS 15031 5:April ~~30,~~ 2002," April2002May 2007 (SAE J1979), incorporated by reference (section (h)(1.4)). For diesel applications, the calculated load value is determined by the ratio of current engine output torque to maximum engine output torque at current engine speed as defined by parameter definition 5.2.1.7 of SAE J1939-71 "Vehicle Application layer (Through February 2008)," January 2009.

"Confirmed fault code," for purposes of engines using International Standards Organization (ISO) 15765-4,·is defined as the diagnostic trouble code stored when an OBD system has confirmed that a malfunction exists (e.g., typically on the second driving cycle that the malfunction is detected) in accordance with the requirements of sections (d)(2), (f),Jg), and (h)(4.4).

"Continuously," if used in the context of monitoring conditions for circuit continuity, lack of circuit continuity, circuit faults, and out-of-range values, means monitoring is always enabled, unless alternate enable conditions have been approved by the Executive Officer in accordance with section (d)(3.1.1), and sampling of the signal used for monitoring occurs ata rate no less than two samples per second. If a computer input component is sampled less frequently for engine control purposes, the signal of the component may instead be evaluated each time sampling occurs.

"Deactivate" means to turn-off, shutdown, desensitize, or otherwise make inoperable through software programming or other means during the actual life of the engine.

"Diagnostic or emission criticaf' electronic control unit refers to the engine and any other on-board electronic powertrain control unit containing software that: (1) has primary control over any of the monitors required by sections (e)(1) through (f)(9), (g)(1) through (g)(2), and (g)(4); or (2) excluding anti-lock brake system (ABS) control units or stability/traction control units, has primary control over the diagnostics for more than two of the components required to be monitored by section (g)(3). For purposes of criteria (2) above, all glow plugs in an engine shall be considered "one" component in lieu of each glow plug being considered a separate component.

"Diesel engine" refers to an engine using a compression ignition thermodynamic cycle.

"Driving cycle" is defined as a trip that meets any of the four conditions below:

(a) Begins with engine start and ends with engine shutoff;

(b) Begins with engine start and ends after four hours of continuous engine-on operation;

(c) Begins at the end of the previous four hours of continuous engine-on operation and ends after four hours of continuous engine-on operation; or

(d) Begins at the end of the previous four hours of continuous engine-on operation and ends with engine shutoff.

For monitors that run during engine-off conditions, the period of engine-off time following engine shutoff and up to the next engine start may be considered part of the driving cycle for conditions (a) and (d). For vehicles.that employ engine shutoff strategies that do not require the vehicle operator to restart the engine to continue driving (e.g., hybrid bus with engine shutoff at idle), the manufacturer may request

Executive Officer approval to use an alternate definition for driving cycle (e.g., key on and key off). Executive Officer approval of the alternate definition shall be based on equivalence to engine startup and engine shutoff signaling the beginning and ending of a single driving event for a conventional vehicle. Engine restarts following an engine shut-off that has been neither commanded by the vehicle operator nor by the engine control strategy but caused by an event such as an engine stall may.be considered a new driving cycle or a continuation of the existing driving cycle. For engines that are not likely to be routinely operated for long continuous periods of time, a manufacturer may also request Executive Officer approval to use an alternate definition for driving cycle (e.g., solely based on engine start and engine shutoff without regard to four hours of continuous engine-on time). Executive Officer approval of the alternate definition shall be based on manufacturer-submitted data and/or information demonstrating the typical usage, operating habits, and/or driving patterns of these vehicles.

"Engine family" means a grouping of vehicles or engines in a manufacturer's product line determined in accordance with 40 CFR 86.098-24.

"Engine rating" means a unique combination of displacement, rated power, calibration (fuel, emission, and engine control), AECOs, and other engine and emission control components within an engine family.

"OBD parent rating" means the specific engine rating selected according to section (d){7.1.1) or (d){7.2.2){B) for compliance with section 1971.1.

"OBD child rating" means an engine rating (other than the OBO parent rating) within the engine family containing the OBO parent rating selected according to section (d){7.1.1) or an engine rating within the OBO group{s) defined according to section (d){7.2.1) and subject to section (d){7.2.3).

"Engine misfire" means lack of combustion'in'the cylinder due to absence of spark, poor fuel metering, poor compression, or any other cause. This does not include lack of combust10n events in non-active cylinders due to default fuel shut-off or cylinder deactivation strategies.

"Engine start" is defined as the point when the engine reaches a speed 150 rpm below the normal, warmed-up idle speed (as determined in the drive position for vehicles equipped with an automatic transmission). For hybrid vehicles or for engines employing alternate engine start hardware or strategies (e.g., integrated starter and generators.), the manufacturer may request Executive Officer approval to use an alternate definition for engine start (e.g., ignition key "on"). Executive Officer approval of the alternate definition shall be based on equivalence to an engine start for a conventional vehicle.

"Family Emission Limit (FEL)" refers to the exhaust emission levels to which an engine family is certified under the averaging, banking, and trading program , incorporated by reference in title 13, CCRsection 1956.8.

"Fault memory" means information pertaining to malfunctions stored in the onboard computer, including fault codes, stored engine conditions, and MIL status.

"Federal Test Procedure (FTP) tesf' refers to an exhaust emission test conducted according to the test procedures incorporated by reference in title 13, CCR section 1956.8{b) and (d) that is used to determine compliance with the FTP standard to which an engine is certified.

"FTP cycle". For engines certified on an engine dynamometer, FTP cycle refers to the engine dynamometer schedule in 40 CFR appendix 1 of part 86,

section (f)(1), entitled, "EPA Engine Dynamometer Schedule for Heavy-Duty Otto-Cycle Engines," or section (f)(2), entitled, "EPA Engine Dynamometer Schedule for Heavy-Duty Diesel Engines." .

"FTP standard" refers to the certification exhaust emission standards and test procedures applicable to the FTP cycle incorporated by reference ifi title 13, CCR sections 1956.8(b) and (d) to which the engine is certified.

"Fuel trim" refers to feedback adjustments to the base fuel schedule. Short-term fuel trim refers to dynamic or instantaneous adjustments. Long-term fuel trim refers to much more gradual adjustments to the fuel calibration schedule than short-term trim adjustments. .

"Functional checK' for an output component or system means verification of proper response of the component and system to a computer command.

"Gasoline engine" refers to an Otto-cycle engine or an alternate-fueled engine.

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

"Heavy-duty vehicle" means any motor vehicle having a manufacturer's gross vehicle weight rating (GVWR) greater than 14,000 pounds.

"Ignition Cycle" means a driving cycle that begins with engine start, meets the engine' start definition for at least two seconds plus or minus one second, and ends with engine shutoff.

"Keep-alive memory (KAM)," for the purposes of this regulation, is defined as a type of memory that retains its contents as long as power is provided to the on-board control unit. KAM is not erased upon shutting off the engine but may be erased if power to the on-board control unit is interrupted (e.g., vehicle battery disconnected, fuse to control unit removed). In some cases, portions of KAM may be erased with a scan tool command to reset KAM.

"Key on, engine off *position"* refers to a vehicle with the ignition key in the engine run position (not engine crank or accessory position) but with the engine not running.

"Malfunction" means any deterioration or failure of a component that causes the performance to be outside of the applicable limits in sections (e) through (g).

"Manufacturer" for the purpose of this regulation means the holder of the Executive Order for the engine family..

"MIL-on fault code," for purposes of engines using Society of Automotive Engineers (SAE) J1939, refers to the diagnostic trouble code stored when an OBD system has confirmed that a malfunction exists (e.g., typically on the second driving cycle that the malfunction is detected) and has commanded the MIL on in accordance with the requirements of sections (d)(2), (e), (g), and (h)(4.4).

"Non-volatile random access memory (NVRAM)," for the purposes of this regulation, is defined as. a type of memory that retains its contents even when power to the on-board control unit is interrupted (e.g., vehicle battery disconnected, fuse to control unit removed). NVRAM is typically made non-volatile either by use of a back-up battery within the control unit or through the use of an electrically erasable and programmable read-only memory (EEPROM) chip.

"Not-To-Exceed. (NTE) control area" refers to the bounded region of the engine's torque and speed map, as defined in 40 CFR 86.1370-2007, where emissions must not exceed a specific emission cap for a given pollutant under the NTE requirement.

"Manufacturer-specific NOx NTE carve-out area" refers to regions within the NTE control area for NOx where the manufacturer has limited NTE testing as allowed by 40 CFR 86.1370-20014(b)(7).

"Manufacturer-specific PM NTE carve-out area" refers to regions within the NTE control area for PM where the manufacturer has limited NTE testing as allowed by 40 CFR 86.1370-20014(b)(7).

"NTE deficiency" refers to regions or conditions within the NTE control area for NOx or PM where the manufacturer has received a deficiency as allowed by 40 CFR 86.007-11 (a)(4)(iv).

_*"Non volatile random access memory (N'IRAM),"* for the purposes of this regulation, is defined as a type of memory that retains its contents even when power to the on board oontrol unit is interrupted (e.g., vehiole batte!)' disoonneoted, fuse to oontrol unit removed). NVRAM is typioally made non volatile either by use of a back up battery within the oontrol unit or through the use of an electrioally erasable and programmable read oniy memory (EEPROM) chip.

"OBD group" refers to a combination of en'gines, engin'e families, or engine ratings that use the same OBO strategies and similar calibrations. A manufacturer is required to submit a grouping plan for Executive Officer review and approval detailing the OBO groups and the engine families and engine ratings within each group for a model year.

"Pending fault code" is defined as the diagnostic trouble code stored upon the initial detection of a malfunction (e.g., typically on a single driving cycle) prior to illumination of the MIL in accordance with the requirements of sections (d)(2), (e) through (g), and (h)(4.4).

"Permanent fault code" is defined as a confirmed or MIL-on fault code that is currently commanding the MIL on and is stored in NVRAM as specified in sections (d)(2) and (h)(4.4).

"Percentage of misfire" as used in sections (e)(2) and (f)(2) means the percentage of misfires out of the total number of firing events for the specified interval.

"Power Take-Off (PTO) unif' refers to an engine driven output provision for the purposes of powering auxiliary equipment (e.g., a dump-truck bed, aerial bucket, or tow-truck winch).

"Previously MIL-on fault code," for purposes of engines using SAE J1939, is defined as the diagnostic trouble code stored when an OBO system has confirmed that a malfunction no longer exists (e.g., after the third consecutive driving cycle in which the corresponding monitor runs and the malfunction is not detected), extinguishes the MIL, and erases the'corresponding MIL-on fault code in accordance with the requirements of sections (d)(2), (e), (g), and (h)(4.4).

"Rationality fault diagnostic" for an input component means verification of the accuracy of the input signal while in the range of normal operation and when compared to all other available information.

"Redline engine speed" shall be defined by the manufacturer as either the recommended maximum engine speed as normally displayed on instrument panel tachometers or the engine speed at which fuel shutoff occurs.

"Response rate" for exhaust gas sensors refers to the delay from when the sensor is exposed to a different make-up of exhaust gas constituents until it outputs a signal reflecting the different make-up of exhaust gas constituents. For example,

for oxygen sensors, response rate is the delay from when the oxygen sensor is exposed to a change in exhaust gas from richer/leaner than stoichiometric to leaner/richer than stoichiometric to the time when the oxygen sensor indicates the leanlrich condition. Similarly, for wide-range air-fuel (AIF) sensors, response rate is the delay from when the sensor is exposed to a different AIF ratio to the time it indicates the different AIF ratio. For NOx and PM sensors, response rate is the delay from when the sensor is exposed to a different NOx or PM exhaust gas level until it indicates the different NOx or PM exhaust gas levelbetween a change in sensor output in response to a commanded change in the sensed exhaust gas parameter. Specifically, the response rate is the delay from the time when the exhaust gas sensor is exposed to an increase/decrease of the exhaust gas parameter to the time when the exhaust gas sensor indicates the increase/decrease of the sensed parameter (e.g., for an oxygen sensor, response rate is the delay from the timel,Nhen the sensor is exposed to a change in exhaust gas from richer/leaner" than stoichiometric to leaner/richer than stoichiometric to the time when the sensor indicates the lean/rich condition; for a NOx sensor, response rate is the delay from the time when the sensor is exposed to an inorease/decrease in NOx concentration to the time when the sensor indicates the increased/decreased NOx concentration).

"Secondary air" refers to air introduced into the exhaust system by means of a pump or aspirator valve or other means that is intended to aid in the oxidation of HC and CO contained in the exhaust gas stream.

"Similar conditions" as used in sections (e)(1), (e)(2), (f)(1), and (f)(2) means engine conditions haVing an engine speed within 375 rpm, load conditions within 20 percent, and the same warm-up status (Le., cold or hot) as the engine conditions stored pursuant to (e)(1.4.2)(E), (e)(2.4.2)(C), (f)(1.4.5), and (f)(2.4.4). The Executive Officer may approve other definitions of similar conditions based on comparable timeliness and reliability in detecting similar engine operation.

"Start of production" is the time when the manufacturer has produced two percent of the projected volume for the engine or vehicle, whichever is being evaluated in accordance with section (l).

"Supplemental Emission Test (SET) cycle" refers to the driving schedule defined as the "supplemental steady state emission test" in 40 CFR 86.1360-2007.

"SET standard" refers to the certification exhaust emission standards and test procedures applicable to the SET cycle incorporated by reference in title 13, CCR sections 1956.8(b) and (d) to which the engine is certified

"Warm-up cycle" means sufficient vehicle operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine start and reaches a minimum temperature of at least 160 degrees Fahrenheit (140 degrees Fahrenheit for applications with diesel engines).

"Weighted sales *number'* means a manufacturer's projected sales number for engines to be used in California heavy-duty vehicles multiplied by a weight class factor. Sales numbers for diesel engines for heavy-duty vehicles less than 19,499 pounds GVWR shall be multiplied by 1.0. Sales numbers for diesel engines for heavy-dUty vehicles from 19,500 to 33,000 pounds shall be multiplied by 1.68. Sales numbers for diesel engines for heavy-duty vehicles greater than 33,000 pounds and urban buses shall be multiplied by 3.95. Sales numbers for all gasoline engines for heavy-duty vehicles shall be multiplied by 1.0.

(d) *GENERAL REQUIREMENTS*

Section (d) sets forth the general requirements of the OBO system. Specific performance requirements for components and systems that shall be monitored are set forth in sections (e) through (g) below. The OBO system is required to detect all malfunctions specified in sections (e) through (g). However, except as specified elsewhere, the OBO system is not required to use a unique monitor to detect each malfunction specified.

(1) *The OBD System.*

(1.1) If a malfunction is present as specified in sections (e) through (g), the OBO system shall detect the malfunction, store a pending, confirmed, MIL-on, or . previously MIL-on fault code in the onboard computer's memory, and illuminate 1he MIL as required.

(1.2) The OBO system shall be equipped with a standardized data link connector to provide access to the stored fault codes as specified in section (h).

(1.3) The OBD system shall be designed to operate, without any required scheduled maintenance, for the actual life of the engine in which it is installed' and may not be programmed or otherwise designed to deactivate based on age and/or mileage of the vehicle during the actual life of the engine. This section is not intended to alter existing law and enforcement practice regarding a manufacturer's liability for an engine beyond its useful· life, except where an engine has been programmed or otherwise designed so that an OBO system deactivates based on age and/or mileage of the engine.

(1.4) Computer-coded engine operating parameters may not be changeable without the use of specialized tools and procedures (e.g. soldered or potted computer components or sealed (or soldered) computer enclosures). Subject to Executive Officer approval, manufacturers may exempt from this requirement those product lines that are unlikely to require protection. Criteria to be evaluated in making an exemption include current availability of performance chips, performance capability of the engine, and sales volume.

(2) MIL *and Fault Code Requirements.*

(2.1) MIL Specifications.

(2.1.1) The MIL shall be located on the driver's side instrument panel and be of sufficient illumination and location to be readily visible under all lighting conditions and shall be amber in color when illuminated. The MIL, when illuminated, shall display the International Standards Organization (ISO) engine symbol. There shall be only one MIL used to indicate all faults detected by the OBD system on a single vehicle.

(2.1.2) The MIL shall illuminate in the key on, engine off position before engine cranking to indicate that the MIL is functional. The MIL shall continuously illuminate during this functional check for a minimum of 15-20 seconds. Ouring this functional check of the MIL, the data stream value for MIL status shall indicate commanded off (see section (h)(4.2)) unless the MIL has also been commanded on for a detected malfunction. This functional check of the MIL is not required during vehicle operation in the key on, engine off position subsequent to the initial engine cranking of an ignition cycle (e.g., due to an engine stall or other non-commanded engine shutoff).

(2.1.3) At the manufacturer's option, the MIL may be used to indicate readiness status in a standardized format (see section (h)(4.1.3)) in the key on, engine off position.

(2.1.4) A manufacturer may request Executive Officer approval to also use the MIL to indicate which, if any, fault codes are currently stored (e.g., to "blink" the stored codes). The Executive Officer shall approve the request upon determining that the manufacturer has demonstrated that the method used to indicate the fault codes will not be unintentionally activated during a California inspection test or during routine driver operation.

(2.1.5) The MIL may not be used for any purpose other than specified in this regulation.

(2.2) MIL Illumination and Fault Code Storage Protocol.

(2.2,1) For vehicles using the ISO 15765-4 protocol for the standardized functions required in section (h):

(A) Upon detection of a malfunction, the aBO system shall store a pending fault code within 10 seconds indicating the likely area ofthe malfunction.

(8) After storage of a pending fault code, if the identified malfunction is again detected before the end of the next driving cycle in which monitoring occurs, the aBO system shall illuminate the MIL continuously, keep the pending fault code stored, and store a confirmed fault code within 10 seconds. If a malfunction is not detected before the end of the next driving cycle in which monitoring occurs (Le., there is no indication of the malfunction at any time during the driving cycle), the corresponding pending fault code set according to section (d)(2.2.1)(A) shall be erased at the end of the driving cycle.

(C) A manufacturer may request Executive Officer approval to employ alternate statistical MIL illumination and fault code storage protocols to those .specified in these requirements. The Executive Officer shall grant approval upon determining that the manufacturer has provided data and/or engineering evaluation that demonstrate that the alternative protocols can evaluate system performance and detect malfunctions in a manner that is equally effective and timely. Strategies requiring on average more than six driving cycles for MIL illumination may not be accepted.

(D) The aBO system shall store and erase "freeze frame" conditions (as defined in section (h)(4.3)) present at the time a malfunction is detected. The storage and erasure of freeze frame conditions shall be done in conjunction with the storage and erasure of either pending or confirmed fault codes as required elsewhere in section (d)(2.2).

(E) The aBO system shall illuminate the MIL and store a confirmed fault code within 10 seconds to inform the vehicle operator whenever the engine enters a default or "limp home" mode of operation that can affect emissions or the performance of the aBO system or in the event of a malfunction of an on-board computer(s) itself that can affect the performance of the aBO system. If the default or "limp home" mode of operation is recoverable (Le., the diagnostic or control strategy that caused the default or "limp home" mode of operation can run on the next driving cycle and confirm the presence of the condition that caused the default or "limp home" operationoperation automatically returns to normal' at the beginning of the ~~following~~ ignition cycle), the aBO system may, in lieu of illuminating the MIL within 10 seconds on the first driving cycle where the default or "limp home" mode of operation is entered, delay illumination of ~~wait~~ and illuminate the MIL until the condition causing the default or "limp home" mode of operation is again detected before the end of the next driving cycle and store the confirmed fault code only if the defaultor"limp home" mode of operation is again entered before the end of the next ignition cycle in lieu of illuminating the MIL ~~within~~ ~~10~~ seconds on the first driving ~~cycle~~ ~~where~~ the default or "limp home" mode of operation is entered.

(F) Before the end of an ignition cycle, the aBO system shall store confirmed fault codes that are currently causing the MIL to be illuminated in NVRAM as permanent fault codes (as defined in section (h)(4.4.1)(F)).

(2.2.2) For vehicles using the SAE J1939 protocol for the standardized functions required in section (h):

(A) Upon detection of a malfunction, the aBO system shall store a pending fault code within 10 seconds indicating the likely area of the malfunction.

(B) After storage of a pending fault code, if the identified malfunction is again detected before the end of the next driving cycle in which monitoring occurs, the OBO system shall iIluminat.e the MIL continuously, erase the pending fault code, and store a MIL-on fault code within 10 seconds. If a malfunction is not detected before the end of the next driving cycle in which monitoring occurs (Le., there is no indication of the malfunction at any time during the driving cycle), the corresponding pending fault code set according to section (d)(2.2.2)(A) shall be erased at the end of the driving cycle.

(C) A manufacturer may request Executive Officer approval to employ alternate statistical MIL illumination and fault code storage protocols to those specified in these req!Jirements. The Executive Officer shall grant approval upon determining that the manufacturer has provided data and/or engineering evaluation that demonstrate that the alternative protocols can evaluate system performance and detect malfunctions in a . manner that is equally effective and timely. Strategies requiring on . average more than six driving cycles for MIL illumination may not be accepted.

(D) Storage and erasure of freeze frame conditions.

(i) The OBO system shall store and erase "freeze frame" conditions (as defined in section (h)(4.3)) present at the time a malfunction is detected.

(ii) The OBO system shall store freeze frame conditions in conjunction with the storage of a pending fault code.

(iii) If the pending fault code is erased in the next driving cycle in which monitoring occurs and a malfunction is not detected (as described under section (d)(2.2.2)(B)), the aBO system may erase the corresponding freeze frame conditions.

(iv) If fhe pending fault code matures to a MIL-on fault code (as described under section (d)(2.2.2)(B)), the aBO system shall either retain the currently stored freeze frame conditions or replace the stored freeze frame conditions with freeze frame conditions regarding the MIL-on fault code. The aBO system shall erase the freeze frame information in conjunction with the' erasure of the previously MIL-on fault code (as described under section (d)(2.3.2)(C)).

(E) The aBO system shall illuminate the MIL and·store a MIL-on fault code within 10 seconds to inform the vehicle operator whenever the engine enters a default or "limp home" mode of operation that can affect emissions or the performance of the aBO system or in the event of a malfunction of an on-board computer(s) itself that can affect the performance of the aBO system. If the default or "limp home" mode of operation is recoverable (Le., the diagnostic or control strategy that caused the default or "limp home" mode of operation can run on the next driving cycle and confirm the presence of the condition that caused the default or "limp home" operationoperation automatically returns to normal at the beginning of the following ignition cycle), the aBO system may, in lieu of illuminating the MIL within 10 seconds on the first driving cycle where the default or "limp home" mode of operation is entered. delay illumination of the MIL until the condition causing the default or "limp home" mode of operation is again detected before the end of the next driving cycle wait and illuminate the MIL ~~only~~ if the default or "limp home" mode of operation is again entered before the end of the next ignition cycle in lieu of illuminating the MIL ~~within~~ 10 seconds on the first driving cycle where the default or "limp home" mode of operation is entered.

(F) Before the end of an ignition cycle, the aBO system shall store MIL-on fault codes that are currently causing the MIL to be illuminated in NVRAM as permanent fault codes (as defined in section (h)(4.4.2)(F)).

(2.3)' MIL Extinguishing and Fault Code Erasure Protocol.

(2.3.1) For vehicles using the ISO 15765-4 protocol for the standardized functions required in section (h):

(A) Extinguishing the MIL. Except as otherwise provided in sections (f)(1.4.6), (f)(2.4.5), and (f)(7.4.2) for fuel system, misfire, and evaporative system malfunctions, once the MIL has been illuminated, it may be extinguished after three subsequent sequential driving cycles during which the monitoring system responsible for illuminating the MIL functions and the previously detected malfunction is no longer present provided no other malfunction has been detected that would independently illuminate the MIL according to the requirements outlined above.

(B) Erasing a confirmed fault code. The aBO system may erase a confirmed fault code if the identified malfunction has not been again detected in at least 40 engine warm-up cycles and the MIL is presently not illuminated for that malfunction.

(C) Erasing a permanent fault code. The aBD system shall erase a permanent fault code only if either of the ~~following~~ conditions occur:

(i) If the aBO system is commanding the MIL on, the aBO system shall erase a permanent fault code only if ~~T~~the OBO system itself determines that the malfun.ction that caused the confirmed permanent fault code to be stored is no longer present and is not commanding the MIL on, concurrent 'Nithpursuant to the requirements of section (d)(2.3.1)(A) (which for the purposes of this section shall apply to all monitors). Erasure of the permanent fault code shall occur in conjunction with extinguishing the MIL or no later than the start of the first drive cycle that begins with the MIL commanded off., or

(ii) SUbsequen't to a clearing of theIf all fault information in the on-board computer other than the permanent fault code has been cleared (Le., through the use of a scan tool or battery disconnect) and the aBO system is not commanding the MIL on, the diagnostic for the malfunction that caused the permanent fault code to be stored has fully executed (Le., has executed the minimum number of checks necessary for MIL illumination) and determined the malfunction is no longer present.:

a. Except as provided for in section (d}(2.3.1 }(C)(ii}c., if the monitor of the malfunction that caused the permanent fault code to be stored is subject to the minimum ratio requirements of section (d)(3.2) (e.g., catalyst monitor, comprehensive component input component rationality monitors), the aBO system shall erase the permanent fault code at the end of a driving cycle if the monitor has run and made one or more determinations during a driving cycle that the malfunction of the component or the system is not present and has not made any determinations within the same driving cycle that the malfunction is present.

b. If the monitor of the malfunction that caused the permanent fault code to be stored is not subject to the minimum ratio requirements of section (d)(3.2) (e.g;, gasoline misfire monitor, gasoline fuel system monitor, comprehensive component circuit continuity monitors), the aBO system shall erase the permanent fault code at the end of a driving cycle if:

1. The monitor has run and made one or more determinations during a driving cycle that the malfunction of the component or the system is not present and has not made any determinations within the same driving cycle that the 'malfunction is present;
2. The monitor has not made any determinations that the malfunction is present subsequent to the most recent driving cycle in which the criteria of section (d)(2.3.1}(C)(ii}b.1. are met; and
3. The following criteria are satisfied on any single driving cycle (which may be a different driving cycle than that in which the criteria of section (d)(2.3.1)(C)W)b.1. are satisfied):
   i. Cumulative time since engine start is greater than or equal to 600 seconds;
   ii. Cumulative gasoline engine operation at or above 25 miles per hour or diesel engine operation at or above 1150 rpm, either of which occurs for greater than or equal to 300 seconds; and

iii. Continuous vehicle operation at idle (Le., accelerator pedal released by driver and either vehicle speed less than or equal to one mile per hour or engine speed less than or equal to 200 rpm above normal warmed-up idle (as determined in the drive position for vehicles equipped with an automatic transmission)) for greater than or equal to 30 seconds;. and

iv. The monitor has not made any determinations that the malfunction is present.

4. Monitors required to use "similar conditions" as defined in section (cl to store and erase pending and confirmed fault codes may not require that the similar conditions be met prior to erasure of the permanent fault code.

c. For monitors subject to section (d)(2.3.1)(C)(ii)a., the manufacturer may choose to erase the permanent fault code using the criteria under section (d)(2.3.1)(C)(ii)b. in lieu of the criteria under section (d)(2.3.1 *)(C)W)a.*

d. For 2010 through 2012 model year engines, manufacturers may request Executive Officer approval to use alternate criteria to erase the permanent fault code. The Executive Officer shall approve alternate criteria that will not likely require driving conditions that are longer and more difficult to meet than those required under section (d)(2.3.1)(C)(ii)b.

(2.3.2) For vehicles using the SAE J1939 protocol for the standardized functions required in section (h):

(A) Extinguishing the MIL. Except as otherwise provided in sections (e)(1.4.2)(F), (e)(2.4.2)(0) and (e)(6.4.2) for fuel system malfunctions, misfire malfunctionsJ. and empty reductant tanks, once the MIL has been illuminated, it may be extinguished after three subsequent sequential driving cycles during which the monitoring system responsible for illuminating the MIL functions and the previously detected malfunction is no longer present provided no other malfunction has been detected that would independently illuminate the MIL according to the requirements outlined above.

(B) Erasing a MIL-on fault code. The OBO system may erase a MIL-on fault code iri conjunction with extinguishing the MIL as described under section (d)(2.3.2)(A). In addition to the erasure of the MIL-on fault code, the OBO system shall store a previously MIL-on fault code for that failure.

(C) Erasing a previously MIL-on fault code. The OBO system may erase a previously MIL-on fault code if the identified malfunction has not been again detected in at least 40 engine warm-up cycles and the MIL is presently not illuminated for that malfunction.

(D) Erasing a permanent fault code. The aBO system shall erase a permanent fault code only if either of the following conditions occur:

(i) If the OBD system is commanding the MIL on, the OBD system shall erase a permanent fault code only if Tthe OBO system itself determines that the malfunction that caused the MIL on permanent fault code to be stored is no longer present and is not commanding the

MIL on, oonourrent with pursuant to the requirements of section (d)(2.3.2)(A) (which for the purposes of this section shall apply to all monitors). Erasure of the permanent fault code shall occur in conjunction with extinguishing the MIL or no later than the start of the first drive cycle that begins with the MIL commanded off., or

(ii) Subsequent to a clearing of theIf all fault information in the on-board computer has been cleared (Le., through the use of a scan tool or battery disconnect) and the aBO system is not commanding the MIL on, the diagnostio for the malfunotion that caused the permanent fault code to be stored has fully executed (Le., has exeouted the minimum number of oheoks neoessary for MIL illumination) and determined the malfunction is no longer present.:

a. Except as provided for in section (d)(2.3.2)(O)(ii)c., if the monitor of the malfunction that caused the permanent fault code to be stored is subject to the minimum ratio requirements of section (d)(3.2) (e.g., catalyst monitor, comprehensive component input component rationality monitors), the aBO system shall erase the permanent fault code at the end of a driving cycle if the monitor has run and made one or more determinations during a driving cycle that the malfunction of the component or the system is not present and has not made any determinations within the same driving cycle that the malfunction is present.

b. If the monitor of the malfunction that caused the permanent fault code to be stored is not subject to the minimum ratio requirements of section (d)(3.2) (e.g., continuous diesel fuel system monitors, comprehensive component circuit continuity monitors), the aBO system shall erase the permanent fault code at the end of a driving cycle if:

1. The monitor has run and made one or more determinations during a driving cycle that the malfunction of the component or the system is not present and has not made any determinations within the same driving cycle that the malfunction is present;
2. The monitor has not made any determinations that the malfunction is present subsequent to the most recent driving cycle in which the criteria of section (d)(2.3.2)(O)(ii)b.1. are met; and
3. The following criteria are satisfied on any single driving cycle (which may be a different driving cycle than that in which the criteria of section (d)(2.3.2)(O)(ii)b.1. are satisfied):
   i. Cumulative time since engine start is greater than or equal to 600 seconds;
   ii. Cumulative gasoline engine operation at or above 25 miles per-hour or diesel engine operation at or above 1150 rpm, either of which occurs for greater than or equal to 300 seconds; and
   iii. Continuous vehicle operation at idle (i.e., accelerator pedal released by driver and either vehicle speed less than or equal to one mile per hour or engine speed less than or

equal to 200 rpm abovenormal warmed-up idle (as determined in the drive position for vehicles equipped with an-automatic transmission)) for greater than or equal to 30 seconds. .

4. Monitors required to use "similar conditions" as defined in section (c) to store and erase pending and confirmed/MIL-on fault codes may not require that the similar conditions be met prior to erasure of the permanent fault code.

c. For monitors subject to section (d)(2.3.2)(O)(ii)a., the manufacturer may choose to erase the permanent fault code using the criteria under section (d)(2.3.2)(O)(ii)b. in lieu of the criteria under section (d)(2.3.2)(O)(ii)a.

d. For 2010 through 2012 model year engines, manufacturers may request Executive Officer approval to use alternate criteria to erase the permanent fault code. The Executive Officer shall approve alternate criteria that will not likely require driving conditions that are longer and more difficult to meet than those required under section (d)(2.3.2)(O)(ii)b.

(2.4) Exceptions to MIL and Fault Code Requirements.

(2.4.1) If the engine enters a default mode of operation, a manufacturer may request Executive Officer approval to be exempt from illuminating the MIL if any of the following conditions listed below occurs. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or engineering evaluation that verify the conditions below: .

(A) The default strategy (1) causes an overt indication (e.g., illumination of a red engine shut-down warning light) such that the driver is certain to respond and have the problem corrected and (2) is not caused by or invoked to protect a component required to be monitored by the OBO system under sections (e) through (g); or

(B) The default strategy is an AECO that is properly activated due to the occurrence of conditions that have been approved by the Executive Officer. -

(2.4.2) For gasoline engines, a manufacturer may elect to meet the MIL and fault code requirements in title 13, CCR section 1968.2(d)(2) in lieu of meeting the requirements of (d)(2).

(3) Monitoring Conditions.

Section (d)(3) sets forth the general monitoring requirements while sections (e) through (g) sets forth the specific monitoring requirements as well as identifies which of the following general monitoring requirements in sectio'n (d)(3) are applicable for each monitored component or system identified in sections (e) through (g).

(3.1) For all engines:

(3.1.1) As specifically provided for in sections (e) through (g), manufacturers shall define monitoring conditions, subject to Executive Officer approval, for detecting malfunctions identified in sections (e) through (g). The Executive Officer shall approve manufacturer-defined monitoring conditions that are determined (based on manufacturer-submitted data and/or other engineering documentation) to be: technically necessary to ensure robust detection of malfunctions {e.g., avoid false passes and false indications of malfunctions); designed to ensure monitoring will occur under conditions that may reasonably be expected to be encountered in normal vehicle operation and use; and designed to ensure monitoring will occur during the FTP cycle.

(3.1.2) Monitoring shall occur at least once per driving cycle in which the monitoring conditions are met.

(3.1.3) Manufacturers may request Executive Officer approval to define monitoring conditions that are not encountered during the FTP cycle as required in section (d){3.1.1). In evaluating the manufacturer's request, the Executive Officer shall consider the degree to which the requirement to run during the FTP cycle restricts in-use monitoring, the technical necessity for defining monitoring conditions that are not encountered during the FTP cycle, data and/or an engineering evaluation submitted by the manufacturer which demonstrate that the component/system does not normally function, or monitoring is otherwise not feasible, during the FTP cycle, and, where applicable in section (d){3.2), the ability of the manufacturer to demonstrate the monitoring conditions will satisfy the minimum acceptable in-use monitor performance ratio requirement as defined in section (d){3.2) (e.g., data which show in-use driving meets the minimum requirements).

(3.2) As specifically provided for in sections (e) through (g), manufacturers shall define monitoring conditions in accordance with the criteria in sections (d){3.2.1) through (3.2.3).

(3.2.1) Manufacturers shall implement software algorithms in the OBD system to individually track and report in-use performance of the following monitors in the standardized format specified in section (d){5):

(A) NMHC converting catalyst (section (e){5.3.1))
(B) NOx converting catalyst {section (e){6.3.1))
(C) Catalyst {section (f){6.3));
(D) Exhaust gas sensor {sections (e){9.3.1){A) or (f){8.3.1){A));
(E) Evaporative system {section (f){7.3.2));
(F) EGR system {sections (e){3.3.2) and (3.3.3) or (f){3.3.1)) and VVT system {sections (e){10.3) or (f){9.3));
(G) Secondary air system {section (f){5.3.1));
(H) PM filter {section (e){8.3));
(I) Boost pressure control system {sections (e){4.3.2) and (e){4.3.3)); ~~and~~
(J) NOx adsorber {section (e)(7.3.1));
(K) Fuel system (section (e)(1.3.3)); and
(I) Secondary oxygen sensor (section (f)(8.3.2)(A)).

The OBD system is not required to track and report in-use performance for monitors other than those specifically identified above.

(3.2.2) For all 2013 and subsequent model year engines, manufacturers shall define monitoring conditions that, in addition to meeting the Criteria in sections (d){3.1) and (d){3.2.1), ensure that the monitor yields an in-use performance ratio {as defined in section (d){4)) that meets or exceeds the minimum acceptable in-use monitor performance ratio for in-use vehicles.

For purposes of this regulation, the minimum acceptable in-use monitor performance ratio is 0.100 for all monitors specifically required in sections *(e)* through (g) to meet the monitoring condition requirements of section (d)(3.2).

(3.2.3) Manufacturers may not use the calculated ratio (or any element thereof) or any other indication of monitor frequency as a monitoring condition for a monitor (e.g., using a low ratio to enable more frequent monitoring through diagnostic executive priority or modification of other monitoring conditions, or using a high ratio to enable less frequent monitoring).

(3.2.4) Upon request of a manufacturer or upon the best engineering judgment of the ARB, the Executive Officer may revise the minimum acceptable in-use monitoring performance ratio specified in section. (d)(3.2.2) for a specific monitor if the most reliable monitoring method developed requires a lower ratio.

(4) In-Use Monitor Performance Ratio Definition.

(4.1) For monitors required to meet the requirements in section (d)(3.2), the ratio shall be calculated in accordance with the following specifications for the numerator, denominator, and ratio.

(4.2) Numerator Specifications

(4.2.1) Definition: The numerator is defined as a measure of the number of times a vehicle has been operated such that all monitoring conditions necessary for a specific monitor to detect a malfunction have been encountered.

(4.2.2) Specifications for incrementing:

(A) Except as provided for in section (d)(4.2.2)(E), the numerator, when incremented, shall be incremented by an integer of one. The numerator may not be incremented more than once per driving cycle.

(B) The numerator for a specific monitor shall be incremented within 10 seconds if and only if the following criteria are satisfied on a single driving cycle:

(i) Every monitoring condition necessary for the monitor of the specific component to detect a malfunction and store a pending fault code has been satisfied, including enable criteria, presence or absence· of related fault codes, sufficient length of monitoring time, and diagnostic executive priority assignments (e.g., diagnostic "A" must execute prior to diagnostic "B"). For the purpose of incrementing the numerator, satisfying all the monitoring conditions necessary for a monitor to determine the component is passing may not, by itself, be sufficient to meet this criteria.

(ii) For monitors that require multiple stages or events in a single driving cycle to detect a malfunction, every monitoring condition necessary for all events to have completed must be satisfied.

(iii) For monitors that require intrusive operation of components to detect a malfunction, a manufacturer shall request Executive Officer approval of the strategy used to determine that, had a .malfunction been present, the monitor would have detected the malfunction. Executive Officer approval of the request shall be based on the equivalence of the strategy to actual intrusive operation and the ability of the strategy to accurately determine if every monitoring condition necessary for the intrusive event to occur was'satisfied.

(iv) For the secondary air system monitor, the criteria in sections (d)(4.2.2)(B)(i) through (iii) above are satisfied during normal operation of the secondary air system. Monitoring during intrusive operation of the secondary air system later in the same driving cycle solely for the purpose of monitoring may not, by itself, be sufficient to meet this criteria.

(G) For monitors that can generate results in a "gray zone" or "non-detection zone" (Le., results that indicate neither a passing system nor a malfunctioning system) or in a "non-decision zone" (e.g., monitors that increment and decrement counters until a pass or fail threshold is reached), the manufacturer shall submit a plan for appropriate incrementing of the numerator to the Executive Officer for review and approval. In general, the Executive Officer shall not approve plans that allow the numerator to be incremented when the monitor indicates a result in the "non-detection zone" or prior to the monitor reaching a decision. In reviewing the plan for approval, the Executive Officer shall consider data and/or engineering evaluation submitted by the manufacturer demonstrating the expected frequency of results in the "non-detection zone" and the ability of the monitor to accurately determine if a monitor would have deteGted a malfunction instead of a result in the "non-detection zone" had an actual malfunction been present.

(D) For monitors that run or complete during engine-off operation, the numerator shall be incremented within 10 seconds after the monitor has completed during engine-off operation or during the first 10 seconds of engine start on the subsequent driving cycle.

(E) Except as specified in section (d)(4.2.2)(F) for exponentially weighted moving averages, Mmanufacturers utilizing alternate statistical MIL illumination protocols as allowed in sections (d)(2.2.1)(G) and (d)(2.2.2)(G) for any of the monitors requiring a numerator shall submit a plan for appropriate incrementing of the numerator to the Executive Offieer for review and approval. Executive Officer approval of the plan shall be conditioned upon the manufacturer providing supporting data and/or engineering evaluation demonstrating the equivalence of the incrementing in the manufacturer's plan to the incrementing specified in section (d)(4.2.2) for monitors using the standard MIL illumination protocol and the overall equivalence of the manufacturer's plan in determining that the minimum acceptable in-use performance ratio in section (d)(3.2) is satisfied.

(F) Manufacturers using an exponentially weighted moving average (EWMA) as the alternate statistical MIL illumination protocol approved in accordance with sections (d)(2.2.1)(G) and (d)(2.2.2)(G) shall increment the numerator as follows:

(i) Following a reset or erasure of the EWMA result, the numerator may not be incremented until after the requisite number of decisions necessary for MIL illumination have been fully executed.

(ii) After the number of decisions required in section (d)(4.2.2)(F)(i) above, the numerator, when incremented, shall be incremented by an integer' of one and may not be incremented more than once per driving cycle. Incrementing of the numerator shall also be in accordance with sections (d)(4.2.2)(B), (C), and (0).

(4.3) Denominator Specifications

(4.3.1) Definition: The denominator is defined as a measure of the number of times a vehicle has been operated as defined in (d)(4.3.2).

(4.3.2) Specifications for incrementing:

(A) The denominator, when incremented, shall be incremented by an integer of one. The denominator may not be incremented more than once per driving cycle.

(B) The denominator for each monitor shall be incremented within 10 seconds if and only if the following criteria are satisfied on a single driving cycle:

(i) Cumulative time since start of driving cycle is greater than or equal to 600 seconds while at an elevation of less than 8,000 feet above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit;

(ii) Cumulative gasoline engine operation at or above 25 miles per hour or diesel engine operation at or above 15% calculated load 1150 rpm, either of which occurs for greater than or equal to 300 seconds while at an elevation of less than 8,000 feet above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit; and

(iii) Continuous vehicle operation at idle (i.e.~~g.~~, accelerator pedal released by driver and either vehicle speed less than or equal to one mile per hour or engine speed less than or equal to 200 rpm above normal warmed-up idle (as determined in the drive position for vehicles equipped with an automatic transmission)) for greater than or equal to 30 seconds while at an elevation of less than 8,000 feet above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit.

(iv) For 2010 through 2012 model year diesel engines, manufacturers may use diesel engine operation at or above 15% calculated load in lieu of 1150 rpm for the criterion in section (d)(4.3.2)(B)(ii) above.

(C) In 'addition to the requirements of section (d)(4.3.2)(B) above, the evaporative system monitor denominator(s) shall be incremented if and only if:

(i) Cumulative time since start of driving cycle is greater than or equal to 600 seconds while at an ambient temperature of greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit; and

(ii) Engine cold start occurs with engine coolant temperature at engine start greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit and less than or equal to 12 degrees Fahrenheit higher than ambient temperature at engine start.

(D) In addition to the requirements of section (d)(4.3.2)(B) above, the denominator(s) for the following monitors shall be incremented if and only if the component or strategy is commanded "on" 'for a cumulative time

greater than or equal to 10 seconds:
(i) Secondary Air System (section (f)(5»
(ii) Cold Start Emission Reduction Strategy (sections *(e)(11)* or (f)(4»
(iii) Components or systems that operate only at engine start-up (e.g., glow plugs, intake air heaters) and are subject to monitoring under "other emission control systems" (section (g)(4» or comprehensive component output components (section (g)(3»

For purposes of determining this commanded "on" time, the OBD system may not include time during intrusive operation of any of the components or strategies later in the same driving cycle solely for the purposes of monitoring.

(E) In addition to the requirements of section (d)(4.3.2)(B) above, the denominator(s) for the following monitors of output components (except those operated only at engine start-up and subject to the requirements of the previous section (d)(4.3.2)(D» shall be incremented if and only if the component is commanded to function (e.g., commanded "on", "open", "closed", "locked") on two or more occasions for greater than two seconds during the driving cycle or for a cumulative time greater than or equal to 10 seconds, whichever occurs first:
(i) Variable valve timing and/or control system (sections (e)(10) or (f)(9»
(ii) "Other emission control systems" (section (g)(4»
(iii) Comprehensive component output component(section (g)(3» (e.g., turbocharger waste-gates, variable length manifold runners)

(F) For monitors of the following components, the manufacturer may request Executive Officer approval to use alternate or additional criteria to that set forth in section (d)(4.3.2)(B) above for incrementing the denominator. Executive Officer approval of the proposed criteria shall be based on the equivalence of the proposed criteria in measuring the frequency of monitor operation relative to the amount of vehicle operation in accordance with the criteria in section (d)(4.3.2)(B) above:
(i) Engine cooling system input components (section (g)(1»
(ii) "Other emission control systems" (section (g)(4»
(iii) Comprehensive component input components that require extended monitoring evaluation (section (g)(3» (e.g., stuck fuel level sensor rationality)
(iv) Comprehensive component input component temperature sensor rationality monitors (section (g)(3)) (e.g., intake air temperature sensor, ambient temperature sensor, fuel temperature sensor)
(v) PM filter frequent regeneration (section (e)(8.2.2))

(G) Fot monitors of the following components or other emission controls that experience infrequent regeneration events, the manufacturer may request Executive Officer approval to use alternate or additional criteria to that set forth in section (d)(4.3.2)(B) above for incrementing the ~~denominator.~~ Executive Officer approval of the proposed criteria shall be based on the effectiveness of the proposed criteria in measuring the frequency of monitor operation relative to the amount of vehicle operationthe denominator(s) shall be incremented by one if and only if, in addition to meeting the requirements of section (d)(4.3.2)(B) on the current driving cycle, at least 750 minutes of cumulative engine run time have occurred since the last time the denominator was incremented. The 750-minute engine run time counter shall be reset to zero and begin counting again after the denominator has been incremented and no later than the start of the next ignition cycle:

(i) Oxidation Diesel NMHC converting catalyst (section (e)(5))

(ii) Particulate matter filters (sections (e)(8.2.1), (8.2.4), and (8.2.5))

(H) In addition to the requirements of section (d)(4.3.2)(B) above, the denominator's) for the following monitors shall be incremented if and only if a regeneration event is commanded for a time greater than or equal to 10 seconds:

(i) PM filter incomplete regeneration (section (e)(8.2.3))

Oi) PM filter active/intrusive injection (section (e)(8.2.6))

~~(H)~~(I) For hybrid vehicles, vehicles that employ alternate engine start hardware or strategies (e.g., integrated starter and generators), or alternate fuel vehicles (e.g., dedicated, bi-fuel, or dual-fuel applications), the manufacturer may request Executive Officer approval to use alternate criteria to that set forth in section (d)(4.3.2)(B) above for incrementing the denominator. In general, the Executive Officer shall not approve alternate criteria for vehicles that only employ engine shut off at or near idle/vehicle stop conditions. Executive Officer approval of the alternate criteria shall be based on the equivalence of the alternate criteria to determine the amount. of vehicle operation relative to the measure of conventional vehicle operation in accordance with the criteria in section (d)(4.3.2)(B) above.

(4.4) Ratio Specifications

(4.4.1) Definition: The ratio is defined as the numerator divided by the denominator.

(4.5) Disablement of Numerators and Denominators

(4.5.1) Within 10 seconds of a malfunction being detected (Le., a pending, confirmed, or MIL-on fault code being stored) that disables a monitor required to meet the. monitoring conditions in section (d)(3.2), the OBD system shall disable further incrementing of the corresponding numerator and denominator for each monitor that is disabled. When the' malfunction is no longer detected (e.g., the pending code is erased through self-clearing or through a scan tool command), incrementing of all corresponding numerators and denominators shall resume within 10 seconds.

(4.5.2) Within 10 seconds of the start of a PTO (see section (c)) operation that disables a monitor required to meet the monitoring conditions in section (d)(3.2), the OBD system shall disable further incrementing of the corresponding numerator and denominator for each monitor that is disabled. When the PTO operation ends, increment.ing of all corresponding numerators and denominators shall resume within 10 seconds.

(4.5.3) The OBD system shall disable further incrementing of all numerators and denominators within 10 seconds if a malfunction of any component used to determine if the criteria in sections (d)(4.3.2)(B) through (C) are satisfied (Le., vehicle speed/calculated load, ambient temperature, elevation, idle operation, engine cold start, or time of operation) has been detected (i.e., a pending, confirmed, or MIL-on fault code has been stored land the ~~corresponding~~ pending fault code has been stored. Incrementing of all numerators and denominators shall resume within 10 seconds when the malfunction is no longer present (e.g., pending code erased through self-clearing or by a scan tool command).

(5) *Standardized tracking and reporting of monitor performance.*

(5.1) For monitors required to track and report in-use monitor performance in section (d)(3.2), the performance data shall be tracked and reported in accordance with the specifications in sections (d)(4), (d)(5), and (h).(5.1). The aBO system shall separately report an in-use monitor performance numerator and denominator for each of the foliowing components:

(5.1.1) For diesel engines, fuel system, NMHC catalyst bank 1, NMHC catalyst bank 2, NOx catalyst bank 1, NOx catalyst bank 2, exhaust gas sensor bank 1, exhaust gas sensor bank 2, EGRNVT system, PM filter, boost pressure control system, and NOx adsorber. The OBO system shall also report a general denominator and an ignition cycle counter in the standardized format specified in sections (d)(5.5), (d)(5.6), and (h)(5.1).

(5.1.2) For gasoline engines, catalyst bank 1, catalyst bank 2, primary oxygen sensor bank 1, primary oxygen sensor bank 2, secondary oxygen sensor evaporative leak detection system, EGRNVT system, and secondary air system. The aBO system shall also report a general denominator and an ignition cycle counter in the standardized format specified in sections (d)(5.5), (d)(5.6), and (h)(5.1).

(5.2) Numerator

(5.2.1) The aBO system shall report a separate numerator for each of the components listed in section (d)(5.1).

(5.2.2) For specific components or systems that have multiple monitors that are required to be reported under section (e) (e.g., exhaust gas sensor bank 1 may have multiple monitors for sensor response or other sensor characteristics), the aBO system shall separately track numerators and denominators for each of the specific monitors and report only the corresponding numerator and denominator for the specific monitor that has the lowest numerical ratio. If two or more specific monitors have identical ratios, the corresponding numerator and denominator for the specific monitor that has the highest denominator shall be reported for the specific component.

(5.2.3) The numerator(s) shall be reported in accordance with the specifications in section (h)(5.1.2)(A).

(5.3) Denominator

(5.3.1) The aBO system shall report a separate denominator for each of the components listed in section (d)(5.1).

(5.3.2) The denominator(s) shall be reported in accordance with the specifications in section (h)(5.1.2)(A).

(5.4) . Ratio

(5.4.1) For purposes of determining which corresponding numerator and denominator to report as required in section (d)(5.2.2), the ratio shall be calculated in accordance with the specifications in section (h)(5.1.2)(B).

(5.5) Ignition cycle counter

(5.5.1) Definition:

(A) The ignition cycle counter is defined as a counter that indicates the number of ignition cycles a vehicle has experienced as defined in section (d)(5.5.2)(B).

(B) The ignition cycle counter shall be reported in accordance with the specifications in section (h)(5.1.2)(A).

(5.5.2) Specifications for incrementing:

(A) The ignition cycle counter, when incremented, shall be incremented by an integer of one. The ignition cycle counter may not be incremented more than once per ignition cycle.

(B) The ignition cycle counter shall be incremented within 10 seconds if and only if the -engine exceeds an engine speed of 50 to 150 rpm below the normal, warmed-up idle speed (as determined in the drive' position for vehicles equipped with an automatic transmission) for at least two seconds plus or minus one second.

. (C) The OBD system shall disable further incrementing of the ignition cycle counter within 10 seconds if a malfunction of any component used to determine if the criteria in section (d)(5.5.2)(B) are satisfied (Le., engine speed or time of operation) has been detected and the corresponding pending fault code has been stored. The ignition cycle counter may not be disabled from incrementing for any other condition. Incrementing of the ignition cycle counter shall resume within 10 seconds when the malfunction is no longer present (e.g., pending code erased through self-clearing or by a scan tool command).

(5.6) General Denominator

(5.6.1) Definition:

(A) The general denominator is defined as a measure of the number of times a vehicle has been operated as defined in section (d)(5.6.2)(B).

(B) The general denominator shall be reported in accordance with the specifications in section (h)(5.1.2)(A).

(5.6.2) Specifications' for incrementing:

(A) The general denominator, when incremented, shall be incremented by an integer of one. The general denominator may not be incremented more than once per driving cycle.

(B) The general denominator shall be incremented within 10 seconds if and only if the criteria identified in section (d)(4.3.2)(B) are satisfied on a single driving cycle. .

(C) The OBD system shall disable further incrementing of the general denominator within 10 seconds if a malfunction of any component used to determine if the criteria in section (d)(4.3.2)(B) are satisfied (Le., vehicle speed/load, ambient temperature, elevation, idle operation, or time of operation) has been detected and the corresponding pending fault code has been stored. The general denominator may not be disabled from incrementing for any other condition (e.g., the disablement criteria in sections (d)(4.5.1) and (d)(4.5.2) may not disable the general denominator). Incrementing of the general denominator shall resume within 10 seconds when the malfunction is no longer present (e.g., pending code erased through self-clearing or by a scan tool command).

(6) ***Malfunction Criteria Determination.***

(6.1) In determining the malfunction criteria for diesel engine monitors in sections (e) and (g) that are required to indicate a malfunction before emissions exceed an emission threshold based on any applicable standard (e.g., 2.0 times any of the applicable standards), the manufacturer shall:

(6.1.1) Use the emission·test cycle and standard (Le., FTP or SET) determined by the manufacturer, through use of data and/or engineering analysis, to be more stringent (Le., to result in higher emissions with the same level of monitored component malfunction) as the "applicable standard". The manufacturer shall use data and/or engineering analysis to determine the test cycle and standard that is more stringent.

(6.1.2) Identify in·the certification documentation required under section (j), the test cycle and standard determined by the manufacturer to be ~~the most~~more stringent for each applicable monitor.

(6.1.3) If the Executive Officer reasonably believes that a manufacturer has incorrectly determined the test cycle and standard that is ~~most~~ more stringent, the Executive Officer shall require the manufacturer to provide emission data and/or engineering analysis showing that the other test cycle and standard are less stringent.

(6.2) On engines equipped with emission controls that experience infrequent regeneration events, a manufacturer shall adjust the emission test results that are used to determin"e the malfunction criterion for monitors that are required to "indicate a malfunction before emissions exceed a certain emission threshold (e.g., 2.0 times any of the applicable standards). Except as provided in section (d)(6.2.3), ~~F~~for each monitor, the manufacturer shall adjust the emission result using the procedure described in CFR title 40, part 86.004-28(i) with the component for which the malfunction criteria is being established deteriorated to the malfunction threshold. The adjusted emission value shall be used for purposes of determining whether or not the specified emission threshold is exceeded (e.g., a malfunction must be detected before the adjusted emission value exceeds 2.0 times any applicable standard).

(6.2.1) For purposes of section (d)(6.2), "regeneration" means an event during which emissions levels change while the emission control performance is being restored by design.

(6.2.2) For purposes of section (d)(6.2), "infrequent" means having an expected frequency of less than once per FTP cycle.

(6.2.3) In lieu of using the procedure described inCFR title 40, part 86.004-28(i), the manufacturer may submit an alternate plan to calculate the adjustmentfactors for determining the adjusted emission values to the Executive Officer for review and approval. Executive Officer approval of the plan shall be conditioned upon the manufacturer providing data and/or engineering evaluation demonstrating the procedure is consistent with good engineering judgment in determining appropriate modifications to the tailpipe certification adjustment factors.

"(6.3) In lieu of meeting the malfunction criteria for gasoline engine monitors in sections (f) and (g), the manufacturer may request Executive Officer approval to utilize aBO systems certified to the requirements of title 13, CCR section 1968.2 on medium-duty engines. or vehicles. The Executive Officer shall approve the request upon finding that the manufacturer has used good engineering judgment in determining equivalent malfunction detection criteria on the heavy-duty engine.

(7) ***Implementation Schedule***

(7.1) Except as specified in sections (d)(7.4) and (d)(7.5) for small volume manufacturers and alternate-fueled engines, for the 2010 through 2012 model year engines: '

(7.1.1) Full aBO. Except as specified in section (d)(7.1.3) below, a manufacturer shall implement an aBO system meeting the requirements of section 1971.1 on one engine rating (Le., the aBO parent rating) within one of the . manufacturer's engine families. The aBO par.ent rating shall be from the manufacturer's heavy-duty engine family with the highest weighted sales number for the 2010 model year and shall be the engine rating with the highest weighted sales number within that engine family.

(7.1.2) Extrapolated aBO. For all other engine ratings within the engine family selected according to section (d)(7.1.1) (Le., the aBO child ratings), except as specified in section (d)(7.1.3) below), a manufacturer shall implement an aBO system meeting the requirements of section 1971.1 with the exception that the aBO system is not required to detect a malfunction prior to exceeding the emission thresholds specified in the malfunction criteria in sections (e) through (g). In lieu of detecting a malfunction prior to exceeding the emission thresholds, a manufacturer shall submit a plan for Executive Officer review and approval detailing the engineering evaluation the manufacturer will use to establish the malfunction criteria for the aBO child ratings. The Executive Officer shall approve the plan upon determining that the manufacturer is using good engineering judgment to establish the malfunction criteria for robust detection of malfunctions, including consideration of differences of base engine, calibration, emission control components, and emission control strategies.

(7.1.3) For all engine ratings (Le., aBO parent and aBO child ratings) within the engine family selected according to (d)(7.1.1):

(A) The aBO system is exempt from having'to comply with the standardization requirements set forth in the incorporated documents to this regulation (e.g., SAE J1939 defined format) within the following sections:

(i) (d)(1.2) and (h)(2) (standardized connector)

(ii) (d)(2.1.1) and (2.1.5) (dedicated standardized MIL)

(iii) (h)(3) (communication protocol)

(iv) (h)(4) (standardized communication functions with respect to the requirements to make the data available in a standardized format or in accordance with SAE J1979/1939 specifications)

(v) (h)(5.1.1), and (h)(5.2.1) with respect to the requirements to make the data available in a standardized format or in accordance with SAE J1979/1939 specifications.

(B) The aBO system shall meet the requirements of either sections (d)(2.2.1) and (2.3.1) or (d)(2.2.2) and (2.3.2) regardless of the communication protocol (e.g., standardized, proprietary) used by the OBO system.

(7.1.4) Engine Manufacturer Diagnostic (EMD) Systems. For all engine ratings in the manufacturer's engine families not selected according to section (d)(7.1.1), a manufacturer shall:

(A) Implement an EMO system meeting the requirements of title 13, CCR section 1971 in lieu of meeting the requirements of section 1971.1; and

(B) Monitor the NOx aftertreatment (Le., catalyst, adsorber) on engines so-equipped. A malfunction shall be detected if:

(i) The NOx aftertreatment system has no detectable amount of NOx aftertreatment capability (Le., NOx catalyst conversion or NOx adsorption);

.(ii) The NOx aftertreatment substrate is completely destroyed, removed, or missing; or

(iii) The NOx aftertreatment assembly is replaced with a straight pipe.

(7.2) Except as specified in section (d)(7.5) for alternate-fueled engines, for the 2013 thrQugh 2015 model year engines:

(7.2.1) A manufacturer shall be required to define one or more OBO groups to cover all engine ratings in all engine families.

(7.2.2) Full OBO. A manufacturer shall implement an OBD system meeting the requirements of section 1971.1:.

(A) On all engine ratings (Le., OBO parent and OBO child ratings) within the engine family selected according to section (d)(7.1.1); and

(B) On one engine rating (Le., OBO parent rating) within each of the manufacturer's OBO groups. The OBO parent rating shall be. the engine rating with the highest weighted sales number for the 2013 model year within each OBO ·group.

(7.2.3) Extrapolated OBO. For all engine ratings not subject to section (d)(7.2.2) (Le., OBO child ratings), a manufacturer shall implement an OBO system meeting the requirements of section 1971.1 with the exception that the OBO system is not required to detect a malfunction prior to exceeding the emission thresholds specified in the malfunction criteria in sections (e) through (g). In lieu of detecting a malfunction prior to exceeding the emission thresholds, a manufacturer shall submit a plan for Executive Officer review and approval detailing the engineering evaluation the manufacturer will use to establish the malfunction criteria for the OBO child ratings. The Executive Officer shall approve the plan upon determining that the manufacturer is using good engineering judgment to establish the malfunction criteria for robust detection of malfunctions, including consideration of differences of base engine, calibration, emission control components, and emission control strategies.

(7.3) Except as specified in section (d)(7.5) for alternate-fueled engines, for the 2016 and subsequent model year engines:

(7.3.1) A manufacturer shall implement an OBO system meeting the requirements of section 1971.1 on all engine ratings in all engine families.

(7.4) Small volume manufacturers shall be exempt from the requirements of section 1971.1 for 2010 through 2012 model year engines. For purposes of this requirement, a small volume manufacturer is defined as a manufacturer with projected engine sales for California heavy-duty vehicles of less than 1200 engines per year for the 2010 model year. '

(7.5) For alternate-fueled engines:

(7.5.1) For 2010 through 2012 model year engines, a manufacturer shall be exempt from the requirements of section 1971.1.

(7.5.2) For 2013 through 2019 model year engines, the manufacturer shall:

(A) Implement an EMO system meeting the requirements of title 13, CCR section 1971 in lieu of meeting the requirements of section 1971.1; and

(B) Monitor the NOx aftertreatment (Le., catalyst, adsorber) on engines so-equipped. A malfunction shall be detected if: '

(i) The NOx aftertreatment system has no detectable amount of NOx aftertreatment capability (Le., NOx catalyst conversion or NOx adsorption);

(ii) The NOx aftertreatment substrate is completely destroyed, removed, or missing; or ,

(iii) The NOx aftertreatment assembly is replaced with a straight pipe.

(7.5.3) For 2020 and subsequent model year engines, a manufacturer shall implement an OBO system meeting the requirements of section 197'1.1.

(e) ***MONITORING REQUIREMENTS FOR DIESEUCOMPRESSION-IGNITION ENGINES***

(1) ***FUEL SYSTEM MONITORING***

(1.1) Requirement:

The OBO system shall monitor the fuel delivery system to determine its ability to comply with emission standards. The individual electronic components (e.g., actuators, valves, sensors, pumps) that are' used in the fuel system and not specifically addressed in this section shall be monitored in accordance with the comprehensive component requirements in section (g)(3).

(1.2) Malfunction Criteria:

(1.2.1) Fuel system pressure control: The OBO system shall detect a malfunction of the fuel system pressure control system (e.g., fuel, hydraulic fluid) when the fuel system pressure control system is unable to maintain an engine's NMHC, NOx, or CO emissions at or below 2.0 times the applicable standards or the engine's PM emissions at or 'below the applicable standard plus 0.02 grams per brake horsepower-hour (g/bhp-hr). For engines in which no failure or deterioration of the fuel system pressure control could result in an engine'S emissions exceeding these emission levels, the OBO system shall detect a malfunction when the system has reached its control limits such that the commanded fuel system pressure cannot be delivered.

(1.2.2) Injection quantity: The OBO system shall detect a malfunction of the fuel injection system when the system is unable to deliver the commanded quantity of fuel necessary to maintain an engine's NMHC, CO, and NOx emissions at or below 2.0 times the applicable standards or the engine's PM emissions at or below the applicable standard plus 0.02 g/bhp-hr. For engines in which no failure or deterioration of the fuel injection quantity could result in an engine's emissions exceeding these emission levels, the aBO system shall detect a malfunction when the system has reached its control limits such that the commanded fuel quantity cannot be delivered.

(1.2.3) Injection Timing: The aBO system shall detect a malfunction of the fuel injection system when the system is unable to deliver fuel at the proper crank angle/timing (e.g., injection timing too advanced or too retarded)' necessary to maintain an engine's NMHC, CO, and NOx emissions at or , below 2.0 times the applicable standards or the engine's PM emissions at or below the applicable standard plus 0.02 g/bhp-hr. For engines in which no failure or deterioration of the fuel injection timing could result in an engine's emissions exceeding these emission levels, the aBO system shall detect a malfunction when the system has reached its control limits such that the commanded fuel injection timing cannot be achieved.

(1.2.4) Feedback control: Except as provided for in section (e)(1.2.5), if the engine is equipped with feedback or feed-forward control of the fuel system (e.g., feedback control of pressure or pilot injection quantity), the aBO system shall detect a malfunction:

(A) If the system fails to begin feedback control within a manufacturer specified time interval;

(B) If a failure or deterioration causes open loop or default operation; or

(C) If feedback the control system has used up all of the adjustment allowed by. the manufacturer or reached its maximum authority and cannot achieve the target. '

(1.2.5) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (e)(1.2.4)(C) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on an eng,ine with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(1.2.6) In lieu of detecting the malfunctions specified in sections (e)(1.2.4)(A) and (B) with a fuel system-specific monitor, the aBO system may monitor the individual parameters or components that are used as inputs for fuel system feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (e)(1.2.4)(A) and (B).

0.2.7) For purposes of determining the fuel system malfunction criteria in sections (e)(1.2.1) through (1.2.3):

(A) For 2010 through 2012 model year engines, the malfunction criteria shall be established by using a fault that affects either a single injector or all injectors equally.

(B) For 2013 and subsequent model year engines, for section (e)(1.2.1), the malfunction criteria shall be established by using a fault that affects all injectors equally. Additionally, for systems that have single component failures which could affect a single injector (e.g., systems that build injection pressure within the injector that could have a single component pressure fault caused by the injector itself), the malfunction criteria shall also be established by using a fault that affects a single injector.

(e) For 2013 and subsequent model year engines, for sections (e)(1.2.2) through (1.2.3), the malfunction criteria shall be established by both (1) a fault that affects all the injectors equally and (2) a fault that affects only one injector.

(1.3) Monitoring Conditions:

(1.3.1) Except as provided in sections (e)(1.3.2) and (e)(1.3.4), Tthe OBO system shall monitor continuously for malfunctions identified in sections (e)(1.2.1) and (e)(1.2.4) (i.e., fuel pressure control and feedback operation).

0.3.2) For fuel systems that achieve injection fuel pressure within the injector or increase pressure within the injector(e.g. in the injector of an amplified common rail system), manufacturers may request Executive Officer approval to define the monitoring conditions for malfunctions identified in sections (e)(1.2.1) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). The Executive Officer shall approve the monitoring conditions upon the manufacturer submitting data and/or analysis identifying all possible failure modes and the effect each has (e.g., failure modes and effects analysis) on fuel pressure across the entire range ·of engine operating conditions, and upon the Executive Officer determining based on the data and/or analysis that the monitoring conditions allow for robust detection of all causes of fuel pressure malfunctions.

(1.3.2)(1.3.3) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (e)(1.2.2) and (e)(1.2.3) (i.e., injection quantity and timing) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements). For all 2013 and subseguent model year engines, for purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in sections (e)(1.2.2)and (e)(1.2.3) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(1.3.4) Manufacturers may request Executive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering' evaluation which demonstrate that a properly operating system cannot be distinguished from a malfunctioning system and that the disablement interval is limited only to that which is technically necessary.

(1.4) MIL Illumination and Fault Code Storage:

(1.4.1) General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(1.4.2) Additionally, for malfunctions identified in section (e)(1.2.1) (Le., fuel pressure control) on all 2013 and subsequent model year vehicles:

(A) A pending fault code shall be stored immediately upon the fuel system exceeding the malfunction criteria established pursuant to section (e)(1.2.1).

(B) Except as provided below, if a pending fault code is stored, the OBO system shall immediately illuminate the MIL and store a confirmed/MIL-on fault code if a malfunction is again detected during either of the following two events: (a) the driving cycle immediately following the storage of the pending fault code, regardless of the conditions encountered during the driving cycle; or (b) on the next driving cycle in which similar conditions (see section (en to those that occurred when the pending fault code was stored are encountered.

(C) The pending fault code may be erased at the end of the next driving cycle in which similar conditions have been encountered without an exceedance of the specified fuel system malfunction criteria. The pending code may also be erased if similar conditions are not encountered during the 80 driving cycles immediately after the initial detection of a malfunction for which the pending code was set.

(D) Storage of freeze frame conditions.

(i) A manufacturer shall store and erase freeze frame conditions either in conjunction with storing and erasing a pending fault code or in conjunction with .storing and erasing a conlirmed/MIL-on fault code.

(ii) If freeze frame conditions are stored for a malfunction other than misfire (see section (e)(2)) or fuel system malfunction when a fault code is stored as specified ih section (e)(1.4.2) above. the stored freeze frame information shall be replaced with freeze frame information regarding the fuel system malfunction.

(E) Storage of fuel system conditions for determining similar conditions of operation.

0) Upon detection of a fuel system malfunction under section (e)(1.4.2), the aBO system shall store the engine speed. load. and warm-up status of the first fuel system malfunction that resulted in the storage of the pending fault code. .

(ii) The manufacturer may request Executive Officer approval to use an alternate definition of similar conditions in lieu of the definition specified in·section (c). The Executive Officer shall approve the alternate definition upon the manufacturer providing data or analysis demonstrating that the alternate definition provides for equivalent robustness in detection of fuel system faults that vary in severity depending on engine speed. load. and/or warm-up status.

(F) Extinguishing the MIL. The MIL may be extinguished after three sequential driving cycles in which similar conditions have been encountered without a malfunction of the fuel system.

(2) ***MISFIRE MONITORING***

(2.1) Requirement:

(2.1.1) The aBO system shall monitor the engine for misfire causing excess emissions. The aBO system shall be capable of detecting misfire occurring in one or more cylinders. To the extent possible without adding hardware for this specific purpose, the aBO system shall also identify the specific misfiring cylinder.

(2.1.2) If more than one cylinder is continuously misfiring, a separate fault code shall be stored indicating that multiple cylinders are misfiring. When identifying multiple cylinder misfire, the manufacturer aBO system is not required to also identify each of the continuously misfiring cylinders individually through separate fault codes.

(2.2) Malfunction Criteria:

(2.2.1) The OBD system shall detect a misfire malfunction when one or more cylinders are continuously misfiring.

(2.2.2) Additionally, for 2013 and subsequent model year engines equipped with sensors that can detect combustion or combustion quality (e.g., for use in homogeneous charge compression ignition (HCCI) control systems), the OBO system shall detect a misfire malfunction causing the engine's NMHC, CO, or NOx emissions to exceed 2.0 times the applicable standards or the engine's PM emissions to exceed the applicable standard plus 0.02 g/bhp-hr.

(A) Manufacturers shall determine the percentage Of misfire evaluated in 1000 revolution increments that would cause NMHC, CO, or NOx emissions from an emission durability demonstration engine to exceed 2.0 times any of the applicable standards or PM emissions to exceed the applicable standard plus 0.02 g/bhp-hr if the percentage of misfire were present from the beginning of the test. To establish this percentage of misfire, the manufacturer shall utilize misfire events occurring at equally spaced, complete engine cycle intervals, across randomly selected cylinders throughout each 1ODD-revolution increment. If this percentage of misfire is determined to be lower than one percent, the manufacturer may set the malfunction criteria at one percent.

(B) Subject to Executive Officer approval, a manufacturer may employ other revolution increments. The Executive Officer shall grant approval upon determining that the manufacturer has demonstrated that the strategy would be equally effective and timely in detecting misfire.

(2.2.3) A malfunction shall be detected if the percentage of misfire established in section (e){2.2.2){A) is exceeded regardless of the pattern of misfire events (e.g., random, equally spaced, continuous).

(2.2.4) For multiple cylinder misfire situations that result in a misfire rate greater than or equal to 50 percent, the OBO system shall only be required to detect a misfire malfunction for situations that are caused bva single component failure.

(2.3) Monitoring Conditions:

(2.3.1) The OBD system shall monitor for misfire during engine idle conditions at least once"per driving cycle in which the monitoring conditions for misfire are met. A manufacturer shall submit monitoring conditions to the Executive Officer for approval. The Executive Officer shall approve manufacturer-defined monitoring conditions that are determined (based on manufacturer-submitted data and/or other engineering documentation) to: (i) be technically necessary to ensure robust detection of malfunctions (e.g., avoid false passes and false detection of malfunctions), (ii) require no more than 1000 cumulative engine revolutions, and (iii) do not require any single continuous idle.operation of more than 15 seconds to make a determination that.a malfunction is present (e.g., a decision can be made with data gathered during several idle operations of 15 seconds or less);

or satisfy the requirements of (d)(3.1) with alternative engine operating conditions.

(2.3.2) Manufacturers may request Executive Officer approval to use alternate monitoring conditions (e.g., off-idle). The Executive Officer shall approve alternate monitoring conditions that are determined (based on manufacturer-submitted data and/or other engineering documentation) to ensure equivalent robust detection of malfunctions and equivalent timeliness in detection of malfunctions.

(2.3.3) Additionally, for 2013 and subsequent model year engines equipped with sensors that can detect combustion or combustion quality:

(A) The OBO system shall continuously monitor for misfire under all positive torque engine speeds and load conditions.

(B) If a monitoring system cannot detect all misfire patterns under all required engine speed and load conditions as required in section (e)(2.3.~~2~~3)(A), the manufacturer may request Executive Officer approval to accept the monitoring system. In evaluating the manufacturer's request, the . Executive Officer shall consider the following factors: the magnitude of the region(s) in which misfire detection is limited, the degree to which misfire detection is limited in the region(s) (Le., the probability of detection of misfire events), the frequency with which said region(s) are expected to be encountered in-use, the type of misfire patterns for which misfire detection is troublesome, and demonstration that the monitoring technology employed is not inherently incapable of detecting misfire under required conditions (Le., compliance can be achieved on other engines). The evaluation shall be based on the following misfire patterns: equally spaced misfire occurring on randomly selected cylinders, single cylinder continuous misfire, and paired cylinder (cylinders firing at the same crank angle) continuous misfire.

(2.4) MIL Illumination and Fault Code Storage:

(2.4.1) General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(2.4.2) Additionally, for 2013 and subsequent model year engines equipped with sensors that can detect combustion or combustion quality:

(A) Upon detection of the percentage of misfire specified in section (e)(2.2.2)(A), the following criteria shall apply for MIL illumination and fault code storage:

(i) A pending fault code shall be stored no later than after the fourth exceedance o.f the percentage of misfire specified in section (e)(2.2.2) during a single driving cycle.

(ii) If a pending fault code is stored, the OBO system shalf illuminate the MIL and store a confirmed/MIL-on fault code within 10 seconds if the percentage of misfire specified in section (e)(2.2.2) is again exceeded four times during: (a) the driving cycle immediately following the storage of the pending fault code, regardless of the conditions encountered during the driving cycle; or (b) on the next driving cycle in which similar conditions (see section (c)) to the engine conditions that occurred when the pending fault code was stored are encountered.

(iii) The pending 'fault code may be erased at the end of the next driving cycle in which similar conditions to the engine conditions that occurred when the pending fault code was stored have been encountered without an exceedance of the specified percentage of misfire. The pending code may also be erased if similar conditions are not encountered during the next 80 driving cycles immediately following initial detection of the malfunction.

(B) Storage of freeze frame conditions.

(i) The OBO system shall store and erase freeze frame conditions either in conjunction with storing and erasing a pending fault code orin conjunction with storing a confirmed/MIL-on fault code and erasing a confirmed/previously MIL-on fault code.

(ii) If freeze frame conditions are stored for a malfunction other than a misfire malfunction'when a fault code is stored as specified in section (e)(2.4.2), the stored freeze frame information shall be replaced with freeze frame information regarding the misfire malfunction. .

(C) Storage of misfire conditions for similar conditions determination. Upon detection of misfire under section (e)(2.4.2), the OBO system shall store the following engine conditions: engine speed, load, and warm-up status of the first misfire event that resulted in the storage of the pending fault code.

(D) Extinguishing the MIL. The MIL may be extinguished after three sequential driving cycles in which similar conditions have been encountered without an exceedance of the specified percentage of misfire.

(3) ***EXHAUST GAS RECIRCULATION*** *(EGR)* ***SYSTEM MONITORING***

(3.1) Requirement:

(3.1.n The aBO system shall monitor the EGR system on engines so-equipped for low flow rate, high flow rate, and slow response malfunctions. For engines equipped with EGR coolers (e.g., heat exchangers), the OBO system shall monitor the cooler system for insufficient cooling malfunctions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the EGR system shall be monitored in accordance with the comprehensive component requirements in section (g)(3).

(3.1.2) For engines with other charge control strategies that affect EGR flow (e.g., systems that modify EGR flow to achieve a desired fresh air flow rate instead of a desired EGR flow rate), the manufacturer shall submit a monitoring plan to the Executive Officer for approval. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and an engineering evaluation that demonstrate that the monitoring plan is as reliable and effective as the monitoring plan required for EGR systems under section *(e)(3).*

(3.2) Malfunction Criteria:

(3.2.1) Low Flow: The OBO system shall detect a malfunction of the EGR system prior to a decrease from the manufacturer's specified EGR flow rate that would cause an engine's NMHC, CO, or NOx emissions to exceed 2.0

times any of the applicable standards or the engine's PM emissions to exceed the applicable standard plus 0.02 g/bhp-hr. For engines in which no failure or deterioration of the EGR system that causes a decrease in flow could result in an engine's emissions exceeding these levels, the aBO system shall detect a malfunction when either the EGR system has reached its control limits such that it cannot increase EGR flow to achieve the commanded flow rate or, for non-feedback controlled EGR systems, the EGR system has no detectable amount of EGR flow when EGR flow is expected.

(3.2.2) High Flow: The aBO system shall detect a malfunction of the EGR system, including·a leaking EGR valve (Le., exhaust gas flOWing through the valve when the valve is commanded closed), prior to an increase from the manufacturer's specified EGR flow rate that would cause an engine's NMHC, CO, or NOx emissions to exceed 2.0 times any of the applicable standards or the engine's PM emissions to exceed the applicable standard plus 0.02 g/bhp-hr. For engines in which no failure or deterioration of the EGR system that causes an increase in flow could result in an engine's emissions exceeding these levels, the aBO system shall detect a malfunction when either the EGR system has reached its control limits such that it cannot reduce EGR flow to achieve the commanded flow rate or, for non-feedback controlled EGR systems, the EGR system has maximum detectable EGR flow when little or no EGR flow is expected.

(3.2.3) Slow Response: The aBO system shall detect a malfunction of the EGR system prior to any failure or deterioration in the capability of the EGR system response (e.g., capability to achieve the com'mandedspecified flow rate within a manufacturer-specified time) that would cause an engine's NMHC, CO, or NOx emissions to exceed 2.0 times any of the applicable standards or the engine's PM emissions to exceed the applicable standard plus 0.02 g/bhp-hr. The aBO system shall monitor both the capability of the EGR system response under both increasing and decreasing EGR flow ratesto respond to a commanded/expected increase in flow and the capability of the EGR system to respond to a commanded decrease in flow. For engines in which no failure or deterioration of the EGR system response could result in an engine's emissions exceeding these levels, the aBO system shall detect a malfunction of the EGR system when no detectable response to a change in commanded or expected flow rate occurs.

(3.2.4) Feedback control: Except as provided for in section (e)(3.2.6), if the engine is equipped with feedback or feed-forward control of the EGR system (e.g., feedback control of flow, valve position, pressure differential across the valve via intake throttle or exhaust backpressure), the aBO system shall detect a malfunction:

(A) If the system fails to begin feedbacl{ control within a manufacturer specified time interval;

(B) If a failure or deterioration causes open loop or default operation; or

(C) If feedback the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the target. .

(3.2.5) EGR Cooler Performance: The OBD system shall detect a malfunction of the EGR cooler system cooler prior to a reduction from the manufacturer's specified cooling performance that would cause. an engine's NMHC, CO, or NOx emissions to exceed 2.0 times any of the applicable standards or the engine's PM emissions to exceed the applicable standard plus 0.02 g/bhp-hr. For engines in which no failure or deterioration of the EGR cooler system cooler could result in an engine's emissions exceeding these levels, the OBO system shall detect a malfunction when the system has no detectable amount of EGR cooling.

(3.2.6) EGR Catalyst Performance: For catalysts located in the EGR system on 2013 and subsequent model year engines and used to convert constituents to reduce emissions or protect or extend the durability of other emission-related components (e.g., to reduce fouling of an EGR cooler or valve), theOSD system shall detect a malfunction when the catalyst has no detectable amount of constituent (e.g., hydrocarbons, soluble organic fractions) oxidation.

(3.2.6)(3.2.7) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (e)(3.2.4)(C) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on an engine with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(3.2.7)(3.2.8) In lieu of detecting the malfunctions specified in sections (e)(3.2.4)(A) and (B) with an EGR system-specific monitor, the OBD system may monitor the individual parameters,or components that are used as inputs for EGR system feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (e)(3.2.4)(A) and (B).

(3.2.9) For purposes of determining the EGR cooler performance malfunction criteria in section (e)(3.2.5) for EGR cooler systems that consist of more than one cooler (e.g., a pre-cooler arid a main cooler, two or more coolers in series), the manufacturer shall submit an EGR cooler system aging and monitoring plan to the Executive Officer for review and approval. The plan shall include the description and location of each component. the monitoring strategy for each component and combination of components, and the method for determining the malfunction criteria of section (e)(3.2.5) including the deterioration/aging process. Executive Officer approval of the plan shall be based on the representativeness of the aging to real world EGR cooler system component deterioration under normal and malfunctioning engine operating conditions and the effectiveness of the method used to determine the malfunction criteria of section (e)(3.2.5).

(3.3) Monitoring Conditions:

(3.3.1) Except as provided in section (e)(3.3.4), Tthe OBO system shall monitor continuously for malfunctions identified in sections (e)(3.2.1), (3.2.2), and (e)(3.2.4) (Le., EGR low and high flow, feedback control).

(3.3.2) Manufacturers shall define the monitoring conditions for malfunctions identified in section (e)(3.2.3) (Le., slow response) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in section (e)(3.2.3) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2). "

(3.3.3) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (e)(3.2.5) and (e)(3.2.6) (Le., cooler performance and EGR catalyst performance) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as req"uired in section (d)(3.2.1), all monitors used to detect malfunctions identified in section (e)(3.2.5) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(3.3.4) Manufacturers may request Executive Officer approval to temporarily disable the EGR system checkcontinuous monitoring, under specific conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions (e.g., disable EGR low flow monitoring when no or very little flow is commanded, disable EGR high and low flow monitoring when freezing may affect performance of the system). The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a reliable checl< cannot be made ~~when~~ these conditions exist properly operating EGR system cannot be distinguished from a malfunctioning EGR system and that the disablement interval is limited only to that which is technically necessary.

(3.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(4) BOOST PRESSURE CONTROL SYSTEM MONITORING

(4.1) Requirement: .

(4.1.1) The OBO system shall monitor the boost pressure control system (e.g., turbocharger) on engines so-equipped for under and over boost" malfunctions and slow response malfunctions. For engines equipped with variable geometry turbochargers (VGT), the aBO system shall monitor the VGT system for ~~slow~~ response malfunctions. For engines equipped with charge air cooler systems, the OBO system shall monitor the charge air cooler system for cooling system performance malfunctions. The individual electronic components (e.g., actuators, valves, sensors) that are . used in the boost pressure control system shall be monitored in accordance with the comprehensive component requirements in section (g)(3).

(4.1.2) For engines with other charge control strategies that affect boost pressure (e.g., systems that modify boost pressure to achieve a desired air-fuel ratio instead of a desired boost pressure), the manufacturer shall submit a monitoring plan to the Executive Officer for approval. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and an engineering evaluation that demonstrate that the monitoring plan is as reliable and effective as the monitoring plan required for boost pressure control systems under section (e)(4).

(4.2) Malfunction Criteria:

(4.2.1) Underboost: The aBO system shall detect a malfunction of the boost pressure control system prior to a decrease from the manufacturer's commanded or expected boost pressure that would cause an engine's NMHC, CO, or NOx emissions to exceed 2.0 times any of the" applicable standards or the engine's PM emissions to exceed the applicable standard plus 0.02 g/bhp-hr. For engines in which no failure or deterioration of the boost pressure control system that causes a decrease in boost could result in an engine's emissions exceeding these levels, the aBO system shall detect a malfunction when either the boost system has reached its control limits such that it cannot increase boost to achieve the commanded boost pressure or, for non-feedback controlled boost systems, the boost system has no detectable "amount of boost when boost is expected.

(4.2.2) Overboost: The aBO system shall detect a malfunction of the boost pressure control system prior to an increase from the manufacturer's commanded or expected boost pressure that would cause an engine's NMHC, CO, or NOx emissions to exceed 2.0 times any of the applicable standards or the engine's PM emissions to exceed the applicable standard plus 0.02 g/bhp-hr. For engines in which no failure or deterioration of the boost pressure control system that causes an increase in boost could result in an engine's emissions exceeding these levels, the aBO system shall detect a malfunction when either the boost system has" reached its control limits such that it cannot decrease boost to achieve the commanded boost pressure or, for non-feedback controlled boost systems, the boost system has maximum detectable boost when little or no boost is expected.

(4.2.3) VGT sSlow response:

(A) For 2010 through 2012 model year engines equipped with variable geometry turbochargers (VGT), Tthe aBO system shall detect a malfunction prior to any failure or deterioration in the capability of the VGT system to achieve the commanded turbocharger geometry within a manufacturer-specified time that would cause an engine's NMHC, CO, or NOx emissions to exceed 2.0 times any of the applicable standards or the engine's PM emissions to exceed the" applicable standard plus 0;02 g/bhp-hr. For engines in which rio failure or deterioration of the VGT system response could result in an engine's emissions exceeding these levels, the aBO system shall detect a malfunction of the VGT system when proper functionalno detectable response of the system to computer a change in commandsed turbocharger geometry does not occurs.

(B) For 2013 and subsequent model year engines, the OBO system shall detect a malfunction prior to any failure or deterioration in the boost pressure control system response (e.g., capability to achieve the commanded or expected boost pressure within a manufacturer-specified time) that would cause an engine's NMHC, CO, or NOx emissions to exceed 2.0 times anyof the applicable standards or the engine's PM emissions to exceed the applicable standard plus 0.02 g/bhp-hr. For engines in which no failure or deterioration of the boost system response could result in an engine's emissions exceeding these levels, the OBO-system shall detect a malfunction of the boost system when' no detectable response to a commanded or expected change in boost pressure occurs.

(4.2.4) Charge Air Undercooling: The OBO system shall detect a malfunction of the charge air cooling system prior to a decrease from the manufacturer's specified cooling rate that would cause an engine's NMHC, CO, or NOx emissions to exceed 2.0 times any of the applicable standards or the engine's PM emissions to exceed the applicable standard plus 0.02 g/bhp-hr. For engines in which no failure or deterioration of the charge air cooling system that causes a decrease in cooling performance could result in an engine's emissions exceeding these levels, the OBO system shall detect a malfunction when the system has no detectable amount of charge air cooling.

(4.2.5) Feedback control: Except as provided for in section (e)(4.2.6), if the engine is equipped with feedback or feed-forward control of the boost pressure system (e.g., control of ~~VGT~~ variable geometry turbocharger position, turbine speed, manifold pressure) the OBO system shall detect a malfunction:

(A) If the system fails to begin feedback control within a manufacturer specified time interval;

(B) If a failure or deterioration causes open loop or default operation; or

(C) If feedback the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the target.

(4.2.6) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (e)(4.2.5)(C) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on an engine with all emission' controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(4.2.7) In lieu of detecting the malfunctions specified in sections (e)(4.2.5)(A) and (B) with a boost pressure system":specific monitor, the OBO system may monitor the individual parameters or components that are used as inputs for boost pressure system feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (e){4.2.5){A) and (B).

(4.2.8) For purposes of determining the charge air cooling performance malfunction criteria in section (e)(4.2.4) for charge air cooling systems that consist of more than one cooler (e.g., a pre-cooler and a main cooler, two or more coolers in series), the manufacturer shall submit a charge air cooling system aging and monitoring plan to the Executive Officer for review and approval. The plan shall include the description and location of each component, the monitoring strategy for each component and combination of components, and the method for determining the malfunction criteria of section (e)(4.2.4) including the deterioration/aging process. Executive Officer approval of the plan shall be based on the representativeness of the aging to real world charge air cooling system component deterioration under normal and malfunctioning engine operating conditions and the effectiveness of the method used to determine the malfunction criteria of section (e)(4.2.4).

(4.3) Monitoring Conditions:

(4.3.1) Except as provided in section (e)(4.3.4), ~~T~~the OBD system shall monitor continuously for malfunctions identified in sections {e){4.2.1),(4.2.2), and (4.2.5) (Le., over and under boost, feedback control).

(4.3.2) Manufacturers shall define the monitoring conditions for malfunctions identified in section (e){4.2.3) (Le., ~~VGT~~ slow response) in accordance with sections (d){3.1) and (d){3.2) (Le., minimum ratio requirements), with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d){3.1.2). For purposes of tracking and reporting as required in section (d){3.2.1), all monitors used to detect malfunctions identified in section (e){4.2.3) shall be tracked separately but reported as a single set of values as specified in section (d){5.2.2).

(4.3.3) Manufacturers shall define the monitoring conditions for malfunctions identified in section (e){4.2.4) (Le., charge air cooler performance) in accordance with sections (d){3.1) and (d){3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d){3.2.1), all monitors used to detect malfunctions identified in section (e){4.2.4) shall be tracked separately but reported as a single set of values as specified in section (d){5.2.2).

(4.3.4) Manufacturers may request Executive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions (e.g., disable monitoring of underboost when commanded or expected boost pressure is very low). The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating system cannot be distinguished from a malfunctioning system and that the disablement interval is limited only to that which is technically necessary.

(4.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d){2).

(5) NON-METHANE HYDROCARBON (NMHC) CONVERTING CATALYST **MONITORING**

(5.1) Requirement: The aBO system shall monitor the NMHC converting catalyst(s) for proper NMHC conversion capability. For'engines equipped with catalyzed PM filters that convert NMHC emissions, the catalyst function of the PM filter shall be monitored in accordance with the PM filter requirements in section (e)(8).

(5.2) Malfunction Criteria:

(5.2.1) For purposes of section (e)(5), each catalyst in a series configuration that converts NMHC shall be monitored either individually or in combination with others.

(5.2.2) Conversion Efficfency:

(A) For 2010 through 2012 model year engines, ~~T~~the aBO system shall detect an NMHC catalyst malfunction when the catalyst conversion capability decreases to the point that NMHC emissions exceed 2.0 times any of the applicable standards.

(B) For 2013 and subsequent model year engines, the aBO system shall detect an NMHC catalyst malfunction when the catalyst conversion capability decreases to the point that NMHC emissions exceed 2.0 times any of the applicable standards or NOx emissions exceed any of the applicable standards by more than 0.2 g/bhp-hr (e.g., cause emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr).

~~(B)~~(C) If no failure or deterioration of the catalyst NMHC conversion capability could result in an engine's NMHC or NOx emissions exceeding 2.0 times any of the applicable standardsmalfunction criteria of section (e)(5.2.2), the aBO system shall detect a malfunction when the catalyst has no detectable amount of NMHC or NOx conversion capability.

(5.2.3) Other Aftertreatment Assistance Functions:

(A) For catalysts used to generate an exotherm to assist PM filter regeneration, the aBO system shall detect a malfunction when the catalyst is unable to generate a sufficient exotherm .to achieve regeneration of the PM filter.

(B) For 2013 and subsequent model year engines, ~~F~~for catalysts used to generate a feedgas constituency to assist SCR systems (e.g., to increase N02 concentration upstream of an SCR system), the aBO system shall detect a malfunction when the catalyst is unable to generate the necessary feedgas constituents for proper SCR system operation.

(C) For catalysts located downstream of a PM filter and used to convert NMHC emissions during PM filter regeneration, the aBO system shall detect a malfunction when the catalyst has no detectable amount of NMHC conversion capability.

(D) For catalysts located downstream of an SCR system (e.g., to prevent ammonia slip), the OBD system shall detect a malfunction when the catalyst has no detectable amount of NMHC, CO, NOx, Of PM conversion capability. Monitoring of the catalyst is not required if there is no measurable emission impact on the criteria pollutants (Le., NMHC, CO, NOx, and PM) during any reasonable driving condition where the catalyst is most likely to affect criteria pollutants (e.g., during conditions most likely to result in ammonia generation or excessive reductant delivery).

(5.2.4) Catalyst System Aging and Monitoring

(A) For purposes of determining the catalyst malfunction criteria in sections (e)(5.2.2) and (5.2.3) for individually monitored catalysts, the manufacturer shall use a catalyst deteriorated to the malfunction criteria using methods established by the manufacturer to represent real world catalyst deterioration under normal and malfunctioning engine operating conditions. If the catalyst system contains catalysts in parallel (e.g., a two bank exhaust system where each bank has its own catalyst), the malfunction criteria shall be determined with the "parallel" catalysts equally deteriorated.

(8) For purposes of determining the catalyst malfunction criteria in sections *(e)(5.2.2)* and (5.2.3) for catalysts monitored in combination with others, the manufacturer shall submit a catalyst system aging and monitoring plan to the Executive Officer for review and approval. The plan shall include the description, emission control purpose, and location of each component, the monitoring strategy for each component and/or combination of components, and the method for determining the malfunction criteria of sections *(e)(5.2.2)* and (5.2.3) including the deterioration/aging process. If the catalyst system contains catalysts in parallel (e.g., a two bank exhaust system where each bank has its own catalyst), the malfunction criteria shall be determined with the "parallel" catalysts equally deteriorated. Executive Officer approval of the plan shall be based on the representativeness of the aging to real world catalyst system component deterioration under normal and malfunctioning engine operating conditions, the effectiveness of the method used to determine the malfunction criteria of section *(e)(5.2),* the ability of the component monitor(s) to pinpoint the likely area of malfun.ction and ensure the correct components are repairedlreplaced in-use, and the ability of the componentmonitor(s) to accurately verify that each catalyst component is functioning as designed and as required in sections *(e)(5.2.2)* and (5.2.3).

(5.3) Monitoring Conditions:

(5.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in sections *(e)(5.2.2)* and (5.2.3) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in sections *(e)(5.2.2)* and (5.2.3) shall be tracked separately but reported as ,a single set of values as specified in section (d)(5.2.2). .

(5.4) MIL Illumination and Fault Code Storage:

(5.4.1) General requirements for MIL illumination and fault code storage are set forth in section (d)(2). .

(5.4.2) The monitoring method for the catalyst(s) shall be capable of detecting all instances, except diagnostic self-clearing, when a catalyst fauJt code has been cleared but the catalyst has not been replaced (e.g., catalyst' overtemperature histogram approaches are not acceptable).

(6) *OXIDES·* OF ***NITROGEN** (NOx)* ***CONVERTING CATALYST MONITORING***

(6.1) Requirement: The 0!30 system shall monitor the NOx converting catalyst(s) for proper conversion capability. For engines equipped with selective catalytic reduction (SCR) systems or other catalyst systems that utilize an activelintrusive reductant injection (e.g., active lean NOx catalysts utilizing diesel fuel injection), 'the OBO system shall monitor the SCR or active/intrusive reductant injection system for proper performance. The individual electronic components (e.g., actuators, valves, sensors, heaters, pumps) in the SCR or activelintrusive reductant injection system shall be monitored in accordance with the comprehensive component requirements in section (g)(3).

(6.2) Malfunction Criteria: For purposes of section *(e)(6),* each catalyst in a series configuration that converts NOx shall be monitored either individually or in combination with others.

(6.2.1) Conversion Efficiency:

(A) For 2010 through 2012 model year engines:

(i) The OBO system shall detect a catalyst malfunction when the catalyst conversion capability decreases to the point that would cause an engine's NOx emissions to exceed any of the applicable standards by more than 0.~~3~~4 g/bhp-hr (e.g., cause emissions to exceed 0.~~5~~6 g/bhp-hr if the emission standard is 0.2 glbhp-hr) as measured from an applicable cycle emission test (Le., FTP or SET).

(ii) If no failure or deterioration of the catalyst NOx conversion capability could result in an engine's NOx emissions exceeding any of the applicable standards by more than 0.~~3~~4 g/bhp-hr, theOBO system shall detect a malfunction when the catalyst has no detectable amount of NOx conversion capability.

(B) For 2013 and subsequent model year engines:

(i) The OBO system shall detect a catalyst malfunction when the catalyst conversion capability decreases to the point that would cause an engine's ~~NOx~~ emissions to exceed any of the applicable NOx standards by more than 0.2 g/bhp-hr (e.g., cause emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 2.0 times the applicable NMHC standard.

(ii) If no failure or deterioration of the 'catalyst system NOx conversion capability could result in an engine's NOx or NMHC emissions exceeding any of the applicable standards by more than 0.2 g/bhp hr the applicable malfunction criteria of section (e)(6.2.1)(B)(i), the OBO system shall detect a malfunction when the catalyst has no detectable amount of NOx or NMHC conversion capability.

(6.2.2) Selective Catalytic Reduction (SCR) or Other Active/Intrusive Reductant Injection System Performance:

(A) Reductant Delivery Performance:

(i) For 2010 through 2012 model year engines, the OBO system shall detect a malfunction prior to any failure or deterioration of the system to properly regulate reductant delivery (e.g., urea injection, separate injector fuel injection, post injection of fuel, air assisted injection/mixing) that would cause an engine's NOx emissions to exceed any of the applicable standards by more than 0.~~3~~4 g/bhp-hr (e.g., cause emissions to exceed 0.~~5~~6 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test (Le., FTP or SET). If no failure or deterioration of the SCR system could result in an engine's NOx emissions exceeding any of the applicable standards by more than 0.~~3~~4 g/bhp-hr, the OBO system shall detect a malfunction when the system has reached its control limits such that it is no longer able to deliver the desired quantity of reductant.

(ii) For 2013 and subsequent model year engines, the OBO system shall detect a system malfunction prior to any failure or deterioration of the 'system to properly regulate reductant delivery (e.g., urea injection, separate injector fuel injection, post injection of fuel, air assisted injection/mixing) that would cause an engine's ~~NOx~~ emissions to exceed any of the applicable NOx standards by more than 0.2 g/bhp-hr (e.g., cause emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 2.0 times the applicable NMHC standard. If no failure or deterioration of the SCR system could result in an engine's NOx or NMHC emissions exceeding the applicable standards by more than 0.2 g/bhp hr applicable malfunction criteria above, the OBO system shall detect a malfunction when the system has reached its control limits such that it is no longer able to deliver the desired quantity of reductant.

(B) If the catalyst system uses a reductant other than the fuel used for the engine or uses a reservoir/tank for the reductant that is separate from the fuel tank used for the engine, the OBO system shall detect a malfunction when there is no longer sufficient reductant available to properly operate the reductant system (e.g., the reductant tank is empty).

(C) If the catalyst system uses a reservoir/tank for the reductant that is separate from the fuel tank used for the engine, the OBO system shall detect a malfunction when an improper reductant is used in the reductant reservoir/tank (e.g., the reductant tank is filled with something other than the reductant).

(0) Feedback control: Except as provided for in section (e)(6.2.2)(E), if the engine is equipped with feedback or feed-forward control of the reductant injection, the OBO system shall detect a malfunction:

(i) If the system fails to begin feedback control within a manufacturer specified time interval;

(ii) If a failure or deterioration causes open loop or default operation;' or

(iii) If the feedback control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the target.

(E) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (e)(6.2.2)(0)(iii) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly o"perating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on an engine with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(F) In lieu of detecting the malfunctions specified in sections (e)(6.2.2)(O)(i) and (ii) with a reductant injection system-specific monitor, the OBO system may monitor the individual parameters or components that are used as inputs for reductant injection feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (e)(6.2.2)(O)(i) and (ii).

(6.2.3) Catalyst System Aging and Monitoring

(A) For purposes of determining the catalyst malfunction criteria in section (e)(6.2.1) for individually monitored catalysts, the manufacturer shall use a catalyst deteriorated to the malfunction criteria using methods established by the manufacturer to represent real world catalyst deterioration under normal and malfunctioning engine operating conditions. If the. catalyst system contains catalysts in parallel (e.g., a two bank exhaust system where each bank has its own catalyst), the malfunction criteria shall be determined with the "parallel" catalysts equally deteriorated.

(B) For purposes of determining the catalyst malfunction criteria in section (e)(6.2.1) for catalysts monitored in combination with others, the manufacturer shall submit a catalyst system aging and monitoring plan to the Executive Officer for review and approval. The plan shall include the description, emission control purpose, and location of each component, the monitoring strategy for each cOITIPonent and/or combination of components, and the method for determining the malfunction criteria of section (e)(6.2.1) including the deterioration/aging process". If the catalyst system contains catalysts in parallel (e.go, a two bank exhaust system where each bankohas its own catalyst), the malfunction criteria shall be determined with the "parallel" catalysts equally deteriorated. Executive Officer approval of the plan shall be based on the representativeness of the aging to real world catalystsystem component deterioration under normal and malfunctioning engine operating conditions, the effectiveness of the method used to determine the malfunction criteria of section (e)(6.2.1), the ability of the component monitor(s)'to pinpoint the likely area of malfunction and ensure the correct components are repaired/replaced in-use, and the ability of the component monitor(s) to accurately verify that each catalyst component is functioning as designed and as required in section (e)(6.2.1).

(6.3) Monitoring Conditions:

(6.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (e)(6.2.1) and (e)(6.2.2)(C) (Le., catalyst efficiency, improper reductant) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in section (e)(6.2.1) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(6.3.2) Except as provided in section (e)(6.3.3), Tthe OBO system shall monitor continuously for malfunctions identified in sections (e)(6.2.2)(A), (B), and (D) (e.g., SCR performance, insufficient reductant, feedback control).

(6.3.3) Manufacturers may request Executive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating system cannot be distinguished from a malfunctioning system and that the disablement interval 'is limited only to that which is technically necessary.

(6.4) MIL Illumination and Fault Code Storage:

(6.4.1) Except as provided below for reductant faults, general requirements for MIL illumination and fault code storage are set forth'in section (d)(2).

(6.4.2) If the OBO system is capable of discerning that a system fault is being caused by a empty reductant tank:

(A) The manufacturer may request Executive Officer approval to delay illumination of the MIL if the vehicle is equipped with an alternative indicator for notifying the vehicle operator of the malfunction. The Executive Officer shall approve the request upon determining the alternative indicator is of sufficient illumination and location to be readily visible under all lighting conditions and provides equivalent assurance that a vehicle operator will be promptly notified and that corrective action will be undertaken.

(B) If the vehicle is not equipped with an alternative indicator and the MIL illuminates, the MIL may be immediately extinguished and the corresponding fault codes erased once the OBO system has verified that the reductant tank has been properly refilled and the MIL has not been illuminated for any other type of malfunction.

(C) The Executive Officer may approve other strategies that provide equivalent assurance that a vehicle operator will be promptly notified and that corrective action will be undertaken.

(6.4.3) The monitoring method for the catalyst(s) shall be capable of detecting all instances, except diagnostic self-clearing, when a catalyst fault code has been cleared but the catalyst has not been replaced (e.g., catalyst overtemperature histogram approaches are not acceptable).

(7) ***NOx ADSORBER MONITORING***

(7.1) Requirement: The OBO system shall monitor the NOx adsorber(s) on engines so-equipped for proper performance. For engines equipped with active/intrusive injection (e.g., in-exhaust fuel and/or air injection) to achieve desorption of the NOx adsorber(s), the OBO system shall moriitor the active/intrusive injection system for proper performance. The individual electronic components (e.g., injectors, valves, sensors) that are used in the active/intrusive injection system shall be monitored in accordance with the comprehensive component requirements in section (g)(3).

(7.2) Malfunction Criteria:

(7.2.1) NOx adsorber capability:

(A) For 2010 through 2012 model year engines, the OBO system shall detect a NOx adsorber system malfunction when the NOx adsorber system capability decreases to the point that would cause an engine's NOx emissions to exceed any of the applicable standards by more than 0.3 g/bhp-hr (e.g., cause emissions to exceed 0.5 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test (Le., FTP or SET). If no failure or deterioration of the NOx adsorber system capability could result in an engine's NOx emissions exceeding any of the applicable standards by more than 0.3 g/bhp-hr, the OBO system shall detect a malfunction when the system has no detectable amount of NOx adsorber capability.

(B) For 2013 and subsequent model year engines, the OBO system shall detect a NOx adsorber system malfunction when the NOx adsorber capability decreases to the point that would cause an engine's ~~NOx~~ emissions to exceed any of the applicable NOx standards by more than 0.2 g/bhp-hr (e.g., cause emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 glbhp-hr) as measured from an applicable cycle emission test (Le., FTP or SET) or 2.0 times the applicable NMHC standard. If no failure or deterioration of the NOx adsorber capability could result in an engine's NOx or NMHC emissions exceeding the applicable malfunction criteria aboveany of the applicable standards by more than 0.2 g/bhp hr, the OBO system shall detect a malfunction when the system has no detectable amount of NOx adsorber capability.

(7.2.2) For systems that utilize. active/intrusive injection (e.g., in-cylinder post fuel injection, in-exhaust air-assisted fuel injection) to achieve desorption of the NOx adsorber, the OBO system shall detect a malfunction if any failure or deterioration of the injection system's ability to properly regulate injection causes the system to be unable to achieve desorption of the NOx adsorber.

(7.2.3) Feedback control: Except as provided for in section *(e)(7.2.4),* if the engine is equipped with feedback or feed-forward control of the NOx adsorber or active/intrusive injection system (e.g., feedback control of injection quantity, time), the OBO system shall detect a malfunction:

(A) If the system fails to begin feedback control within a.manufacturer specified time interval;

(B) If a failure or deterioration causes open loop or default operation; or

(C) If feedback the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the target.

(7.2.4) A manufacturer may request Executive Officer approval to temporarily disable monitoring ·for the malfunction criteria specified in sectiqn (e)(7.2.3)(C) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on an engine with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(7.2.5) In lieu of detecting the malfunctions specified in sections (e)(7.2.3)(A) and (B) with a NOx adsorber-specific monitor, the OBD system may monitor the individual parameters or components that ·are used as inputs for NOx adsorber or active/intrusive injection system feedback control provided thatthe monitors detect all malfunctions that meet the criteria in sections (e)(7.2.3)(A) and (B).

(7.2.6) For purposes of determining the NOx adsorber system malfunction criteria in section (e)(7.2.1) for NOx adsorber systems that consist of more than one NOx adsorber (e.g., two or more adsorbers in series), the manufacturer shall submit a system aging and monitoring plan to the Executive Officer for review and approval. The plan shall include the description and location of each component, the monitoring strategy for each component and/or combination of components, and the method for determining the malfunction criteria of section (e)(7.2.1) including the deterioration/aging process. Executive Officer approval of the plan shall be based on the representativeness of the aging to real world NOx adsorber system component deterioration under normal and malfunctioning engine operating conditions, the effectiveness of the method used to determine the malfunction criteria of section *(e)(7.2.1*), the ability of the component monitor(s) to pinpoint the likely area of malfunction and ensure the correct components are repaired/replaced in-use, and the ability of the component.monitor(s) to accurately verify that each NOxadsorber system component is functioning as designed and as required in section *(e)(7.2.1*).

(7.3) Monitoring Conditions:

(7.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in sections *(e)(7.2.1)* (Le., adsorber capability) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect'malfunctions identified in sections (e)(7.2.1) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(7.3.2) Except as provided in section *(e)(7.3.3),* ~~T~~the OBD system shall monitor continuously for malfunctions identified in sections *(e)(7.2.2)* and (7.2.3) (e.g., injection function, feedback control). .

(7.3.3) Manufacturers may request Executive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating system cannot be distinguished from a malfunctioning system and that the disablement interval is limited only to that which is technically necessary.

(7.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(8) PARTICULATE MAITER (PM) FILTER MONITORING

(8.1) Requirement: The OBO system shall monitor the PM filter on engines so-equipped for proper performance. For engines equipped with active regeneration systems that utilize an active/intrusive injection (e.g., in-exhaust fuel injection, in-exhaust fuel/air burner), the OBO system shall monitor the active/intrusive injection system for proper performance. The individual electronic components (e.g., injectors, valves, sensors) that are used in the active/intrusive injection system shall be. monitored in accordance with the comprehensive component requirements in section (g)(3).

(8.2) Malfunction Criteria:

(8.2.1) Filtering Performance:

(A) Except as specified in section (e)(8.2.1.)(B) ~~below,~~ fFor2010 through ~~2015~~ 2012 model year engines, the OBO system shall detect a malfunction prior to a decrease in the filtering capability of the PM filter (e.g., cracking) that would cause an engine's PM emissions to exceed either of the following thresholds, whichever is higher: 0.07 g/bhp-hr as measured from an applicable emission test cycle (Le., FTP or SET): or the applicable standard plus 0.06 g/bhp-hr (e.g.. 0.07 g/bhp-hr if the emission standard is 0.01 g/bhp-hr). If no failure or deterioration of the PM filtering performance could result in an engine's PM emissions exceeding these levels, the OBO system shall detect a malfunction when no detectable amount of PM filtering occurs. .

(B) Except as specified in section (e)(8.2.1.)(C) below, for 2013 through 2015 model year engines, the OBO system shall detect a malfunction prior to a decrease in the filtering capability of the PM filter (e.g., cracking) that would cause an engine's PM emissions to exceed either of the following thresholds, whichever is higher: 0.05 g/bhp-hr as measured from an applicable emission test cycle (Le., FTP or SET); or the applicable standard plus 0.04 g/bhp-hr (e.g., 0.05 g/bhp-hr if the emission standard is 0.01 g/bhp-hr). If no failure or deterioration of the PM filtering performance could result in an engine's PM emissions exceeding these levels, the OBO system shall detect a malfunction when no detectable amount of PM filtering occurs.

~~(B)~~(C) For 2013 through 2015 model year engines SUbject to (d)(7.2.2)(A) and for all 2016 and subsequent model year engines, the OBO system shall detect a malfunction prior to a decrease in the filtering capability of the PM filter that would cause an engine's PM emissions to exceed either of the following thresholds, whichever is higher: 0.03 g/bhp-hr as measured from an applicable emission test cycle (Le., FTP or SET); or the applicable standard plus 0.02 g/bhp-hr (e.g., 0.03 g/bhp-hr.if the emission standard is 0.01 g/bhp-hr). If no failure or deterioration of the PM filtering performance could result in an engine's PM emissions exceeding these levels, the OBO system shall detect a malfunction when no detectable amount of PM filtering occurs.

(8.2.2) Frequent Regeneration: The OBO system shall detect a malfunction when the PM filter regeneration occurs more frequencytly increases fromthan (Le., occurs more often than) the manufacturer's specified regeneration frequency to a level such that it would cause an engine's NMHC emissions to exceed the following:

(A) For 2010 through 2012 model year engines, 2.0 times the applicable NMHC standards.:.

(8) For 2013 and subsequent model year engines, 2.0 times the applicable NMHC standards or the applicable NOx standard by more than 0.2g/bhp-hr (e.g.. cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr).

(C) If no failure or deterioration causes an increase in the PM filter regeneration frequency that could result in an engine's NMHC emissions exceeding 2.0 times the applicable standardsthe emission levels specified above, the OBO system shall detect a malfunction when the PM filter regeneration frequency exceeds the manufacturer's specified design limits for allowable regeneration frequency.

(8.2.3) Incomplete regeneration: The OBO system shall detect a regeneration . malfunction when the PM filter does not properly regenerate under manufacturer-defined conditions where regeneration is designed to occur.

(8.2.4) NMHC conversion: For 2013 and subsequent model year engines, Ffor catalyzed PM filters that convert NMHC emissions, the OBO system shall monitor the catalyst function of the PM filter and detect a malfunction when the NMHC conversion capability decreases to the point that NMHC emissions exceed 2.0 times the applicable standards. If no failure or deterioration of the NMHC conversion capability could result in an engine's NMHC emissions exceeding 2.0 times the applicable standards, the OBO system shall detect a malfunction when the system has no detectable amount of NMHC conversion capability.

(8.2.5) Missing substrate: The OBO system shall detect a malfunction if either the PM filter substrate is completely destroyed, removed, or missing, or if the . PM filter assembly is replaced with a muffler or straight pipe.

(8.2.6) Active/Intrusive Injection: For systems that utilize activelintrusive injection (e.g., in-cylinder post fuel injection, in-exhaust air-assisted fuel injection) to achieve regeneration of the PM filter, the OBO system shall detect a malfunction if any failure or deterioration of the injection system's ability to properly regulate injection causes the system to be unable to achieve regeneration of the PM filter.

(8.2.7)Feedback Control: Except as provided for in section (e)(8.2.8), if the engine is equipped with feedback or feed-forward control of the PM filter regeneration (e.g., feedback control of oxidation catalyst inlet temperature, PM filter inlet or outlet temperature, in-cylinder or in-exhaust fuel injection), the OBO system shall detect a malfunction:

(A) If the system fails to begin feedback control within a manufacturer specified time interval;

(B) If a failure or deterioration causes open loop or default operation; or

(C) If feedback the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the target

(8.2.8) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (e)(8.2.7)(C) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on an engine with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(8.2.9) In lieu of detecting the malfunctions specified in sections (e)(8.2.7)(A) and (B) with a PM filter-specific monitor, the OBO system may monitor the individual parameters or components that are used as inputs for PM filter regeneration feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (e)(8.2.7)(A) and (B).

(8.3) Monitoring Conditions:

(8.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (e)(8.2.1) through (8.2.~~7~~6) in accordance with sections '(d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that mqnitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in sectipns (e)(8.2.1) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(8.3.2) Except as provided in section (e)(8.3.3), the OBO II system shall monitor continuously for malfunctions identified in section (e)(8.2.7) (Le., PM filter feedback control).

(8.3.3) Manufacturers may request Executive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating system cannot be distinguished from a malfunctioning system and that the disablement interval is limited only to that which is technically necessary.

(8.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(9) EXHAUST GAS SENSOR MONITORING

(9.1) Requirement:

(9.1.1) The OBO system shall monitor all exhaust gas sensors (e.g., oxygen, air-fuel ratio, NOx) used for emission control system feedback (e.g., EGR control/feedback, SCR control/feedback, NOx adsorber control/feedback) or as a monitoring device for proper output signal, activity, response rate, and any other parameter that can affect emissions.

(9.1.2) For engines equipped with heated exhaust gas sensors, the OBO system shall monitor the heater for proper performance.

(9.2) Malfunction Criteria:

(9.2.1) Air-Fuel Ratio Sensors:

(A) For sensors located upstream of the exhaust aftertreatment:

(i) Sensor performance faults: The OBO system shall detect a malfunction prior to any failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause an engine's NMHC, CO, or NOx emissions to exceed 2.0 times any of the applicable standards or the engine's PM emissions to exceed any of the applicable standards plus 0.02 g/bhp-hr.

(ii) Circuit faults: The OBO system shall detect malfunctions of the sensor caused by either a lack of circuit continuity or out-of-range values.

(iii) Feedback faults: The OBO system shall detect a malfunction of the sensor when a sensor failure or deterioration causes an emission , control system (e.g., EGR, SCR, or NOx adsorber) to stop using that sensor as a feedback or feed-forward input (e.g., causes default or open-loop operation).

(iv) Monitoring capability: To the extent feasible, the OBO system shall detect a malfunction of the sensor when the sensor output voltage, 'resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OBO system monitoring device (e.g., for catalyst, EGR, SCR, or NOx adsorber monitoring).

(B) For sensors located downstream of the exhaust aftertreatment:

(i) Sensor performance faults:

a. For 2010 through 2012 model year engines, the OBO system shall detect a malfunction prior to any failure' or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause an engine's NMHC emissions to exceed 2.5 times any of the applicable standards, cause an engine's NOx emissions to exceed any of the applicable standards by more than 0.3 g/bhp-hr (e.g." cause emissions to exceed 0.5 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test (Le., FTP or SET), or cause an engine's PM emissions to exceed (whichever is higher): 0.05 g/bhp-hr as measured from an applicable cycle emission test (Le., FTP or SET); or any of the applicable standards by more than 0.04 g/bhp-hr (e.g., cause emissions to exceed 0.05 g/bhp-hr if the emission standard is 0.01 g/bhp-hr).

b. For 2013 and subsequent model year engines, the OBO system shall detect a malfunction prior to any failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause an engine's NMHC emissions to exceed 2.0 times any of the applicable .standards, cause an engine's NOx emissions to exceed any of the applicable standards by more than 0.2 g/bhp-hr (e.g., cause emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test (Le., FTP or SET), or cause an engine's PM emissions to exceed (whichever is higher): 0.03 g/bhp-hr as measured.from an applicable cycle emission test (Le., FTP or SET); orany of the applicable standards by more than 0.02 g/bhp-hr (e.g., cause emissions to exceed 0.03 g/bhp-hr if the emission standard is 0.01 g/bhp-hr)..

(ii) Circuit faults: The OBO system shall detect malfunctions of the sensor caused by either a lack of circuit continuity or out-of-range values.

(iii) Feedback faults: The OBO system shall detect a malfunction of the sensor when a sensor failure or deterioration causes an emission control system (e.g., EGR, SCR, or NOx adsorber) to stop using that sensor as a feedback or feed-forward input (e.g., causes default or open-loop operation).

(iv) Monitoring capability: To the extent feasible, the OBO system shall detect a malfunction of the sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OBO system monitoring device (e.g., for catalyst, EGR, SCR, or NOx adsorber monitoring).

(9.2.2) NOx and PM sensors:

(A) Sensor performance faults: .

(i) For 2010 through 2012 model year engines, the OBO system shall detect a malfunction prior to any failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause an engine's NOx emissions to exceed any of the applicable standards by more than 0.~~3~~4 g/bhp-hr (e.g., cause emissions to exceed 0.~~5~~6 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test (Le., FTP or SET), or cause an engine's PM emissions to exceed (whichever is higher): 0.05 g/bhp-hr as measured from an applicable cycle emission test (Le., FTP or SET); or any of the applicable standards by more than 0.04 g/bhp-hr (e.g., cause emissions to exceed 0.05 g/bhp-hr if the emission standard is 0.01 g/bhp-hr).

(ii) For 2013 and subsequent model year engines, the OBO system shall detect a malfunction prior to any failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause an engine's NOx emissions to exceed any of the applicable standards by more than 0.2 g/bhp-hr (e.g., cause emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable. cycle emission test (i.e., FTP or SET), or cause an engine's PM emissions to exceed (whichever is higher): 0.03 g/bhp-hr as measured from an applicable cycle emission test (Le., FTP or SET); or any of the applicable standards by more than 0.02g/bhp-hr (e.g., cause emissions to exceed 0.03 g/bhp-hr if the emission standard is 0.01 g/bhp-hr).

(B) Circuit faults: The OBO system shall detect malfunctions of the sensor caused by either a lack of circuit continuity or out-of-range values.

(C) Feedback faults: The OBO system shall detect a malfunction of the sensor when a sensor failure or deterioration causes 'an emission control system (e.g., EGR, SCR, or NOx adsorber) to stop using that sensor as a feedback or feed-forward input (e.g., causes default or open-loop operation).

(D) Monitoring capability: To the .extent feasible, the OBO system shall detect a malfunction of the sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OBO system monitoring device (e.g., for catalyst, EGR, PM filter, SCR, or NOx adsorber monitoring).

(9.2.3) Other exhaust gas sensors:

(A) For other exhaust gas sensors, the manufacturer shall submit a monitoring plan to the Executive Officer for approval. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and an engineering evaluation that demonstrate that the monitoring plan is as reliable and effective as the monitoring plan required for air-fuel ratio sensors, ~~and~~ NOx sensors, and PM sensors· under sections (e)(9.2.1) and (e)(9.2.2).

(9.2.4) Sensor Heaters:

(A) The OBO system shall detect a malfunction of the heater performance when the current or voltage drop in the heater. circuit is no longer within the manufacturer's specified limits for normal operation (Le., within the criteria required to be met by the component vendor for heater circuit performance at high mileage). Subject to Executive Officer approval, other malfunction criteria for heater performance malfunctions may be used upon the Executive Officer determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate the monitoring reliability and timeliness to be equivalent to the stated criteria in section (e)(9.2.4)(A).

(B) The OBO system shall detect malfunctions of the heater circuit including open or short circuits that conflict with the commanded state of the heater (e.g., shorted to 12 Volts when commanded to 0 Volts (ground».

(9.3) Monitoring Conditions:

(9.3.1) Exhaust Gas Sensors

(A) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (e)(9.2.1)(A)(i), (9.2.1)(B)(i), and (9.2.2)(A) (e.g., sensor performance faults) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in sections (e)(9.2.1)(A)(i), (9.2.1)(B)(i), and (9.2.2)(A) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(B) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (9.2.1)(A)(iv), (9.2.1)(B)(iv), and (9.2.2)(0) (e.g., . monitoring capability) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements) with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2).

(C) Except as provided in section (e)(9.3.1)(0), monitoring for malfunctions identified in sections *(e)(9.2.1*)(A)(ii), (9.2.1)(A)(iii), (9.2.1)(B)(ii), (9.2.1)(B)(iii), (9.2.2)(B), and (9.2.2)(C) (Le., circuit continuity, and open-loop malfunctions) shall be conducted continuously.

(D) A manufacturer may request Executive Officer approval to disable continuous exhaust gas sensor monitoring when an exhaust gas sensor malfunction cannot be distinguished from other effects (e.g., disable out-of-range low monitoring during fuel cut conditions). The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning sensor cannot be distingUished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(9.3.2) Sensor Heaters

(A) Manufacturers shall define monitoring conditions for malfunctions identified in section (e)(9.2.4)(A) (Le., sensor heater performance) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(B) Monitoring for malfunctions identified in section (e)(9.2.4)(B) (Le., circuit malfunctions) shall be conducted continuously.

(9.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(10) VARIABLE VALVE TIMING AND/OR CONTROL (VVT) SYSTEM MONITORING

(10.1) Requirement: The OBO system shall monitor the VVT system on engines so-equipped for target error and slow response malfunctions. The individual electronic components (e.g.,.actuators, valves, sensors) that are used in the VVT system shall be monitored in accordance with the comprehensive components requirements in section (g)(3).

(10.2) Malfunction Criteria: .

(10.2.1) Target Error: The OBO system shall detect a malfunction prior to any failure or deterioration in the capability of the VVT system to achieve the commanded valve timing and/or control within a crank angle and/or lift tolerance that would cause an engine's NHMC, NOx, or CO emissions to exceed 2.0 times any of the applicable standards or an engine's PM emissions to exceed a threshold of the applicable standard plus 0.02 g/bhp-hr.

(10.2.2) Slow Response:. The OBO system shall detect a malfunction prior to any .failure or deterioration in the capability of the VVT system to achieve the commanded valve timing and/or control within a manufacturer-specified time that would cause an engine's NHMC, NOx, or CO emissions to exceed 2.0 times any of the applicable standards or an engine's PM emissions to exceed a threshold of the applicable standard plus 0.02 g/bhp-hr.

(10.2.3) For engines in which no failure or deterioration of the WT system could result in an engine's emissions exceeding the thresholds of sections (e)(10.2.1) or (10.2.2), the OBO system shall detect a malfunction of the WT system when proper functional response of the system to computer commands does not occur.

(10.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for WT system malfunctions identified in section (e)(10.2) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2). For purposes of tracking and reporting as required in . section (d)(3.2.1), all monitors used to detect malfunctions identified in section (e)(10.2) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(IOA) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(11) COLD START EMISSION REDUCTION STRATEGY MONITORING

(11.1) Requirement:

(11.1.1) For all 2013 and subsequent model year engines, if an engine incorporates a specific engine control strategy to reduce cold start emissions, the aBO system shall-monitor the system to verify the strategy achieves the desired effect (e.g., to achieve accelerated catalyst light-off temperature) and monitor the commanded elements/components for proper function (e.g., injection timing, increased engine idle speed, increased engine load via intake or exhaust throttle activation) while the control strategy is active to ensure proper operation of the control strategy.

(11.2) Malfunction Criteria: The aBO system shall, to the extent feasible, detect a malfunction if either of the following occurs:

(11.2.1) Any single commanded element/component does not properly respond to the commanded action while the cold start strategy is active. For purposes of this section, "properly respond" is defined as when the element responds:

(A) by a robustly detectable amount by the monitor; and

(B) in the direction of the desired command; and

(C) above and beyond what the element/component would achieve on start-up without the cold start strategy active (e.g., if the cold start strategy commands a higher idle engine speed, a fault must be detected if there is no detectable amount of engine speed increase above what the system would achieve without the cold start strategy active);

(11.2.2) Any failure or deterioration of the cold start emission reduction'control strategy that would cause an engine's NMHC, NOx, or CO emissions to exceed 2.0 times the applicable standards or the engine's PM emissions to exceed the applicable standard plus 0.02 gibhp-hr.

01.2.3) For section (e)(11.2.2), to the extent feasible (without adding hardware for this purpose), the OBO system shall monitor the ability of the system to achieve the desired effect (e.g., strategies used to accelerate catalyst light-off by increasing catalyst inlet temperature shall verify the catalyst inlet temperature actually achieves the desired temperatures within an Executive Officer approved time interval after starting the engine) for failures that cause emissions to exceed the applicable emission levels specified in section (e)(11.2.2). For strategies where it is not feasible to be monitored as a system, the aBO system shall monitor the individual elements/components (e.g., increased engine speed, increased engine load from restricting an exhaust throttle) for failures that cause emissions to exceed the applicable emission levels specified in section (e)(11.2.2).

01.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section (e)(11.2) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(11.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(f) *MONITORING REQUIREMENTS FOR GASOLINE/SPARK-IGNITED ENGINES*

(1) ***FUEL SYSTEM MONITORING***

(1.1) Requirement: The aBO system shall monitor the fuel delivery system to determine its ability to provide compliance with emission standards.

(1.2) Malfunction Criteria:

(1.2.1) The OBD system shall detect a malfunction, of the fuel delivery system (including ~~feedback~~ control based on a secondary oxygen sensor) when:

(A) ~~t~~The fuel delivery system is unable to maintain an engine's emissions at or below 1.5 times the applicable standards; or~~.~~

(B) If equipped, the feedback control based on a secondary oxygen or exhaust gas sensor is unable to maintain a vehicle's emissions (except as a result of a malfunction specified in section (0(1.2.1)(C)) at or below 1.5 times any of the applicable standards; or

, (C) Except as required in section (f)(1.2.6), for 2014 and subsequent model , year vehicles, an 'air-fuel ratio cylinder imbalance (e.g., the air-fuel ratio in one or more cylinders is different than the other cylinders due to a cylinder specific malfunction such as an intake manifold leak at a particular cylinder, fuel injector problem, an individual cylinder EGR runner flow delivery problem, an individual variable cam lift malfunction such that an individual cylinder is operating on the wrong cam lift profile, or other similar problems) occurs in one or more cylinders such that the fuel delivery system is unable to maintain a vehicle's emissions at or below: 3.0 times the app1icab.le standards 'for the 2014 through 2016 model years; and '1.5 times the applicable FTP standards for all 2017 and subsequent model year vehicles.

(1.2.2) Except as proVided for in section (f)(1.2.3) below, if the engine is equipped with adaptive feedback control, the OBO system shall detect a malfunction when the adaptive feedback control has used up all of the adjustment allowed by the manufacturer. '

(1.2.3) If the engine is equipped with feedback control that is based on a secondary oxygen (or equivalent) sensor, the OBO system is not required to detect a'malfunction of the fuel system solely when the feedback control based on a secondary oxygen sensor has used up all. of the adjustment allowed by the manufacturer. However, if a failure or deterioration results in engine emissions that exceed the malfunction criteria in section (f)(1.2.1)(B), the OBO system is required to detect a malfunction.

(1.2.4) The aBO system shall detect a malfunction whenever the fuel control system fails to enter closed-loop operation within an Executive Officer-approved time interval after engine start. Executive Officer approval of the time interval shall be granted upon determining that the data and/or engineering evaluation submitted by the manufacturer supports the specified times.

0.2.5) For engines that employ engine shutoff strategies that do not require the vehicle operator to restart the engine to continue driving (e.g., hybrid bus with engine shutoff at idle), the aBO system shall detect whenever the fuel control system fails to enter closed-loop operation within an Executive Officer-approved time interval after an engine restart. Executive Officer approval of the time interval shall be granted upon determining that the data and/or engineering evaluation submitted by the manufacturer supports the specified times.

(1.2.5)Manufacturers may adjust the malfunction criteria and/or monitoring conditions to compensate for changes in altitude,for temporary introduction of large amounts of purge vapor, or for other similar identifiable operating conditions when they occur.

(1.2.6) Notwithstanding the phase':'in specified in section (f)(1.2.1)(C), if a vehicle is equipped with separate EGR flow delivery passageways (internal or external) that deliver EGR flow to individual cylinders (e.g., an EGR system with individual delivery pipes to each cylinder), the aBD system shall monitor the fuel delivery system for malfunctions specified in section (f)(1.2.1)(C) on all 2014 and subsequent model year vehicles so equipped.

(1.3) Monitoring Conditions:

0.3.1) Except as provided in section (f)(1.3.5), Tthe aBO system shall monitor fuel system shall be monitored continuously for the presence of a malfunctions identified in sections (f)(1.2.1)(A) and (B) (e.g., fuel delivery system, secondary feedback contro!).

(1.3.2) Manufacturers shall define monitoring conditions for malfunctions identified in section (f)(1.2.1)(C) (i.e., air-fuel ratio cylinder imbalance malfunctions) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements).

(1.3.3) Manufacturers shall define monitoring conditions for malfunctions identified in section (f)(1.2.4) in accordance with sections (d)(3.1).

(1.3.4) Manufacturers shall define monitoring conditions for malfunctions identified in section (f)(1.2.5) in .accordance with sections (d)(3.1) with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d}(3.1.2).

(1.3.5) Manufacturers may request Execl:.ltive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions (e.g., for temporary introduction of large amounts of purge vapor). The Executive Officer shall approve the request upon' determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating system cannot be distinguished from a malfunctioning system and that the . disablement interval is limited only to that which is technically necessary.

(1.4) MIL Illumination and Fault Code Storage: For malfunctions described under section (f)(1.2.1 }(C) (i.e., air-fuel ratio cylinder imbalance malfunctions), general requirements for MIL illumination and fault code storage are set forth in section (d)(2). For all other fuel system malfunctions, the MIL illumination and fault code storage requirements are set forth in sections (f)(1.4.1) through (1.4.6) below.

(1.4.1) A pending fault code shall be stored immediately upon the fuel system exc.eeding the malfunction criteria established pursuant to section (f)(1.2).

(1.4.2) Except as provided below, if a pending fault code is stored, the aBO system shall immediately illuminate the MIL and store a confirmed fault code if a malfunction is again detected during either of the following two events: (a) the driving cycle immediately following the storage of the pending fault code, regardless of the conditions encountered during the driving cycle; or (b) on the next driving cycle in which similar conditions (see section (c)) to those that occurred when the pending fault code was stored are encountered.

(1.4.3) The pending fault code may be erased at the end of the next driving cycle in which similar conditions have been encountered without an exceedance of the spedfied fuel system malfunction criteria. The pending code may also be erased if similar conditions are not encountered during the 80 driving cycles immediately after the initial detection of a malfunction for which the pending code wassel.

(1.4.4) Storage of freeze frame conditions.

(A) The aBO system shall store and erase freeze frame conditions either in conjunction with storing and erasing a pending fault code or in conjunction with storing and erasing a confirmed fault code.

(B) If free.ze frame conditions are stored for a malfunction other than a misfire (see section (f)(2)) or fuel system malfunction when a fault code is stored as specified in section (f)(1.4.1) or (f)(1.4.2) above, the stored freeze frame information shall be replaced with freeze frame information regarding the fuel system malfunction.

(1.4.5) Storage of fuel system conditions for determining similar conditions of operation.

(A) Upon detection of a fuel system malfunction under section (f)(1.2), the aBO system shall store the engine speed, load, and warm-up status of the first fuel system malfunction that resulted in the storage of the pending fault code.

(B) For fuel system faults detected using feedback control that is based on a secondary oxygen (or equivalent) sensor, the manufacturer may request Executive Officer approval to use an alternate definition of similar conditions in lieu of the definition specified in section (c). The Executive Officer shall approve the alternate definition upon the' manufacturer providing data or analysis demonstrating that the alternate definition provides for equivalent robustness in detection of fuel system faults that vary in severity depending on engine speed, load, and/or warm-up status.

(1.4.6) Extinguishing the MIL. The MIL may be extinguished after three sequential driving cycles in which similar conditions have been encountered without a malfunction of the fuel system.

(2) ***MISFIRE MONITORING***

(2.1) Requirement:

(2.1.1) The OBO system shall monitor the engine for misfire causing catalyst damage and misfire causing excess emissions.

(2.1.2) The OBO system shall identify the specific cylinder that is experiencing misfire. Manufacturers may request Executive Officer approval to store a general misfire fault code instead of a cylinder specific fault code under certain operating conditions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that the misfiring cylinder cannot be reliably identified when the conditions occur.

(2.1.3) If more than one cylinder is misfiring, a separate fault code shall be stored indicating that multiple cylinders are misfiring except as allowed below. When identifying multiple cylinder misfire, the OBO system is not required to also identify each of the misfiring cylinders individually through separate fault codes. If more than 90 percent of the detected misfires occur in a single cylinder, the OBO system may elect to store the appropriate fault code indicating the specific misfiring cylinder in lieu of the multiple cylinder misfire fault code. If, however, two or more cylinders individually have more than 10 percent of the total number of detected misfires, a multiple cylinder fault code must be stored.

(2.2) Malfunction Criteria: The OBO system shall detect a misfire malfunction pursuant to the following:

(2.2.1) Misfire causing catalyst damage:

(A) Manufacturers shall determine the percentage of misfire evaluated in 200 revolution increments for each engine speed and load condition that would result in a temperature that causes catalyst damage. The manufacturer shall submit documentation to support this percentage of misfire as required in section (j)(2.5). For eveiy engine speed and load condition that this percentage of misfire is determined to be lower than five percent, the manufacturer may set the malfunction criteria at five percent.

(B) Subject to Executive Officer approval, a manufacturer may employ a longer interval than 200 revolutions but only for determining, on a given driving cycle, the first misfire exceedance as provided in section (f)(2.4.1)(A) below. Executive Officer approval shall be granted upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that catalyst damage would not occur due to unacceptably high catalyst temperatures before the interval has elapsed.

(C) A misfire malfunction shall be detected if the percentage of misfire established in section (f)(2.2.1)(A) is exceeded. For multiple cylinder misfire situations that result in a misfire rate greater than or equal to 50 percent, the OBO system shall only be required to detect a misfire malfunction for situations that are caused by a single component failure.

(D) For purposes of establishing the temperature at which catalyst damage occurs as required in section (f)(2.2.1)(A), manufacturers may not define catalyst damage at a temperature more severe than what the catalyst system could be operated at for 10 consecutive hours and still meet the applicable standards.

(2.2.2) Misfire causing emissions to exceed 1.5 times the app.Jicable standards:

(A) Manufacturers shall determine the percentage of misfire evaluated in 1000 revolution increments that would cause emissions from an emission durability demonstration engine to· exceed 1.5 times any of the applicable standards if the percentage of misfire were present from the beginning of the test. To establish this percentage of misfire, the manufacturer shall utilize misfire events occurring at equally spaced, complete engine cycle intervals, across randomly selected cylinders throughout each 1000-revolution increment. If this percentage of misfire is determined to be lower than one percent, the manufacturer may set the malfunction criteria at one percent. .

(B) Subject to Executive Officer approval, a manufacturer may employ other revolution increments. The Executive Officer shall grant approval upon determining that the manufacturer has demonstrated that the strategy would be equally effective and timely in detecting misfire.

(C) A malfunction shall be detected if the percentage of misfire estab1ished in section (f)(2.2.2)(A) is exceeded regardless of the pattern of misfire events (e.g., random, equally spaced, continuous).

(2.3) Monitoring Conditions:

(2.3.1) The OBD system shall continuously monitor for misfire under the following conditions:

(A) From no later than the end of the second crankshaft revolution after engine start,

(B) While under positive torque conditions ~~D~~during the rise time and settling time for engine speed to reach the desired idle engine speed at engine start-up (i.e., "flare-up" and "f1are-down"),and

(C) Under all positive torque engine speeds and load conditions except within the following range: the engine operating region bound by the positive torque line (i.e., engine load with the transmission in neutral), and the two following engine operating points: an engine speed of 3000 rpm with the engine load at the positive torque line, and the redline engine speed (defined in section (c)) with the engine's manifold vacuum at four inches of mercury lower than that at the positive torque line.

(2.3.2) If a monitoring system cannot detect all misfire patterns under all required engine speed and load conditions as required in section (f)(2.3.1) above, the manufacturer may request Executive Officer approval to accept the monitoring system. In evaluating the manufacturer's request, the Executive Officer shall consider the following factors: the magnitude of the region(s) in which misfire detection is limited, the degree to which misfire detection is limited in the region(s) (Le., the probability of detection of misfire events), the frequency with which said region(s) are expected to be encountered in-use, the type of misfire patterns for which misfire detection is troublesome, and demonstration that the monitoring technology employed is not inherently incapable of detecting misfire under required conditions (Le., compliance can be achieved on other engines). The evaluation shall be based on the following misfire patterns: equally spaced misfire occurring on randomly selected cylinders, single cylinder continuous misfire, and paired cylinder (cylinders firing at the same crank angle) continuous misfire.

(2.3.3) A manufacturer may request Executive Officer approval of a monitoring system that has reduced misfire detection capability during the portion of the first 1000 revolutions after engine start that a cold start emission reduction strategy that reduces engine torque (e.g., spark retard strategies) is active. The Executive Officer shall approve the request upon determining that the manufacturer has demonstrated that the probability of detection is greater than or equal to 75 percent during the worst case condition (Le., lowest generated torque) for a vehicle operated continuously at idle (park/neutral idle) on a cold start between 50 and 86 degrees Fahrenheit and that the technology cannot reliably detect a higher percentage of the misfire events during the conditions.

(2.3.4) A manufacturer may request Executive Officer approval to disable misfire monitoring or employ an alternate malfunction criterion when misfire cannot be distinguished from other effects.

(A) Upon determining that the manufacturer has presented documentation that demonstrates the disablement interval or period of use of an alternate malfunction criterion is limited only to that necessary for avoiding false detection, the Executive Officer shall approve the disablement or use of the alternate malfunction criterion for conditions involving:

(i) rough road,
(ii) fuel cut,
(iii) gear changes for manual transmission vehicles,
(iv) traction control or other vehicle stability control activation such as anti-lock braking or other engine torque modifications to enhance vehicle stability,
(v) off-board control or intrusive activation Of vehicle components or diagnostics during service or assembly plant testing,
(vi) portions of intrusive evaporative system or EGR diagnostics that can significantly affect engine stability (Le., while the purge valve is open during the vacuum pull-down of a evaporative system leak check but not while the purge valve is closed and the evaporative system is

sealed or while an EGR diagnostic causes the EGR valve to be intrusively cycled on and off during positive torque conditions), or

(vii) engine speed, load, or torque transients due to throttle movements more rapid than occurs over the FTP ·cycle for the worst case engine within each engine family.

(B) Additionally, the Executive Officer will approve a manufacturer's request in accordance with sections (g)(5.3), (g)(5.4), and (g)(5.6) to disable misfire monitoring when the fuel level is 15 percent or less of the nominal capacity of the fuel tank, when PTO units are active, or while engine coolant temperature is below 20 degrees Fahrenheit. The Executive Officer will approve a request to continue disablement on engine starts when engine coolant temperature is below 20 degrees Fahrenheit at engine start until engine coolant temperature exceeds 70 degrees Fahrenheit.

(C) In general, the Executive Officer shall not approve disablement for conditions involving normal air conditioning compressor cycling from on-to-off or off-to-on, automatic transmission gear shifts (except for shifts occurring during wide open throttle operation), transitions from idle to off-idle, normal engine speed or load changes that occur during the engine speed rise time and settling time (I.e., "flare-up" and "flare-down") immediately after engine starting without any vehicle operator-induced actions (e.g., throttle stabs), or excess acceleration (except for acceleration rates that exceed the maximum acceleration rate obtainable at wide open throttle while the vehicle is in gear due to abnormal conditions such as slipping of a clutch).

(0) The Executive Officer may approve misfire monitoring disablement or use of an alternate malfunction criterion for any other condition on a case by case basis upon determining that the manufacturer has demonstrated that the request is based on an unusual or unforeseen circumstance and that it is applying the best available computer and monitoring technology.

(2.3.5) For engines with more than eight cylinders that cannot meet the requirements. of section (f)(2.3.1), a manufacturer may request Executive Officer approval to use alternative misfire monitoring conditions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate thafmisfire detection throughout the required operating region cannot be achieved when employing proven monitoring technology (I.e., a technology that provides for compliance with these requirements on other engines) and provided misfire is detected to the fullest extent permitted by the technology. However, the Executive Officer may not grant the request if the misfire detection system is unable to monitor during all positive torque operating conditions encountered during an FTP cycle.

(2.3.6) For engines that employ engine shutoff strategies that do not require the vehicle operator to restart the engine to continue driving (e.g., hybrid bus with engine shutoff at idle), the OBO system shall monitor for misfire from no later than the end of the second crankshaft revolution after each engine restart.

(2.4) MIL Illumination and Fault Code Storage:

(2.4.1) Misfire causing catalyst damage. Upon detection" of the percentage of misfire specified in section (f)(2.2.1) above, the following criteria shall apply for MIL illumination and fault code storage:

(A) Pending fault codes

(i) A pending fault code shall be stored immediately if, during a single driving cycle, the specified percentage of misfire is exceeded three times when operating in the positive torque region encountered during an FTP cycle or is exceeded on a single occasion when operating at any other engine speed and load condition in the positive torque region defined in section (f)(2.3.1).

(ii) Immediately after a pending fault code is stored as specified in section (f)(2.4.1)(A)(i) above, the MIL shall blink once per second at all times while misfire is occurring during the driving cycle.

a. The MIL may be extinguished during those times when misfire is not occurring during the driving cycle.

b. If, at the time a misfire malfunction occurs, the MIL is already illuminated for a malfunction other than misfire, the MIL shall blink as previously specified in section (f)(2.4.1)(A)(ii) while misfire is occurring. If misfiring ceases, the MIL shall stop blinking but remain illuminated as required by the other malfunction.

(B) Confirmed fault codes

(i) If a pending fault code for exceeding the percentage of misfire set forth in section (f)(2.2.1) is stored, the OBO system shall immediately store a confirmed fault code if the percentage of misfire specified in section (f)(2.2.1) is again exceeded one or more times during either: (a) the driving cycle immediately following the storage of the pending fault code, regardless of the conditions encountered during the driving cycle; or (b) on the next driving cycle in which similar conditions (see section (c» to the engine conditions that occurred when the pending fault code was stored are encountered.

(ii) If a pending fault code for exceeding the percentage of misfire set forth in section (f)(2.2.2) is stored from a previous driving cycle, the OBO "system shall immediately store a confirmed fault code if the percentage of misfire specified in section (f)(2.2.1) is exceeded one or more times regardless of the conditions encountered.

(iii) Upon storage of a confirmed fault code, the MIL shall blink as specified in subparagraph (f)(2.4.1)(A)(ii) above as long as misfire is occurring and the MIL shall remain continuously illuminated if the misfiring ceases.

(C) Erasure of pending fault codes

Pending fault codes shall be erased at the end of the next driving cycle in which similar conditions to the engine conditions that occurred when the pending fault code was stored have been encountered without any exceedance of the specified percentage of misfire. The pending code may also be erased if similar driVing" conditions are not encountered during the next 80 driving cycles subsequent to the initial detection of a malfunction.

(D) Exemptions for engines with fuel shutoff and default fuel control. Notwithstanding sections (f)(2.4.1)(A) and (B) above, in engines that provide for fuel shutoff and default fuel control to prevent over fueling during catalyst damage misfire conditions, the MIL is not required to blink. Instead, the MIL may illuminate continuously in accordance with the requirements for continuous MIL illumination in sections (f)(2.4.1)(B)(iii) above upon detection of misfire, provided that the fuel shutoff and default control are activated as soon as misfire is detected. Fuel shutoff and default fuel control may be deactivated only to permit fueling outside of the misfire range. Manufacturers may also periodically, but not more than once every 30 seconds, deactivate fuel shutoff and default fuel control to determine if the specified catalyst damage percentage of misfire is still being exceeded. Normal fueling and fuel control may be resumed if the specified catalyst damage percentage of misfire is no longer being exceeded.

(E) Manufacturers may request Executive Officer approval of strategies that continuously illuminate the MIL in lieu of blinking the MIL during extreme catalyst damage misfire conditions (Le., catalyst damage misfire occurring at all engine speeds and loads). Executive Officer approval shall be granted upon determining that the manufacturer employs the strategy only when catalyst damage misfire levels cannot be avoided during reasonable driving conditions and the manufacturer has demonstrated that the strategy will encourage operation of the vehicle in conditions that will minimize catalyst damage (e.g., at low engine speeds and loads).

(2.4.2) Misfire causing emissions to exceed 1.5 times the FTP standards.· Upon detection of the percentage of misfire specified in section (f)(2.2.2), the following criteria shall apply for MIL illumination and fault code storage:

(A) Misfire within the first 1000 revolutions after engine start.

(i) A pending fault code shall be stored no later than after the first exceedance of the specified percentage of misfire during a single driving cycle if the exceedance occurs within the first 1000 revolutions after engine start (defined in section (c)) during which misfire detection is active.

(ii) If a pending fault code is stored, the OBD system shall illuminate the MIL and store a confirmed fault code within 10 seconds if an exceedance·of the specified percentage of misfire is again detected in the first 1000 revolutions during any subsequent driving cycle, regardless of the conditions encountered during the driving cycle.

(iii) The pending fault code shall be erased at the end of the next driving cycle in which similar conditions to the engine conditions that occurred when the pending fault code was stored have been encountered without an exceedance of the specified percentage of misfire. The pending code may also be erased if similar conditions are not encountered during the next 80 driving cycles immediately following the initial detection of the malfunction.

(B) Exceedances after the first 1000 revolutions after engine start.

(i) A pending fault code shall be stored no later than after the fourth exceedance of the percentage of misfire specified in section (f)(2.2.2) during a single driving cycle.

(ii) If a pending fault code is stored, the aBO system shall illuminate the MIL and store a confirmed fault code within 10 seconds if the percentage of misfire specified in section (f)(2.2.2) is again exceeded four times during: (a) the driving cycle immediately following the storage of the pending fault code, regardless of the conditions encountered during the driving cycle; or (b) on the next driving cycle in which similar conditions (see section (c» to the engine conditions that occurred when the pending fault code was stored are encountered.

(iii) The pending fault code may be erased at the end of the next driving cycle in which similar conditions to the engine conditions that occurred when the pending fault code was stored have been encountered without an exceedance of the specified percentage of misfire. The pending code may also be erased if similar conditions are not encountered during the next 80 driving cycles immediately following initial detection of the malfunction.

(2.4.3) Storage of freeze frame conditions.

(A) The aBO system shall store and erase freeze frame conditions either in conjunction with storing and erasing a pending fault code or in conjunction with storing and erasing a confirmed fault code.

(B) If freeze frame conditions are stored for a malfunction other than a misfire or fuel system malfunction (see section (f)(1» when a fault code is stored as specified in section (f)(2.4) above, the stored freeze frame information shall be replaced with freeze frame information regarding the misfire malfunction.

(2.4.4) Storage of misfire conditions for similar conditions determination. Upon detection of misfire under sections (f)(2.4.1) or (2.4.2), the aBO system shall store the following engine conditions: engine speed, load, and warm-up status of the first misfire event that resulted in the storage of the pending fault code.

(2.4.5) Extinguishing the MIL. The MIL may be extinguished after three sequential driving cycles in which similar conditions have been encountered without an exceedance of the specified percentage of misfire.

(3) ***EXHAUST* GAS *RECIRCULATION (EGR) SYSTEM MONITORING***

(3.1) Requirement: The aBO system shall monitor the EGR system on engines so-equipped for low and high flow rate malfunctions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the EGR system shall be monitored in accordance with the comprehensive component requirements in section (g)(3).

(3.2) Malfunction Criteria:

(3.2.1) The aBO system shall detect a malfunction of the EGR system prior to a decrease from the manufacturer's specified EGR flow rate that would cause an engine's emissions to exceed 1.5 times any of the applicable standards. For engines in which no failure or deterioration of the EGR system that causes a decrease in flow could result in an engine's emissions exceeding 1.5 times any of the applicable standards, the aBO system shall detect a malfunction when the system has no detectable amount of EGR flow.

(3.2.2) The aBO system shall detect a malfunction of the EGR system prior to an increase from the manufacturer's specified EGR flow rate that would cause an engine's emissions to exceed 1.5 times any of the applicable standards. For engines in which no failure or deterioration of the EGR system that causes an increase in flow could result in an engine's emissions exceeding 1.5 times any of the applicable standards, the aBO system shall detect a malfunction when the system has reached its control limits such that it cannot reduce EGR flow.

(3.3) Monitoring Conditions:

(3.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(3.2) (Le., flow rate) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in section (f)(3.2) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(3.3.2) Manufacturers may request Executive Officer approval to temporarily disable the EGR system check under conditions when monitoring may not be reliable *(e.g.,* when freezing may affect performance of the system). The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a reliable check cannot be made when these conditions exist.

(3.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(4) COLD START EMISSION REDUCTION STRATEGY MONITORING

(4.1) Requirement: If an engine incorporates a specific engine control strategy to reduce cold start emissions, the aBO system shall monitor the ~~key~~ components commanded elements/components for proper function (e.g., increased engine idle speed, mass air flow, commanded ignition timing retard idle air control valve), other than secondary air, while the control strategy is active to ensure proper operation of the control strategy. Secondary air systems shall be monitored under the provisions of section (f)(5).

(4.2) Malfunction Criteria:

(4.2.1) For 2010 through 2012 model year engines:

(A) The aBO system shall detect a malfunction prior to any failure or deterioration of the individual elements/components associated with the cold start emission reduction control strategy that would cause an engine's emissions to exceed 1.5 times the applicable standards. Manufacturers shall:

~~(A)~~(i) Establish the malfunction criteria based on data from one or more representative engine(s).

~~(B)~~(ii) Provide an engineering evaluation for establishing the malfunction criteria for the remainder of the manufacturer's product line. The Executive Officer shall waive the evaluation requirement each year if, in the judgment of the Executive Officer, technological changes do not affect the previously determined malfunction criteria.

(4.2.2)(B) For components where no failure or deterioration of the element/component used for the cold start emission reduction strategy could result in an engine's emissions exceeding 1.5 times the applicable standards, the individual element/component shall be monitored for proper functional response in accordance with the malfunction criteria in section (g)(3.2) while the control strategy is active.

(4.2.2) For 2013 and subsequent model year engines, the aBO system shall, to the extent feasible, detect a malfunction if either of the following occurs:

(A) Any single commanded element/component does not properly respond to the commanded action while the cold start strategy is active. For elements/components involving spark timing (e.g., retarded spark timing), the monitor may verify final commanded spark timing in lieu of verifying actual delivered spark timing. For purposes of this section; "properly respond" is defined as when the element responds:

(i) by a robustly detectable amount; and

(ii) in the direction of the desired command;" and

(iii) above and beyond what the element/component would achieve on " start-up without the cold start strategy active (e.g., if the cold start strategy commands a higher idle engine speed, a fault must be detected if there is no detectable amount of engine speed increase above what the system would achieve without the cold start strategy active);

(B) Any failure or deterioration of the cold start emission reduction control strategy that would cause an engine's emissions to be equal to or above 1.5 times the applicable standards. For this requirement, the aBO system shall either monitor the combined effect of the elements/components of the system as a whole (e.g., measuring air flow and modeling overall heat into the exhaust) or the individual elements/components (e.g., increased engine speed, commanded final spark timing) for failures that cause engine emissions to exceed 1.5 times "the applicable standards.

(4.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(4.2) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(4.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(5) SECONDARY AIR SYSTEM MONITORING

(5.1) Requirement:

(5.1.1) The OBD system on engines equipped with any form of secondary air delivery system .shall monitor the proper functioning of the secondary air delivery system including all air switching valve(s). The individual electronic components (e.g., actuators, valves, sensors) in the secondary air system shall be monitored in accordance with the comprehensive component requirements in section (g)(3).

(5.1.2) For purposes of section (f)(5), "air flow" is defined as the air flow delivered by the secondary air system to the exhaust system. For engines using secondary air systems with multiple air flow paths/distribution points, the air flow to each bank (Le., a group of cylinders that share a common exhaust manifold, catalyst, and control sensor) shall be monitored in accordance with the malfunction criteria in section (f)(5.2) unless complete blocking of air delivery to one bank does not cause a measurable increase in emissions.

(5.1.3) For purposes of section (f)(5), "normal operation" is defined as the condition when the secondary air system is activated during catalyst and/or engine warm-up following engine start. "Normal operation" does not include the condition when the secondary air system is intrusively turned on solely for the purpose of monitoring.

(5.2) Malfunction Criteria:

(5.2.1) Except as provided in section (f)(5.2.3), the OBO system shall detect a secondary air system malfunction prior to a decrease from the manufacturer's specified air flow during normal operation that would cause an engine's emissions to exceed 1.5 times any of the applicable standards.

(5.2.2) Except as provided in section (f)(5.2.3), the OBO system shall detect a secondary air system malfunction prior to an increase from the manufacturer's specified air flow during normal operation that would cause an engine's emissions to exceed 1.5 times any of the applicable .standards.

(5.2.3) For engines in which no deterioration or failure of the secondary air system would result in an engine's emissions exceeding 1.5 times any of the applicable standards, the OBO system shall detect a malfunction when no detectable amount of air flow is delivered during normal operation of the secondary air system.

(5.3) Monitoring Conditions:

(5.3.1) Manufacturers shall define the monitoring conditions in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in section (f)(5.2) during normal operation .of the secondary air system shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(5.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(6) ***CATALYST MONITORING***

(6.1) Requirement: The OBO system shall monitor the catalyst system for proper conversion capability.

(6.2) Malfu-nction Criteria: .

(6.2.1) The OBO system shall detect a catalyst system malfunction when the catalyst system's conversion capability decreases to the point that any of the following occurs:

(A) Non-Methane Hydrocarbon (NMHC) emissions exceed 1.75 times the applicable standards to which the engine has been certified.

(B) The average FTP test NMHC conversion efficiency of the monitored portion of the catalyst system falls below 50 percent (Le., the cumulative NMHC emissions measured at the outlet of the monitored catalyst(s) are more than 50 percent of the cumulative engine-out emissions measured at the inlet of the catalyst(s)). With Executive .Officer approval, manufacturers may use a conversion efficiency malfunction criteria of less than 50 percentif the catalyst system is designed such that the monitored portion of the catalyst system must be replaced·along with an adjacent portion of the catalyst system sufficient to ensure that the total portion replaced will meet the 50 percent conversion efficiency criteria. Executive Officer approval shall be based on data and/or engineering evaluation demonstrating the conversion efficiency of the monitored portion and the total portion designed to be replaced, and the·likelihood of the catalyst system design to ensure replacement of the monitored and adjacent portions of the catalyst system.

(C) Oxides of nitrogen (NOx) emissions *eXGeed* 1.75 times the applicable NOx standard to which the engine has been certified.

(6.2.2) For purposes of determining the catalyst system malfunction criteria in section (f)(6.2.1):

(A) The manufacturer shall use a catalyst system deteriorated to the malfunction criteria using methods established by the manufacturer to represent real world catalyst deterioration under normal and malfunctioning operating conditions.

(B) Except as provided below in section (f)(6.2.2)(C), the malfunction criteria shall be established by using a catalyst system with all monitored and unmonitored (downstream of the sensor utilized for catalyst monitoring) catalysts simultaneously deteriorated to the malfunction criteria.

(C) For engines using fuel shutoff to prevent over-fueling during misfire conditions (see section (f)(2.4.1)(D)), the malfunction criteria shall be established by using a catalyst system with all monitored catalysts simultaneously deteriorated to the malfunction criteria while unmonitored catalysts shall be deteriorated to the end of the engine's useful life.

(6.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(6.2) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in section (f)(6.2) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(6.4) MIL Illumination and Fault Code Storage:

(6.4.1) General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(6.4.2) The monitoring method for the catalyst(s) shall be capable of detecting when a catalyst fault code has been cleared (except OBD system self-clearing), but the catalyst has not been replaced (e.g., catalyst overtemperature histogram approaches are not acceptable).

(7) ***EVAPORATIVE SYSTEM MONITORING***

(7.1) Requirement: The OBO system shall verify purge flow from the evaporative system and shall monitor the complete evaporative system, excluding the tubing and connections between the purge valve and the intake manifold, for vapor leaks to the atmosphere. Individual components of the evaporative system (e.g. valves, sensors) shall be monitored in accordance with the comprehensive components requirements in section (g)(3) (e.g., for circuit continuity, out of range values, rationality, proper functional response). Vehicles not required to be equipped with evaporative emission systems shall be exempt from monitoring of the evaporative system.

(7.2) Malfunction Criteria:

(7.2.1) For purposes of section (f)(7), an "orifice" is defined as an O'Keefe Controls Co. precision metal "Type B" orifice with NPT connections with a diameter of the specified dimension (e.g., part number B-31-88 for a stainless steel 0.031 inch diameter orifice).

(7.2.2) The OBO system shall detect an evaporative system malfunction when any of the following conditions exist:

(A) No purge flow from the evaporative system to the engine can be detected by the OBO system; or

(B) The complete evaporative system contains a leak or leaks that cumulatively are greater than or equal to a leak caused by a 0.150 inch diameter orifice.

(7.2.3) A manufacturer may request the Executive Officer to revise the orifice size in section (f)(7.2.2)(B) if the most reliable monitoring method available cannot reliably detect a system leak of the magnitudes specified. The Executive Officer shall approve the request upon determining that the manufacturer has provided data and/or engineering analysis that demonstrate the need for the request.

(7.2.4) Upon request by the manufacturer and upon determining that the manufacturer has submitted data and/or engineering evaluation which support the request, the Executive Officer shall revise the orifice size in section (f)(7.2.2)(B) upward to exclude detection of leaks that cannot cause evaporative or running loss emissions to exceed 1.5 times the applicable evaporative emission standards.

(7.2.5) For vehicles that utilize more than one purge flow path (e.g., a turbo-charged engine with a low pressure purge line and a high pressure purge line), the OBD system shall verify the criteria of (f)(7.2.2)(A) (i.e., purge flow to the engine) for both purge flow paths. If a manufacturer demonstrates that blockage, leakage, or disconneCtion of one of the purge flow paths cannot cause a measurable emission increase during any reasonable in-use driving conditions, monitoring of that flow path is not required.

(7.3) Monitoring Conditions:

(7.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(7.2.2)(A) (Le., purge flow) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(7.3.2) Manufacturers shall define the monitoring conditions for malfunctions identified in sectiqn (f)(7.2.2)(B) (Le., 0.150 inch leak detection) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes' of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in section (f)(7.2.2)(B) shall be tracked separate!y but reported as a single set of values as specified in section (d)(5.2.2).

(7.3.3) Manufacturers may disable or abort an evaporative system monitor when the fuel tank level is over 85 percent·of nominal tank capacity or during a refueling event.

(7.3..4) Manufacturers may request Executive Officer approval to execute the evaporative system monitor only on driving cycles determined by the manufacturer to be cold starts if the condition is needed to ensure reliable monitoring. The Executive Officer shall approve the request upon determining that data and/or an engineering evaluation submitted by the manufacturer demonstrate that a reliable check can only be made on driving cycles when the cold start criteria are satisfied.. However, in making a decision, the Executive Officer will not approve conditions that exclude engine starts from being considered as cold starts solely on the basis that ambient temperature exceeds (Le., indicates a higher temperature than) engine coolant temperature at engine start.

(7.3.5) Manufacturers may temporarily disable the evaporative purge system to perform an evaporative system leak check.

(7.4) MIL Illumination and Fault Code Storage:

(7.4.1) Except as provided below for fuel cap leaks, general requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(7.4.2) If the OBO system is capable. of discerning that a system leak is being caused by a missing or improperly secured fuel cap:

(A) The manufacturer is not required tQilluminate the MIL or store a fault code if the vehicle is equipped with an alternative indicator for notifying the vehicle operator of the malfunction. The alternative indicator shall be of sufficient illumination and location to be readily visible under all lighting conditions.

(B) If the vehicle is.not equipped with an alternative indicator and the MIL illuminates, the MIL may be extinguished and the corresponding fault codes erased once the OBO system has verified that the fuel cap has been securely fastened and the MIL has not been illuminated for any other type of malfunction.

(C) The Executive Officer may approve other strategies that provide equivalent assurance that a vehicle operator will be promptly notified of a missing or improperly secured fuel cap and that corrective action will be undertaken.

(8) EXHAUST GAS SENSOR MONITORING

(8.1) Requirement:

(8.1.1) The OBO system shall monitor the output signal, response rate, and any other parameter which can affect emissions of all primary (fuel control) exhaust gas oxygensensors (conventional switching sensors and wide range or universal sensorse.g., oxygen, wide range air/fuel) for

· malfunction. Both the lean to rich and rich to lean response rates shall be monitored.

(8.1.2) The OBO system shall also monitor all secondary exhaustgasoxygen sensors (those used for secondary fuel trim control or as a monitoring device) for proper output signal, activity, and response rate.

(8.1.3) For engines equipped with heated exhaust gasoxygen sensors, the OBO system shall monitor the heater for proper performance.

(8.1.4) For other types of sensors (e.g., hydrocarbon sensors, NOx sensors), the manufacturer shall submit a monitoring plan to the Executive Officer for approval. The Executive Officer shall approve the request upon' determining that the manufacturer has submitted data and an engineering evaluation that demonstrate that the monitoring plan is as reliable and effective as the monitoring plan required for conventional sensors under section (f)(8).

(8.2) Malfunction Criteria:

(8.2.1) Primary Sensors:

(A) The OBO system shall detect a malfunction prior to any failure or deterioration of the exhaust gasoxygen sensor output voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) (including drift or bias corrected for by secondary sensors) that would cause an engine's emissions to exceed 1.5 times any of the applicable standards. For response rate (see section (cU, the OBO system shall detect asymmetric malfunctions (Le.,malfunctions that primarily affect only the lean-to-rich response rate or only the rich-to-Iean response rate) and symmetric malfunctions (Le., malfunctions that affect both the lean-to-rich and rich-to-Iean response rates). As defined in section (C)i response rate includes delays in the sensor to initially react to a change in exhaust gas composition as well as delays during the transition from a rich-to-Iean (or lean-to-rich) sensor output. For 2013 and subsequent model year engines, the manufacturer shall submit data and/or engineering analysis to demonstrate that the calibration method used ensures proper detection of all symmetric and asymmetric response rate malfunctions as part of the certification application.

(B) The OBO system shall detect malfunctions of the exhaust gas oxygen sensor caused by either a lack of circuit continuity or out-of-range values.

(C) The OBO system shall detect a malfunction of the exhaust gasoxygen sensor when a sensor failure or deterioration causes the fuel system to stop using that sensor as a feedback input (e.g., causes default or open-loop operation) or. causes the fuel system to fail to enter closed-loop operation within a manufacturer-specified time interval.

(D) The OBO system shall detect a malfunction of the exhaust gasoxygen sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, or other characteristics are no longer sufficient for use as an OBO system monitoring device (e.g., for catalyst monitoring).

(8.2.2) Secondary Sensors:

(A) The OBO system shall detect a malfunction prior to any failure or deterioration of the exhaust gasoxygen sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause an engine's' emissions to exceed 1.5 times any of the applicable standards.

(B) The aBO system shall detect malfunctions of the exhaust gasoxygen sensor caused by a lack of circuit continuity.

(C) Sufficient sensor performance for other monitors.

~~(C)~~(i) To the extent feasible, tlhe aBO system shall detect a malfunction of the exhaust gasoxygen sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an aBO system monitoring device (e.g., for catalyst monitoring). For this requirement, "sufficient" is defined as the capability of the worst performing acceptable sensor to detect the best performing unacceptable other monitored system or component (e.g.! catalyst).

(ii) For systems where it is not technically feasible to satisfy the criteria of section (f)(8.2.2)(C)(i) completely, the OBD system shall, at a minimum, detect a slow rich-to-lean response malfunction during a fuel shut-off event (e.g., deceleration fuel cut event) on all 2013 and subsequent model year engines. The rich-to-lean response check shall monitor both the sensor response time from a rich condition (e.g., 0.7 Volts) prior to the start of fuel shut-off to a lean condition (e.g., 0.1 Volts) expected during fuel shut-off conditions and the sensor transition time in the intermediate sensor range (e.g., from 0.55 Volts to 0.3 Volts).

(iii) Additionally, for systems where it is not technically feasible to satisfy the criteria in section (f)(8.2.2)(C)(i), prior to certification of 2013 model year engines, the manufacturer must submit a comprehensive plan to the Executive Officer demonstrating the manufacturer's efforts to minimize any gap remaining between the worst performing acceptable sensor and a sufficient sensor. The plan should include quantification of the gap and supporting documentation for efforts to close the gap including sensor monitoring improvements, other system component monitor improvements (e.g., changes to make the catalyst monitor less sensitive to oxygen sensor response), and sensor specification changes, if any. The Executive Officer shall approve the plan upon determining the submitted information supports the necessity of the gap and the plan demonstrates that the manufacturer is taking reasonable efforts to minimize or eliminate the gap in a timely manner.

(D) The aBO system shall detect malfunctions of the exhaustgasoxygen sensor caused by out-of-range values.

(E) The aBO system shall detect a malfunction of the exhaust gasoxygen sensor when a sensor failure or deterioration causes the fuel system (e.g., fuel control) to stop using that sensor as a feedback input (e.g., causes default or open-loop operation).

(8.2.3) Sensor Heaters:

(A) The aBO system shall detect a malfunction of the heater performance when the current or voltage drop in the heater circuit is no longer within the manufacturer's specified limits for normal operation (Le., within the criteria required to be met by the component vendor for heater circuit performance at high mileage). Subject to Executive Officer approval, other malfunction, criteria for heater performance malfunctions may be used upon the Executive Officer determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate the monitoring reliability and timeliness to be equivalent to the stated criteria in section (f)(8.2.3)(A).

(B) The OBD system shall detect malfunctions of the heater circuit including open or short circuits that conflict with the *commanded* state of the heater (e.g., shorted to 12 Volts when commanded to 0 Volts (ground)).

(8.3) Monitoring Conditions:

(8.3.1) Primary Sensors

(A) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (f)(8.2.1)(A) and (0) (e.g., proper response rate) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.1); all monitors used to detect malfunctions identified in sections (f)(8.2.1)(A) and (0) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(B) Except as provided in section (f)(8.3.1)(C), monitoring for malfunctions identified in sections (f)(8.2.1)(B) and (C) (Le., circuit continuity, out-of-range, and **open-loop** malfunctions) shall be conducted c.ontinuously.

(C) A manufacturer may request Executive Officer approval to disable continuous exhaust gas sensor monitoring when an exhaust gas sensor malfunction cannot be distinguished from other effects (e.g., disable out-of-range low monitoring during fuel cut conditions). The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(8.3.2) Secondary Sensors

(A) Manufacturers shall de·fine monitoring conditions for malfunctions identified in sections (f)(8.2.2)(A); ~~(B),~~ **and** (C) (e.g., proper sensor activity) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For all 2013 and subsequent model year engines meeting the monitoring requirements of section (f)(8.2.2){C){j) or (ji), for purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in sections (f){8.2.2){A) and (C) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2Y ,

(B) Except as provided in section (f)(8.3.2)(C), monitoring for malfunctions identified in sections **(f)(8.2.2)**(B), **(D),** and (E) (Le., open circuit, out-of-range malfunctions, open-loop malfunctions) shall be conducted continuously.

(C) A manufacturer may request Executive Officer approval to disable continuous exhaust gas sensor monitoring when an exhaust gasoxygen sensor malfunction cannot be distinguished from other effects (e.g., disable out-of-range low monitoring during fuel cut conditions). The

Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(8.3.3) Sensor Heaters

(A) Manufacturers shall define monitoring conditions for malfunctions identified in section (f)(8.2.3)(A) (Le., sensor heater performance) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(B) Monitoring for malfunctions identified in section (f)(8.2.3)(B) (Le., circuit malfunctions) shall be conducted continuously.

(8.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(9) VARIABLE VALVE TIMING AND/OR CONTROL (WT) SYSTEM MONITORING

(9.1) Requirement: The aBO system shall monitor the VVT system on engines so-equipped for target error and slow response malfunctions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the VVT system shall be monitored in accordance with the comprehensive components requirements in section (g)(3).

(9.2) Malfunction Criteria:

(9.2.1) Target Error: The aBO system shall detect a malfunction prior to any failure or deterioration in the capability of the VVT system to achieve the commanded valve timing and/or control within a crank angle and/or lift tolerance that would cause an engine's emissions to exceed 1.5 times any of the applicable standards.

(9.2.2) Slow Response: The aBO system shall detect a malfunction prior to any failure or deterioration in the capability of the WT system to achieve the commanded valve timing and/or control within a manufacturer-specified time that would cause an engine's emissions to exceed 1.5 times any of the applicable standards for gasoline engines.

(9.2.3) For'engines in which no failure or deterioration of the VVT system could result in an engine's emissions exceeding 1.5 times any of the applicable standards, the aBO system shall detect a malfunction of the VVT system when proper functional response of the system to computer commands does not occur.

(9.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for VVT system malfunctions identified in section (f)(9.2) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in section (f)(9.2) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(9.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(g) ***MONITORING REQUIREMENTS FOR ALL ENGINES***

(1) ENGINE COOLING SYSTEM MONITORING

(1.1) Requirement:

(1.1.1) The aBO system shall monitor the thermostat on engines so-equipped for proper operation.

(1.1.2) The aBO system shall monitor the engine coolant temperature (ECT) sensor for circuit continuity, out-of-range values, and rationality faults.

(1.1.3) For engines that use a system other than the cooling system and ECT sensor (e.g., oil temperature, cylinder head temperature) for an indication of engine operating temperature for emission control purposes (e.g., to modify spark or fuel injection timing or quantity), the manufacturer shall submit a monitoring plan to the Executive Officer for approval. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and an engineering evaluation that demonstrate that the monitoring plan is as reliable and effective as the monitoring required for the engine cooling system under section (g)(1).

(1.2) Malfunction Criteria: .

(1.2.1) Thermostat

(A) The aBO system shall detect a thermostat malfunction if, within an Executive Officer-approved time interval after engine start, any of the following conditions occur:

(i) The coolant temperature does not reach the highest temperature required by the aBO system to enable other diagnostics;

(ii) The coolant temperature does not reach a warmed-up temperature within 20 degrees Fahrenheit of the manufacturer's nominal thermostat regulating temperature. Subject to Executive Officer approval, a manufacturer may utilize lower temperatures for this criterion upon the Executive Officer determining that the manufacturer has demonstrated that the fuel, spark timing, and/or other coolant temperature-based modifications to the engine control strategies would not cause an emission increase of 50 or more percent of any of the applicable standards (e.g., 50 degree Fahrenheit emission test).

(B) For 2016 and subsequent model year engines, the aBO system shall detect a thermostat fault if, after the coolant temperature has reached the temperatures indicated in sections (g)(1.2.1)(A)(i) and (in, the coolant temperature drops below the temperature indicated in section (g)(1.2.1)(A)(i).

~~(B)~~(C) Executive Officer approval of the time interval after engine start under section (g)(1.2.1)(A) above shall be granted upon determining that the data and/or engineering evaluation submitted by the manufacturer supports the specified times.

~~(C)~~(D) For monitoring of malfunctions under section (9)(1.2.1)(A), Wwith Executive Officer approval, a manufacturer may use alternate malfunction criteria and/or monitoring conditions (see section (g)(1.3» that are a function of temperature at engine start on engines that do not reach the temperatures specified in the malfunction criteria when the thermostat is functioning properly. Executive Officer approval shall be granted upon determining that the manufacturer has submitted data that demonstrate that a properly operating system does not reach the specified temperatures, that the monitor is capable of meeting the specified malfunction criteria at engine start temperatures greater than 50 degrees Fahrenheit, and that the possibility for cooling system malfunctions to go undetected and disable other OBO monitors is minimized to the extent technically feasible.

~~(D)~~(E) A manufacturer may request Executive Officer approval to be exempted from the requirements of thermostat monitoring. Executive Officer approval shall be granted upon determining that the manufacturer has demonstrated that a malfunctioning thermostat cannot cause a measurable increase in emissions during any reasonable driving condition nor cause any disablement of other monitors.

(1.2.2) ECT Sensor

(A) Circuit Continuity. The OBO system shall detect a malfunction when a lack of circuit continuity or out-of-range values occur.

(B) Time to Reach Closed-Loop/Feedback Enable Temperature.

(i) The OBO system shall detect a malfunction if the ECT sensor does not achieve the highest stabilized minimum temperature which is needed for closed-loop/feedback control of all 'emission control systems (e.g., fuel system, EGR system) within an Executive Officer-approved time interval after engine start.

(ii) The time interval shall be a function of starting ECT and/or a function of intake air temperature. Executive Officer approval of the time interval shall be granted upon determining that the data and/or engineering evaluation submitted by the manufacturer supports the specified times.

(iii) Manufacturers are exempted from the requirements of section (g)(1.2.2)(B) if the manufacturer does not utilize ECT to enable closed-loop/feedback control of any emission control system.

(C) Stuck in Range Below the Highest Minimum"Enable Temperature. To the extent feasible when using all available information, the OBO system shall detect a malfunction if the ECT sensor inappropriately indicates a temperature below the highest minimum enable temperature required by the aBO system to enable other diagnostics (e.g., an aBO system that requires ECT to be greater than 140 degrees Fahrenheit to enable a diagnostic must detect malfunctions that cause the ECT sensor to inappropriately indicate a temperature below 140 degrees Fahrenheit). Manufacturers are exempted from this requirement for temperature regions in which the monitors required under sections (g)(1.2.1) or (g)(1.2.2)(S) will detect ECT sensor malfunctions as defined in section (g)(1.2.2)(C).

(D) Stuck in Range Above the Lowest Maximum Enable Temperature.

(i) To the extent feasible when using all available information, the aBO system shall detect a malfunction if the ECT sensor inappropriately indicates a temperature above the lowest maximum enable temperature required by the OBO system to enable other diagnostics (e.g., an OBO system that requires ECT to be less than 90 degrees Fahrenheit at engine start to enable a diagnostic must detect malfunctions that cause the ECT sensor to inappropriately indicate a temperature above 90 degrees Fahrenheit).

(ii) Manufacturers are exempted from this requirement for temperature regions in which the monitors required under sections (g)(1.2.1), (g)(1.2.2)(B), or (g)(1.2.2)(C) (Le., ECT sensor or thermostat malfunctions) will detect ECT sensor malfunctions as defined in section (g)(1.2.2)(O) or in which the MIL will be illuminated under the requirements of sections (d)(2.2.1)(E) or (d)(2.2.2)(E) for default mode operation (e.g., overtemperature protection strategies).

(iii) Manufacturers are exempted from the requirements of section (g)(1.2.2)(D) for temperature regions where the temperature gauge indicates a temperature in the red zone (engine overheating zone) for vehicles that have a temperature gauge (not a warning light) on the instrument panel and utilize the same ECT sensor for input to the OBD system and the temperature gauge.

(1.3) Monitoring Conditions:

(1.3.1) Thermostat

(A) Manufacturers shall define the monitoring conditions for malfunctions identified in section (g)(1.2.1)(A) in accordance with section (d)(3.1) except as provided for in section (9)(1.3.1)(E). Additionally, except as provided for in sections (g)(1.3.1)(B) and (C), monitoring for malfunctions identified in section (g)(1.2.1)(A) shall be conducted once per driving cycle on every driving cycle in which the ECT sensor indicates, at engine start, a temperature lower than the temperature established as the malfunction criteria in section (g)(1.2.1)(A).

(8) Manufacturers shall define the monitoring conditions for malfunctions identified in section (g)(1.2.1)(8) in accordance with section (d)(3.1) With the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle.

~~(B)~~(C) Manufacturers may disable thermostat monitoring at ambient engine ~~start~~ temperatures below 20 degrees Fahrenheit.

~~(C)~~(D) Manufacturers may request Executive Officer approval to suspend or disable thermostat monitoring if the vehicle is subjected to conditions which could lead to false diagnosis (e.g., vehicle operation at idle for more than 50 percent of the warm-up time, hot restart conditions). In general, the Executive Officer shall not approve disablement of the monitor on engine starts where the ECT at engine start is more than 35 degrees Fahrenheit lower than the thermostat malfunction threshold temperature determined under section (g)(1.2.1)(A). The Executive Officer shall approve the request upon determining that the manufacturer has provided data and/or engineerjng analysis that demonstrate the need for the request.

(E) With respect to defining enable conditions that are encountered during the FTP cycle as required in (d)(3.1.1) for malfunctions identified in section (g)(1.2.1)(A), the FTP cycle shall refer to on-road driving following the FTP cycle in lieu of testing on an engine dynamometer.

(1.3.2) ECT Sensor

(A) Except as provided below in section (g)(1.3.2)(E), monitoring for malfunctions identified in section (g)(1.2.2)(A) (Le., circuit continuity and , out-of-range) shall be conducted continuously,.

(B) Manufacturers shall define the monitoring conditions for malfunctions identified in section (g)(1.2.2)(B) in accordance'with section (d)(3.1). Additionally, except as provided for in section (g)(1.3.2)(0), monitoring for malfunctions identified in section (g)(1.2.2)(B) shall be conducted once per driving cycle on every driving cycle in which the ECT sensor indicates a temperature lower than the closed-loop enable temperature at engine start (Le., all engine start temperatures greater than the ECT sensor out-of-range low temperature and less than the closed-loop enable temperature).

(C) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (g)(1.2.2)(C) and (0) in accordance with sections (d)(3.1) and (d)(3.2) (Le.,' minimum ratio requirements).

(0) Manufacturers may suspend or delay the time to reach closed-loop enable temperature diagnostic if the vehicle is subjected to conditions which could lead to false diagnosis (e.g., vehicle operation at idle for more than 50 to 75 percent of the warm-up time). .

(E) A manufacturer may request Executive Officer approval to disable continuous ECT sensor monitoring when an ECT sensor malfunction cannot be distinguished from other effects. The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or engineering evaluation that d.emonstrate a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(1.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2). '

(2) CRANKCASE VENTILATION (CV) SYSTEM MONITORING

(2.1) Requirement:

(2.1.1)The OBO system shall monitor the CV system on engines so-equipped for system integrity. Engines not required subject to crankcase emission control requirements be oquipped with CV systems shall be exempt from monitoring of the CV system.

(2.1.l)For diesel engines, the manuFaeturershall submit a plan for Exeeutive Offieer approval of the monitoring strategy, malfunction eriteria, and monitoring eonditions prior to OBD eertifieation. Exeeutive Offieer approval shall be based on the effeetiveness of the monitoring strategy to monitor the performanee of the CV system to the extent feasible with ~~respect~~ to the malfunetion eriteria in seetion (g)(2.2) belolN and the monitoring eonditions required by the diagnostie.

(2.2) Malfunction Criteria:

(2.2.1) For the purposes of section (g)(2), "CV system" is defined as any form of crankcase ventilation system, regardless of whether it utilizes positive pressure or whether it vents to the atmosphere, the intake, or the exhaust. "CV valve" is defined as any form of valve ~~or~~ orifice, and/or filter/separator used to restrict, ~~or~~ control, or alter the composition (e.g., remove oil vapor or particulate matter) of the crankcase vapor flow. Further, any additional external CV system tubing or hoses used to equalize crankcase pressure or to provide a ventilation path between various areas of the engine (e.g., crankcase and valve cover) are considered part of the CV system "between the crankcase and the CV valve" and subject to the malfunction criteria in section (g)(2.2.2) below.

(2.2.2) Except as provided below, the OBD system shall detect a malfunction of > the CV system when a disconnection of the system occurs between either the crankcase and the CV valve, or between the CV valve and the intake > manifoldducting.

(2.2.3) If disconnection in the system results in a rapid loss of oil or other overt indication of a CV system malfunction such that the vehicle operator is certain to respond and have the vehicle repaired, the Executive> Officer shall exempt the manufacturer from detection of that disconnection.

(2.2.3)(2.2.4) The Executive Officer shall exempt a manufacturer from detecting a disconnection between the crankcase and the CV valve upon determining that the disconnection cannot be made without first disconnecting a monitored portion of the system (e.g., the CV system is designed such that the CV valve is fastened directly to the crankcase in a manner which makes it significantly more difficult to remove the valve from the crankcase rather than disconnect the line between the valve and the intake manifold/ducting (taking aging effects into consideration)) and the line between the valve and the intake ducting is monitored for disconnection. The manufacturer shall file a request and submit data and/or engineering evaluation in support of the exemption.

(2.2.4)(2.2.5) Subject to ~~The~~ Executive Officer approval, shall exempt a manufacturer from detecting a disconnection ~~between~~ the crankcase and the CV valve for system designs that utilize tubing between the valve and the crankcase shall be exempted from the monitoring requirement for detection of disconnection upon determining that the connections between the CV valve and the crankcase. The manufacturer shall file a request and submit data and/or engineering evaluation in support of the request. The Executive Officer shall approve the request upon determining that the connections between the valve and the crankcase are: (1) resistant to deterioration or accidental disconnection, (2) significantly more difficult to disconnect than the line between the valve and the intake manifold/ducting, and (3) not subject to disconnection per manufacturer's maintenance, service, and/or repair procedures for non-CV system repair work. The manufacturer shall file a request and submit data and/or engineering evaluation in support of the exemption.

>(2.2.5)(2.2.6) The Executive Officer shall exempt a manufacturer from detecting a disconnection between the CV valve and the intake manifold upon determining that the disconnection (1) causes the vehicle to stall

immediately during idle operation; or (2) is unlikely to occur due to a CV system design that is integral to the induction system (e.g., machined passages rather than tubing or hoses). The manufacturer shall file a request and submit data and/or engineering evaluation in support of the exemption.

(2.2.7) For engines certified on an engine dynamometer having an open CV system (Le., a system that releases crankcase emissions to the atmosphere without routing them to the intake ducting or to the exhaust upstream of the aftertreatment), the manufacturer shall submit a plan for Executive Officer approval of the monitoring strategy,·malfunction criteria, and monitoring conditions prior to OBO certification. Executive Officer approval·shall be based on the effectiveness of the monitoring strategy to (i) monitor the performance of the CV system to the extent feasible with respect to the malfunction criteria in section (g)(2.2.1) through (g)(2.2.4) and the monitoring conditions required by the diagnostic, and (ii) monitor the ability of the CV system to control crankcase vapor emitted to the atmosphere relative to the manufacturer's design and performance specifications for a properly functioning system (e.g., if the system is equipped with a filter and/or separator to reduce crankcase emissions to the atmosphere, the OBO system shall monitor the integrity of the filter and/or function' of the separator).

(2.3) . Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section (g)(2.2) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(2.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2). The stored fault code need not specifically identify the CV system (e.g., a fault code for idle speed control or fuel system monitoring can be stored) if the manufacturer demonstrates that additional monitoring hardware would be necessary to make this identification, and provided the manufacturer's diagnostic and repair procedures for the detected malfunction include directions to check the integrity of the CV system.

(3) ***COMPREHENSIVE COMPONENT MONITORING*** .

(3.1) Requirement:

(3.1.1) Except as provided in sections (9)(3.1.4), (g)(3.1.5), and (g)(4), the OBO system shall monitor for malfunction any electronic engine component/system not otherwise described in sections *(e)(1)* through (g)(2) that either provides input to (directly or indirectly) or receives commands from the on-board computer(s), and: (1) can affect emissions during any reasonable in-use driving condition, or (2) is used as part of the diagnostic strategy for any other monitored system or component.

(A) Input Components: Input components required to be monitored may include the crank angle sensor, knock sensor, throttle·position sensor, cam position sensor, intake air temperature sensor, boost pressure sensor, manifold pressure sensor, mass air flow sensor, exhaust· temperature sensor, exhaust pressure sensor, fuel pressure sensor, fuel composition sensor (e.g. flexible fuel vehicles), and electronic components used to comply with any applicable engine idling requirements of title 13, CCR section 1956.8.

(8) Output Components/Systems: Output components/systems required to be monitored may include the idle speed control system, fuel injectors, glow plug system, variable length intake manifold runner systems, supercharger or turbocharger electronic components, heated fuel preparation systems, and the wait-to-start lamp on diesel applications, and the MIL.

(3.1.2) For purposes of criteria (1) in section (g)(3.1.1) above, the manufacturer shall determine whether an engine input or output component/system can affect emissions. If the Executive Officer reasonably believes that a manufacturer has incorrectly determined that a component/system cannot affect emissions, the Executive Officer shall require the manufacturer to provide emission data showing that the component/system, when malfunctioning and installed in a suitable test vehicle, does not have an emission effect. The Executive Officer may request Eemission data may be requested for any reasonable driving condition.

(3.1.3) Manufacturers shall monitor for malfunction electronic powertrain input or output components/systems associated with an electronic transfer case, electronic power steering system, or other components that are driven by the engine and not related to the control of fueling, air handling, or emissions only if the transfer case component or system is used as part of the diagnostic strategy for any other monitored system or component. For purposes of section (g)(3), "electronic engine components/systems" does not include components that are driven by the engine and are not related to the control of the fueling, air handling, or emissions of the engine (e.g., PTO components, air conditioning system components, and power steering components).

(3.1.4) Except as specified for hybrids in section (g)(3.1.5), manufacturers shall monitor for malfunction electronic powertrain input or output components/systems associated with components that only affect emissions by causing additional electrical load to the engine and are not related to the control of fueling, air handling, or emissions only if the component or system is used as part of the diagnostic strategy for any other monitored system or component.

(3.1.5) For hybrids, manufacturers shall submit a plan to the Executive Officer for approval of the hybrid components determined by the manufacturer to be subject to monitoring in section (g)(3.1.1). In general, the Executive Officer shall approve the plan if it includes monitoring of all components/systems used as part of the diagnostic strategy for any other monitored system or component. monitoring of all energy input devices to the electrical propulsion system, monitoring of battery and charging system performance, monitoring of electric motor performance, and monitoring of regenerative braking performance.

(3.2) Malfunction Criteria:

(3.2.1) Input Components:

(A) The OBD system shall detect malfunctions of input components caused by a lack of circuit continuity, out-of-range values, and, where feasible, rationality faults. To the extent feasible, the rationality fault diagnostics shall verify that a sensor output is neither inappropriately high nor inappropriately low (Le., shall be "two-sided" diagnostics).

(B) To the extent feasible, the OBO system shall separately detect and store different fault codes that distinguish rationality faults from lack of circuit continuity and out-of-range faults. For input component lack of circuit continuity and out-of-range faults, the OBO system shall, to the extent feasible, separately detect and store different fault codes for each distinct malfunction (e.g., out-of-range low, out-of-range high, open circuit). The aBO system is not required to store separate fault codes for lack of circuit continuity faults that cannot be distinguished from other out-of-range circuit faults.

(C) For input components that are used to activate alternate" strategies that can affect emissions (e.g., AECOs, engine shutdown systems or strategies to meet NOx idling standards required by title 13, CCR section 1956.8), the OBO system shall detect rationality malfunctions that cause the system to erroneously activate or deactivate the alternate strategy. To the extent feasible when using all available information, the rationality fault diagnostics shall detect a malfunction if the input component inappropriately indicates a value that activates or deactivates the alternate strategy. For example, if an alternate strategy requires the intake air temperature to be greater than 120 degrees Fahrenheit to activate, the OBD system shall detect malfunctions that cause the intake air temperature sensor to inappropriately indicate a temperature above 120 degrees Fahrenheit.

(DIFor input components that are directly or indirectly used for any emission control strategies that are not covered under sections (e). (fl, and (g)(1) (e.g.. exhaust temperature sensors used for a control strategy that regulates SCR catalyst inlet temperature within a target window), the OBO system shall detect rationality malfunctions that prevent the component from correctly sensing any condition necessary for the strategy to operate in its intended manner. These malfunctions include faults that inappropriately prevent or delay the activation of the emission control strategy, cause the system to erroneously exit the emission control strategy, or where thecontrol strategy has used up all of the adjustments or authority allowed by the manufacturer and is still unable to achieve the desired condition. The Executive Officer may waive detection of specific malfunctions upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that reliable detection of the malfunction is technically infeasible or would require additional hardware.

~~(D)~~(E) For engines that require precise alignment between the camshaft and the crankshaft, the OBO system shall monitor the crankshaft position sensor(s) and camshaft position sensor(s) to verify proper alignment between the camshaft and crankshaft in addition to monitoring the sensors for circuit continuity and rationality malfunctions. Proper alignment monitoring between a camshaft and a crankshaft shall only be required in cases where both are equipped with position sensors. For engines equipped with VVT systems and a timing belt or chain, the aBO system shall detect a malfunction if the alignment between the camshaft and crankshaft is off by one or more cam/crank sprocket cogs (e.g., the timing belt/chain has slipped by one ormore teeth/cogs). If a manufacturer demonstrates that a single tooth/cog misalignment cannot cause a measurable increase in emissions during any reasonable driving condition, the aBO system shall detect a malfunction when the minimum number of teeth/cogs misalignment needed to cause a measurable emission increase has occurred.

(3.2.2) autput Components/Systems:

(A) The aBO system shall detect a malfunction of an output component/system when proper functional response of the component and system to computer commands does not occur. If a functional check is not feasible, the aBO system shall detect malfunctions of output components/systems caused by a lack of circuit continuity or circuit fault (e.g., short to ground or high voltage). For output component lack of circuit continuity faults and circuit faults, the aBO system is not required to store different fault codes for each distinct malfunction (e.g., open circuit, shorted low). Manufacturers are not required to activate an output component/system when it would not normally be active exclusively for the purposes of performing functional monitoring of output components/systems as required in section (g)(3).

(B) The idle control systemshall be monitored for proper functional response to computer commands.

(i) For gasoline engines using monitoring strategies based on deviation from target idle speed, a malfunction shall be detected when either of the following conditions occur:

a. The idle speed control system cannot achieve the target idle speed within 200 revolutions per minute (rpm) above the target speed or 100 rpm below the target speed. The Executive affic"er shall allow larger engine speed tolerances upon determining that a manufacturer has submitted data and/or an engineering evaluation which demonstrate that the tolerances can be exceeded without a malfunction being present.

b. The idle speed control system cannot achieve the target idle speed within the smallest engine speed tolerance range required by the aBO system to enable any other monitors.

(ii) For diesel engines, a malfunction shall be detected when either any of the following conditions occur:

a. The idle ~~fuel~~ control system cannot achieve or maintain the ~~target~~ idle speed.or fuel injection quantity within +/-50 percent of the manufacturer-specified fuel quantity and target or desired engine speed tolerances.

b. The idle ~~fuel~~ control system cannot achieve the target or desired idle speed or fueling quantity within the smallest engine speed ~~or~~ fueling quantity"tolerance range required by the aBO system to enable any other monitors.

c. For 2013 and subsequent model year engines, the idle control system cannot achieve the fueling quantity within the smallest fueling quantity toleran'ce range required by the OBO system to . enable any other monitors.

d. For 2013 and subsequent model year engines. the idle control system cannot achieve the target idle speed with a fuel injection quantity within +/-50 percent of the fuel quantity necessary to achieve the target idle speed for a properly functioning engine and the given operating conditions.

(C) Glow plugs/intake air heater systems shall be monitored for proper functional response to computer commands and for circuit continuity faults. The glow pluglintake air heater circuit(s) shall be monitored for proper current and voltage drop. The Executive Officer shall approve other monitoring strategies based on manufacturer's data and/or engineering analysis demonstrating equally reliable and timely detection of malfunctions. Except as provided below, the OBO system shall detect a malfunction when a single glow plug no longer operates within the manufacturer's specified limits for normal operation. If a manufacturer demonstrates that a single glow plug failure cannot cause a measurable increase in emissions during any reasonable driving condition, the OBO system shall ,detect a malfunction for the minimum number of glow plugs needed to cause an emission increase. Further, to the extent feasible on existing engine designs (without adding additional hardware for this purpose) and on all ~~new~~ 2013 and subsequent model year design engines, the stored fault code shall identify the specific malfunctioning glow plug(s).

(0) The wait-to-start lamp circuit and the MIL circuit shaH be monitored for malfunctions that cause either the lamp to fail to illuminate when commanded on (e.g., burned out bulb).

(E) For output components/systems that are directly or indirectly used for any emission control strategies that are not covered under sections (e), (f), and (g)(1) (e.g., an intake throttle used for a control strategy that adjusts intake throttle position to regulate SCR catalyst inlet temperature within a target window), the OBO system shall detect functional malfunctions that prevent the component/system from achieving the desired functional response necessarvfor the strategy to operate in its intended manner. These malfunctions include faults that inappropriately prevent or delay the activation of the emission control strategy, cause the system to erroneously exit the emission control strategy. or where the control strategy has used up all of the adjustments or authority allowed by the manufacturer and is still unable to achieve the desired condition. The Executive Officer may waive detection of specific malfunctions upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that reliable detection of the malfunction is technically infeasible or would require additional hardware.

(F) For 2013 and subsequent model year engines that utilize fuel control system components (e.g.. injectors, fuel pump) that have tolerance compensation features implemented in hardware or software during production or repair procedures (e.g., individually coded injectors for flow characteristics that are programmed into an electronic control unit to compensate for injector to injector tolerances. fuel pumps that use in-line resistors to correct for differences in fuel pump volume output), the components shall be monitored to ensure the proper compensation is being used. The system shall detect a fault if the compensation being used by the control system does not match the compensation designated for the installed component (e.g., the flow characteristic coding designated on a specific injector does not match the compensation being used by the fuel control system for that injector). If a manufacturer demonstrates that a single component (e.g., injector) using the wrong compensation cannot cause a measurable increase in emissions during any reasonable driving condition, the manufacturer shall detect a malfunction for the minimum number of components using the wrong compensation needed to cause an emission increase. Further. the stored fault code shall identify the specific component that does not match the compensation.

(3.3) Monitoring Conditions:

(3.3.1) Input Components:

(A) Except as provided in section (g)(3.3.1)(C), input components shall be monitored continuously for proper range of values and circuit continuity.

(B) For rationality monitoring (where applicable) manufacturers shall define the monitoring conditions for detecting malfunctions in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that rationality monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2).

(C) A manufacturer may request Executive Officer approval to disable continuous input component proper range of values or circuit continuity monitoring when a malfunction cannot be distinguished from other effects. The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning input component cannot be distinguished from a malfunctioning input component and that the disablement interval is limited only to that necessary for avoiding false detection.

(3.3.2) Output Components/Systems:

(A) Except as provided in section (g)(3.3.2)(O), monitoring for circuit continuity and circuit faults shall be conducted continuously.

(B) Except as provided in section (g)(3.3.2)(C), for functional monitoring, manufacturers shall define the monitoring conditions for detecting malfunctions in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(C) For the idle control system, manufacturers shall define the monitoring conditions for functional monitoring in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that functional monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2).

(D) A manufacturer may request Executive Officer approval to disable continuous output component circuit continuity or circuit fault monitoring when a malfunction cannot be distinguished from other effects. The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning output component cannot be distinguished from a malfunctioning output component and that the disablement interval is limited only to that necessary for avoiding false detection.

(3.4) MIL Illumination and Fault Code Storage:

(3.4.1) Except as provided in sections (g)(3.4.2) and (3.4.4) and (3.4.3) below, general requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(3.4.2) Exceptions to general requirements for MIL illumination. MIL illumination is not required in conjunction with storing a confirmed or MIL-on fault code for any comprehensive component if:

(A) the component or system, when malfunctioning, could not cause engine emissions to increase by 15 percent or more of the FTP standard during any reasonable driving condition; and

(B) the component or system is not used as part of the diagnostic strategy for any other monitored system or component.

(3.4.3) E*ceptioAs for MIL circuit faults. MIL illumination is not required if a malfunction in the MIL circuit that prevents the MIL from illuminating (e.g., burned out bulb or ~~LED) has~~ been detected. However, the electronic MIL status (see section (h)(4.2)) shall be reported as MIL commanded on and a confirmed or MIL on ~~fault~~ code (see section (h)(4.4)) shall be stored.

(3.4.3) For purposes of determining the emission increase in section (g)(3.4.2)(A). the manufacturer shall request Executive Officer approval of the test cycle/vehicle operating conditions for which the emission increase will be determined. Executive Officer approval shall be granted upon determining that the manufacturer has submitted data and/or engineering evaluation that demonstrate that the testing conditions represent in-use driving conditions where emissions are likely to be most affected by the malfunctIoning component. For purposes of determining whether the specified percentages in section (g)(3.4.2)(A) are exceeded. if the approved testing conditions are comprised of an emission test cycle with an emission standard, the measured increase shall be compared to a percentage of the emission standard (e.g., if the increase is equal to or more than 15 percent of the emission standard for that test cycle). If the approved testing conditions are comprised of a test cycle or vehicle operating condition that does not have an emission standard, the measured increase shall be calculated as a percentage of the baseline test (e.g.. if the increase from a back-to-back test sequence between normal and malfunctioning condition is equal to or more than 15 percent of the baseline test results from the normal condition).

(3.4.4) For malfunctions required to be detected by section (g)(3.2.2)(B)(ii)d. (idle control fuel injection quantity faults). the stored fault code is not required to specifically identify the idle control system (e.g., a fault code for cylinder fuel injection quantity imbalance or combustion quality monitoring can be stored).

(4) ***OTHER EMISSION CONTROL SYSTEM MONITORING***

(4.1) Requirement: For other emission control systems that are: (1) not identified or addressed in sections (e)(1) through (g)(3) (e.g., hydrocarbon traps, homogeneous charge compression ignition (HCCI) control systems), or (2) identified or addressed in section (g)(3) but not corrected or compensated for by an adaptive control system (e.g., swirl control valves), manufacturers shall submit a plan for Executive Officer approval of the monitoring strategy, malfunction criteria, and monitoring conditions prior to introduction on a production engine. Executive Officer approval shall be based on the effectiveness of the monitoring strategy, the malfunction criteria utilized, the monitoring conditions required by the diagnostic, and, if applicable, the determination that the requirements of section (g)(4.2) and (g)(4.3) below are satisfied.

(4.2) For engines that utilize emission control systems that alter intake air flow or cylinder charge characteristics by actuating valve(s), flap(s), etc. in the intake air delivery system (e.g., swirl control valve systems), the manufacturers, in addition to meeting the requirements of section (g)(4.1) above, may elect to have the OBD system monitor the shaft to which all valves in one intake bank are physically attached in lieu of monitoring the intake air flow, cylinder charge, or individual valve(s)/flap(s) for proper functional response. For non-metal shafts or segmented shafts, the monitor shall verify all shaft segments for proper functional response (e.g., by verifying the segment or portion of the shaft furthest from the actuator properly functions). For systems that have more than one shaft to operate valves in multiple intake banks, manufacturers are not required to add more than one set of detection hardware (e.g., sensor, switch) per intake bank to meet this requirement.

(4.3) For emission control strategies that are not covered under sections (e), (f), and (g)(1) (e.g., a control strategy that regulates SCR catalyst inlet temperatures within a target window), Executive Officer approval shall be based on the effectiveness of the plan in detecting malfunctions that prevent the strategy from o.perating in its intended manner. These malfunctions include faults that inappropriately prevent or delay the activation of the emission control strategy, faults that cause the system to erroneously exit the emission control strategy, and faults where the control strategy has used up all of the adjustments or authority allowed by the manufacturer and is still unable to achieve the desired condition. The Executive Officer may waive detection of specific malfunctions upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that reliable detection of the malfunction is technically infeasible or would require additional hardware.

(5) ***EXCEPTIONS* TO *MONITORING REQUIREMENTS***

(5.1) Upon request of a manufacturer or upon the best engineering judgment of the ARB, the Executive Officer may revise the emission threshold for any monitor in sections (e) through (g) or revise the PM filter malfunction criteria of section (e)(8.2.1) to exclude detection of specific failure modes (e.g., partially melted substrates) if the most reliable monitoring method developed requires a higher threshold (or, in the case of section (e)(8.2.1), the exclusion of specific failure modes) to prevent significant errors of commission in detecting a malfunction.

(5.2) For 2010 through 2012 model year diesel engines, in determining the malfunction criteria for diesel engine monitors in sections (e)(1), (3), (4), (5), (8.2.2), (8.2.4), (9.2.1)(A), and (e)(10), the manufacturer shall use a threshold of 2.5 times any of the applicable NMHC, CO, or NOx standards in lieu of 2.0 times any of the applicable standards.

(5.3) Manufacturers may request Executive Officer approval to disable an OBO system monitor at ambient engine start temperatures below 20 degrees Fahrenheit (low ambient temperature conditions may be determined based on intake air or engine coolant temperature at engine start) or at elevations above 8000 feet above sea level. The Executive Officer shall approve the request upon determining that the manufacturer has provided data and/or an engineering evaluation that demonstrate that monitoring during the conditions would be unreliable. A manufacturer may further request, and the· Executive Officer shall approve, that an OBO system monitor be disabled at other ambient engine start temperatures upon determining that the manufacturer has demonstrated with data and/or an engineering evaluation that misdiagnosis would occur at the ambient temperatures because of its effect on the component itself (e,g., component freezing).

(5.4) Manufacturers may request Executive Officer approval to disable monitoring systems that can be affected by low fuel level or running out of fuel (e.g., misfire detection) when the fuel level is 15 percent or less of the nominal capacity of the fuel tank. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that monitoring at the fuel levels would be unreliable and the OBO system is able to detect a malfunction if the component(s) used to determine fuel level erroneously indicates a fuel level that causes the disablement.

(5.5) Manufacturers may disable monitoring systems that can be affected by vehicle battery or system voltage levels.

(5.5.1) For monitoring systems affected by low vehicle battery or system voltages, manufacturers may disable monitoring systems when the battery or system voltage is below 11.0 Volts. Manufacturers may request Executive Officer approval to utilize a voltage threshold higher than 11.0 Volts to disable system monitoring. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that monitoring at the voltages would be unreliable and that either operation of a vehicle below the disablement criteria for extended periods of time is unlikely or the OBO system monitors the battery or system voltage and will detect a malfunction at the voltage used to disable other monitors.

(5.5.2) For monitoring systems affected by high vehicle battery or system voltages, manufacturers may request Executive Officer approval to disable monitoring systems when the battery or system voltage exceeds a manufacturer-defined voltage. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that monitoring above the manufacturer-defined voltage would be unreliable and that either the electrical charging system/alternator warning light is- illuminated (or voltage gauge is in the "red zone") or the OBD system monitors the battery or system voltage and will detect a malfunction at the voltage used to disable other monitors.

(5.6) A manufacturer may disable affected monitoring systems in vehicles designed to accommodate the installation of PTO units (as defined in section (c», provided disablement occurs only while the PTO unit is active, and the OBD readiness status is cleared by the on-board computer (Le., all monitors set to indicate "not cOmplete") while the PTO unit is activated (see section (h)(4.1) below). If the disablement occurs, the readiness status may be restored to its state prior to PTO activation when the disablement ends.

(5.7) Whenever the requirements in sections (e) through (g) of this regulation require monitoring "to the extent feasible", the manufacturer shall submit its proposed monitor(s) for Executive Officer approval. The Executive Officer shall approve the proposal upon determining that the proposed monitor(s) meets the criteria of "to the extent feasible" by considering the best available monitoring technology to the extent that it is known or should have been known to the manufacturer and given the limitations of the manufacturer's existing hardware, the extent and degree to which the monitoring requirements are met in full, the limitations of monitoring necessary to prevent significant errors of commission and omission, and the extent to which the manufacturer has considered and pursued alternative monitoring concepts to meet the requirements in full. The manufacturer's consideration and pursuit of alternative monitoring concepts shall include evaluation of other modifications to the proposed monitor(s), the monitored components themselves, and other monitors that use the monitored components (e.g., altering other monitors to lessen the sensitivity and reliance on the component or characteristic of the component subject to the proposed monitor(s)).

(h) *STANDARDIZATION REQUIREMENTS*

(1) ***Reference Documents:***

The following Society of Automotive Engineers (SAE) and International Organization of Standards (ISO) documents are incorporated by reference into this regulation:

(1.1) SAE J1930 "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms - Equivalent to ISOITR 15031-2:April 30, ~~2002~~", April 2002October 2008 (SAE J1930).

(1.2) SAE J1962 "Diagnostic Connector- Equivalent to ISO/DIS 15031-3: December 14, 2001", April 2002 (SAE J1962).

(1.3) SAE J1978 "OBD II Scan Tool- Equivalent to ISO/DIS 15031-4: December 14,2001", April 2002 (SAE J1978).

(1.4) SAE J1979 "E/E Diagnostic Test Modes Equivalent to ISOIDIS 15031 5:April 30, 2002", April 2002May 2007 (SAE J1979).

(1.5) SAE J2012 "Diagnostic Trouble Code Definitions' ~~Equivalent~~ to ISOIDIS 15031 6:April 30, 2002", April2002December 2007 (SAE J2012).

(1.6) ISO 15765-4:20015 "Road Vehicles-Diagnostics on Controller Area Network (CAN) - Part 4: Requirements for emission-related systems", December ~~2001~~January 2005 (ISO 15765-4).

(1.7) SAE J1939 consisting of:

(1.7.1) J1939 Recommended Practice for a Serial Control and Communications Vehicle Network, March 2009;

(1.7.2) J1939/1 Recommended Practice for Control a'nd Communications Network for On-Highway Equipment. September 2000;

(1.7.3) J1939/11 Physical Layer, 250K bits/s, Twisted Shielded Pair, September 2006;

(1.7.4) J1939/13 Off-Board Diagnostic Connector, March 2004;

(l.7.5) J1939115 Reduced Physical Layer, 250K bits/sec, UN-Shielded Twisted Pair (UTP), 'August 2008;

(1.7.6) J1939/21 Data Link Layer, December 2006; ,

(1.7.7) J1939/31 Network Layer, April 2004;

(l.7.8) J1939/71 Vehicle Application Layer (Through February 2008), January 2009;

(1.7.9) J1939/73 Application Layer-Diagnostics, September 2006;

0.7.10) J1939/81 Network Management. May 2003; and

(1.7.11) J1939/84 aBO Communications Compliance Test Cases For Heavy Duty Components and Vehicles, December 2008.March 2005 "Recommended Practice for a Serial Control and Communications Vehicle ~~Network~~" and the associated subparts included in SAE HS 1939; "Truck and ~~Bus~~ Control and Communications Network Standards Manual", 2005 Edition (SAE J1939).

(1.8) SAE J2403 "Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature," August ~~2004~~ 2007 (SAE J2403).

(1.9) SAE J1699-3 - "aBO II Compliance Test Cases", May 2006 (SAE J1699-3).

0.10) SAE J2534-1 - "Recommended Practice for Pass-Thru Vehicle Programming", December 2004 (SAE J2534-1). '

(2) ***Diagnostic Connector:***

A standard data link connector conforming to SAE J1962 or SAE J1939-13 specifications (except as specified in section (h)(2.3» shall be incorporated in each vehicle.

(2.1) For the 2010 through 2012 model year engines:

(2.1.1) The connector shall be located in the driver's side foot-well region of the vehicle interior in the area bound by the driver's side of the vehicle and the driver's side edge of the center console (or the vehicle centerline' if the vehicle does not have a center console) and at a location no higher than the bottom of the steering wheel when in the lowest adjustable position. The connector may not be located on or in the center console (Le., neither on the horizontal faces near the floor-mounted gear selector, parking brake lever, or cup-holders nor on the vertical faces near the car stereo, climate system, or navigation system controls).

(?.1.2) If the connector is covered, the cover must be removable by hand without the use of any tools and be labeled "OBO" to aid technicians in identifying the location of the connector. Access to the diagnostic connector may not require opening or the removal of any storage accessory (e.g., ashtray, coinbox). The label shall be submitted to the Executive Officer for review and approval, at or before the time the manufacturer submits its certification application. The Executive Officer shall approve the label upon determining that it clearly identifies that the connector is located behind the cover and is consistent with language and/or symbols commonly used in the automotive industry.

(2.2) For 2013 and subsequent model year engines:

(2.2.1) The connector shall be located in the driver's side foot-well region of the vehicle interior in the area bound by the driver's side of the vehicle and the foot pedal closest to the driver's side of the vehicle (left most pedal in a left hand drive vehicle) excluding a foot-activated emergency brake if equipped (e.g., typically the brake pedal for an automatic transmission equipped vehicle 'or the clutch pedal for a manual transmission equipped vehicle) and at a location no higher than the bottom of the steering wheel when in the lowest adjustable position.

(2.2.2) The connector shall be mounted in an uncovered location and may not be covered with or located behind any form of panel, access door, or storage device (e.g., fuse panel cover, hinged door, ashtray, coinbox) that requires opening or removal to access the connector. The connector may be equipped with a dust cap in the shape and size of the diagnostic connector for environmental protection purposes but the dust cap must be removable by hand without the use of any tools and be labeled "OBD" to aid technicians in identifying the connector.

(2.2.3) The connector shall be mounted in a manner that allows vehicle operation and driving (e.g., does not interfere with use of driver controls such as the clutch, brake, and accelerator pedal) while a scan tool is connected to the vehicle.

(2.3) The location of the connector shall be capable of being easily identified and accessed (e.g., to connect an off-board tool). For vehicles equipped with a driver's side door, the connector shall be capable of being easily identified and accessed by a technician standing (or "crouched") on the ground outside the driver's side of the. vehicle with the driver's side door open.

~~(2.3)~~(2.4) If the ISO 15765-4 protocol (see section (h)(3» is used for the required OBO standardized functions, the connector shall meet the "Type A" specifications of SAE J1962. Any pins in the connector that provide electrical power shall be properly fused to protect the integrity and usefulness of the connector for diagnostic purposes and may not exceed 20.0 Volts DC regardless of the nominal vehicle system or battery voltage (e.g., 12V, 24V, 42V).

~~(2.4)~~(2.5) If the SAE J1939 protocol (see section (h)(3» is used for the required. OBO standardized functions, the connector shall meet the specifications of SAE J1939-13. Any pins in the connector that provide electrical power shall be properly fused to protect the integrity and usefulness of the connector for diagnostic purposes.

~~(2.5)~~(2.6) Manufacturers may equip vehicles with additional diagnostic connectors for manufacturer-specific purposes (Le., purposes other than the required aBO functions). However, if the additional connector conforms to the "Type A" specifications of SAE J1962 or the specifications of SAE J1939-13 and is located in the vehicle interior near the required connector of section (h)(2.3) or (2.4), the connector(s) must be clearly labeled to identify which connector is used to access the standardized aBO information required in section (h).

(3) ***Communications* to a *Scan Tool:***

All aBO control modules (e.g., engine, auxiliary emission control module) on a single vehicle shall use the same protocol for communication of required emission-related messages from on-board to off-board network communications to a scan tool meeting SAE J1978 specifications or designed to communicate with an SAE J1939 network. Engine manufacturers shall not alter normal , operation of the engine emission control system due to the presence of off-board test equipment accessing information required by section (h). The aBO system shall use one of the following standardized protocols:

(3.1) ISO 15765-4. All required emission-related messages using this protocol shall use a 500 kbps baud-rate.

(3.2) SAE J1939. This protocol may only be used on vehicles with diesel engines.

(4) ***Required Emission Related Functions:***

The following standardized functions shall be implemented in accordance with the specifications in SAE J1979 or SAE J1939 to allow for access to the required _ information by a scan tool meeting SAE J1978 specifications or designed to communicate with an SAE J1939 network:

(4.1) Readiness Status: In accordance with SAE J1979/J1939-73 specifications, the aBO system shall indicate "complete" or "not complete" since the fault memory was last cleared for each of the installed- monitored components and systems identified in sections (e)(1) through (f)(9), and (g)(3) except (e)(11) and (f)(4). All components or systems identified in (f)(1), (f)(2), or (g)(3) that are monitored continuously shall always indicate "complete". Components or systems that are not subject to continuous monitoring shall immediately - indicate "complete" upon the respective diagnostic(s) being fully executed and determining that the component or system is not malfunctioning. A component or system shall also indicate "complete" if after the requisite number of decisions necessary for determining MIL status has been fully executed, the monitor indicates a malfunction for the component or system. The status for each of the monitored components or systems shall indicate "not complete" whenever fault memory has been cleared or erased by a means other than that aUowed in section (d)(2). Normal vehicle shut down (Le., key off, engine off) may not cause the status to indicate "not complete".

(4.1.1) Subject to Executive Officer approval, a manufacturer may request that the readiness status for a monitor be set to indicate "complete" without monitoring having been completed if monitoring is disabled for a multiple number of driving cycles due to the continued presence of extreme operating conditions (e.g., cold ambient temperatures, high altitudes). Executive Officer approval shall be based on the conditions for monitoring system disablement and the number of driving cycles specified without completion of monitoring before readiness is indicated as "complete".

(4.1.2) For the evaporative system monitor, the readiness status shall be set in accordance with section (h)(4.1) when both the functional check of the purge valve and, if applicable, the leak detection monitor of the" orifice size specified in section (f)(7.2.2)(B) (e.g., 0.150 inch) indicate that they are complete.

(4.1.3) If the manufacturer elects to additionally indicate readiness status through the MIL in the key on, engine off position as' provided for in section (d)(2.1.3), the readiness status shall be indicated in the following manner: If the readiness status for all monitored components or systems is "complete", the MIL shall remain continuously illuminated in the key on, engine off position for at least 15-20 seconds. If the readiness status for one or more of the monitored components or systems is "not complete", after 15-20 seconds of operation in the key on, engine.off position with the MIL illuminated continuously, the MIL shall blink once per second for 5-10 seconds. The data stream value for MIL status (section (h)(4.2)) shall indicate "commanded off' during this sequence unless the MIL has also been "commanded on" for a detected fault.

(4.2) Data Stream: The following signals shall be made available on demand through the standardized data link connector in accordance with SAE J1979/J1939 specifications. The actual signal value shall always be used instead of a default or limp home value.

(4.2.1) For all gasoline engines:

(A) Calculated load value, engine coolant temperat.ure, engine speed, vehicle speed, time elapsed since engine start; and

(B) Absolute load, fuel level (if used to enable or disable any other diagnostics), barometric pressure (directly measured or estimated), engine control module system voltage, commanded equivalence ratio; and

(C) Number of stored confirmed fault codes, catalyst temperature (if directly measured or estimated for purposes of enabling the catalyst monitor(s)), monitor status (Le., disabled for the rest of this driving cycle, complete this driving cycle, or not complete this driving cycle) since last engine shut-off for each monitor used for readiness status, distance traveled (or engine run time for engines not utilizing vehicle speed information) while MIL activated, distance traveled (or engine run time for engines not utilizing vehicle speed information) since fault memory last cleared, and number of warm-up cycles since fault memory last cleared, OBO requirements to which the engine is certified (e.g., California OBO, EPA OBD, European OBO, non-OBO) and MIL status (Le., commanded-on or commanded-off).

(4.2.2) For all diesel engines:

(A) Calculated load (engine torque as a percentage of maximum torque available at the current engine speed), driver's demand engine torque (as a percentage of maximum engine torque), actual engine torque (as a percentage of maximum engine torque), reference engine maximum torque, reference maximum engine torque as a function of engine speed (suspect parameter numbers (SPN) 539 through 543 defined by SAE

J1939 within parameter group number (PGN) .65251 for engine configuration), engine coolant temperature, engine oil temperature (if used for emission control or any OBO diagnostics), engine speed, time elapsed since engine start; and .

(B) Fuel level (if used to enable or disable any other diagnostics), vehicle speed (if used for emission 'control or any OBO diagnostics), barometric pressure (directly measured or estimated), engine control module system voltage; and

(C) Number of stored confirmed/MIL-on fault codes, monitor status (Le., disabled for the rest of this driving cycl.e, complete this driving cycle, or not . complete this driving cycle) since last engine shut-off for each monitor used for readiness status, distance traveled (or engine run time for engines not utilizing vehicle speed information) while MIL activated, distance traveled (or engine run time for engines not utilizing vehicle speed information) since fault memory last cleared, number of warm-up cycles since fault memory last cleared, OBO requirements to which the engine is certified (e.g., California OBO, California OBO-child rating (Le., for engines subject to (d)(7.1.2) or (d)(7.2.3)) EPA OBO, European OBO, non-OBO), and MIL status (Le., commanded-on or comm.anded-off);

(0) NOx NTE control area status (Le., inside control area, outside control area, inside manufacturer-specific NOx NTE carve-out area, or deficiency active area), and PM NTE control area status (Le., inside control area, outside control area, inside manufacturer-specific PM NTE carve-out area, or deficiency active area);

(E) For 2013 and subsequent model year engines, normalized trigger for PM filter regeneration, PM filter regeneration status; and

(F) For 2013 and subsequent model year engines, average distance (or . engine run time for engines not utilizing vehicle speed information) between PM filter regenerations.

(E)(G) For purposes of the calculated load and torque parameters in section (h)(4.2.2)(A), manufacturers shall report the most accurate values that are calculated within the applicable electronic control unit (e.g., the engine control module). "Most accurate values", in this context, shall be of sufficient accuracy, resolution, and filtering to be used for the purposes 'of in-use emission testing with the engine still in a vehicle (e.g., using portable emission measurement equipment).

(4.2.3) For all engines so equipped:

(A) Absolute throttle position, relative throttle position, fuel control system status (e.g., open loop, closed loop), fueltrim, fuel pressure, ignition timing advance, fuel injection timing, intake air/manifold temperature, engine intercooler temperature, manifold absolute pressure, air flow rate from mass air flow sensor, secondary air status (upstream, downstream, or atmosphere),' ambient air temperature, commanded purge valve duty cycle/position, commanded EGR valve duty cycle/position, actual EGR valve duty cycle/position, EGR error between actual and commanded, PTO status (active or not active), redundant absolute throttle position (for electronic throttle or other systems that utilize two or more sensors), absolute pedal position, redundant absolute pedal position, commanded throttle motor position, fuel rate, boost pressure, commanded/target boost pressure, turbo inlet air temperature, fuel rail pressure, commanded fuel rail pressure, PM filter inlet pressure, PM filter inlet temperature, PM filter outlet pressure, PM filter outlet temperature, PM filter delta pressure, exhaust pressure sensor output, exhaust gas temperature sensor output, injection control pressure, commanded injection control pressure, turbocharger/turbine speed, variable geometry turbo position, commanded variable geometry turbo position, turbocharger compressor inlet temperature, turbocharger compressor inlet pressure, turbocharger turbine inlet temperature, turbocharger turbine outlet temperature, wastegate valve position, glow plug lamp status; ~~and~~

(8) For 2013 and subsequent model year engines, EGR temperature, variable geometry turbo control status (e.g., open loop, closed loop), reductant level (e.g., urea tank fillleve!), alcohol fuel percentage, type of fuel currently being used, NOx adsorber regeneration.status, NOx adsorber deSOx status, hybrid battery pack remaining charge;

(C) Oxygen sensor output, air/fuel ratio sensor output, NOx sensor output, ~~and~~ evaporative system vapor pressure; and

-(0) For 2013 and subsequent model year engines, PM sensor output and distance traveled while low/empty SCR reductant driver warning/inducement active.

(4.3) Freeze Frame:~~.~~

(4.3.1) "Freeze frame" information required to be stored pursuant to sections (d)(2.2.1)(0), (d)(2.2.2)(0), (e)(1.4.2)(0), (e)(2.4.2)(8), (f)(1.4.4), and (f)(2.4.3) shall be made available on demand through the standardized data link connector in accordance with SAE J1979/J1939-73 specifications.

(4.3.2) "Freeze frame" conditions must include the fault code which caused the data to be stored and all of the signals required in sections (h)(4.2.1)(A) and (4.2.2)(A). Freeze frame conditions shall also include all of the signals required on the engine in sections (h)(4.2.1)(8), (4.2.2)(8), (4.2.2)(E), ~~and~~ (4.2.3)(A), and (4.2.3)(8) that are used for diagnostic or control purposes in the specific diagnostic or emission-critical powertrain control unit that stored the fault code.

(4.3.3) Only one frame of data is required to be recorded. Manufacturers may choose to store additional frames provided that at least the required frame -can be read by a scan tool meeting SAE J1978 specifications or designed to communicate with an SAE J1939 network.

(4.4) Fault Codes:

(4.4.1) For vehicles using the ISO 15765-4 protocol for the standardized functions required in section (h):

(A) For all monitored components and systems, stored pending, confirmed, and permanent fault codes shall be made available through the diagnostic connector in a standardized format in accordance with SAE J1979 specifications. Standardized fault codes conforming to SAE J2012 shall be employed.

(8) The stored fault code shall, to the fullest extent possible, pinpoint the likely cause of the malfunction. To the extent feasible, manufacturers

shall use separate fault codes for every diagnostic where the diagnostic and repair procedure or likely cause of the failure is different. In general, rationality and functional diagnostics shall use different fault codes than the respective circuit continuity diagnostics. Additionally, input component circuit continuity diagnostics shall use different fault codes for distinct malfunctions (e.g.,out-of-range low, out-of-range high, open circuit).

(C) ManufaCturers shall use appropriate SAE-defined fault codes of SAE J2012 (e.g., POxxx, P2xxx) whenever possible. With ExeGutive Officer approval, manufacturers may use manufacturer-defined fault codes in accordance with SAE J2012 specifications (e.g., P1xxx). Factors to be considered by the Executive Officer for approval shall include the lack of available SAE-defined fault codes, uniqueness of the diagnostic or monitored component, expected future usage of the diagnostic or component, and estimated usefulness in providing additional diagnostic and repair information to service technicians. Manufacturer-defined fault codes shall be used consistently (i.e., the same fault code may not be used to represent two different failure modes) across a manufacturer's entire product line.

(0) A pending or confirmed fault code (as required in sections (d) and (e) through (g)) shall be stored and available to an SAE J1978 scan tool within 10 seconds after a diagnostic has determined that a malfunction has occurred. A permanent fault code shall be stored and available to an SAE J1978 scan tool no later than the end of an ignition cycle (including electronic control unit shutdown) in which the corresponding confirmed fault code causing the MIL to be illuminated has been stored.

(E) Pending fault codes:

(i) Pending fault codes for all components and systems (including continuously and non-continuously monitored components) shall be made available"through the diagnostic connector in accordance with SAE J1979 specifications (e.g., Mode/Service $07).

(ii) A pending fault code(s) shall be stored and available through the diagnostic connector for all currently malfunctioning monitored component(s) or system(s), regardless of the MIL illumination status or " confirmed fault code status (e.g., even after a pending fault has matured to a confirmed fault code and the MIL is illuminated, a pending fault code shall be stored and available if the most recent monitoring event indicates the component.is malfunctioning).

(iii) Manufacturers using alternate statistical protocols for MIL illumination as allowed in section (d)(2.2.1)(C) shall submit to the Executive Officer a protocol for setting pending fault codes. The Executive Officer shall approve the proposed protocol upon determining that, overall, it is equivalent to the requirements in sections (h)(4.4.1)(E)(i) and (ii) and that it effectively provides service technicians with a quick and accurate indication of a pending failure.

(F) Permanent fault codes:

(i) Permanent fault codes for all components and systems shall be made available through the diagnostic connector in a standardized format that distinguishes permanent fault codes from both pending fault codes and confirmed fault codes.

(ii) A confirmed fault code shall be stored as a permanent fault code no later than the end of the ignition cycle and subsequently at all times that the confirmed fault code is commanding the MIL on (e.g., for currently failing systems but not during the 40 warm-up cycle self-healing process described in section (d)(2.3.1)(B».

(iii) Permanent fault codes shall be stored in NVRAM and may not be erasable by any scan tool command (generic or enhanced) or by disconnecting power to the on-board computer.

(iv) Permanent fault codes shall bemay not be ~~erasableed~~ ~~if when~~ the engine control module containing the permanent fault code is reprogrammed unless ~~and~~ the readiness status (refer to section (h)(4.1» for all monitored components and systems are set to "not complete.' in conjunction with the reprogramming event.

(v) The aBO system shall have the ability to store a minimum of four current confirmed fault codes as permanent fault codes in NVRAM. If the number of confirmed fault codes currently commanding the MIL on exceeds the maximum number of permanent fault codes that can be stored, the OBO system shall store the earliest detected confirmed fault codes as permanent fault codes. If additional confirmed fault codes are stored when the maximum number of permanent fault codes is already stored in NVRAM, the OBO system may not replace any existing permanent fault code with the additional confirmed fault codes.

(4.4.2) For vehicles using the SAE J1939 protocol for the standardized functions required in section (h):

(A) For all monitored' components and systems, stored pending, MIL-on, and previously MIL-on fault codes shall be made available through the diagnostic connector in a standardized format in accordance with SAE J1939 specifications (Le., Oiagnostic Message (OM) 6, OM12, and OM23). Standardized fault codes conforming to SAE J1939 shall be employed.

(B) The stored fault code shall, to the fullest extent possible, pinpoint the likely cause of the malfunction. To the extent feasible, manufacturers shall use separate fault codes for every diagnostic where the diagnostic and repair procedure or likely cause of the failure is different. In general, rationality and functional diagnostics shall use different fault codes than the respective circuit continuity diagnostics. Additionally, input component circuit continuity diagnostics shall use different fault codes for distinct malfunctions (e.g., out-of-range low, out-of-range high, open circuit).

(C) Manufacturers shall use appropriate SAE-defined fault codes of SAE J939 whenever possible. With Executive Officer approval, manufacturers may use manufacturer-defined fault codes in accordance with SAE J1939 specifications. Factors to be considered by the Executive Officer for approval shall include the lack of available SAE-defined fault codes, uniqueness of the diagnostic or monitored component, expected future usage of the diagnostic or component, and estimated usefulness in providing additional diagnostic and repair information to service technicians. Manufacturer-defined fault codes shall be used consistently (Le., the same fault code may not be used to represent two different failure modes) across a manufacturer's entire product line.

. (0) A pending or MIL-on fault code (as required in sections (d), (e), and (g» shall be stored and available to an SAE J1939 scan tool within 10 seconds after a diagnostic has determined that a malfunction has occurred. A permanent fault code shall be stored and available to an SAE J1939 scan tool no later than the end of an ignition cycle (including electronic control unit shutdown) in which the corresponding MIL-on fault code causing the MIL to be illuminated has been stored.

(E) Pending fault codes:

(i) Pending fault codes for all components and systems (including · continuously and non-continuously monitored components) shall be made available through the diagnostic connector in accordance with SAE J1939 specifications (Le., OM6).

(ii) Manufacturers using alternate statistical protocols for MIL illumination as allowed in section (d)(2.2.2)(C) shall submit to the Executive Officer a protocol for setting pending fault codes. ·The Executive Officer shall approve the proposed protocol upon determining that, overall, it is equivalent to the requirements in sections (h)(4..4.2)(E)(i) and that it effectively provides service technicians with a quick and accurate indication of a pending failure. .

(F) Permanent fault codes:

(i) Permanent fault codes for all components and systems shall be made · available through the diagnostic connector. in a standardized format that distinguishes permanent fault codes from pending fault codes, MIL-on fault codes, and previously MIL-on fault codes.

(ii) A MIL-on fault code shall be stored as a permanent fault code no later than the end of the ignition cycle and subsequently at all times that the MIL-on fault code is commanding the MIL on (e.g., for currently failing systems).

(iii) Permanent fault codes shall be stored in NVRAM and may not be · erasable by any scan tool command (generic or enhanced) or by disconnecting power to the on-board computer.

(iv) Permanent fault codes shall bemay not be erasableed if when the engine control module containing the permanent fault codes is reprogrammed unlessand the readiness status (refer to section (h)(4.1» for all monitored components and systems are set to "not complete." in conjunction with the reprogramming event.

(v) The OBO system shall have the ability to store a minimum of four current MIL-on fault codes as permanent fault codes in NVRAM.. If the number of MIL-on fault codes currently commanding the MIL on exceeds the maximum number of permanent fault codes that can be . stored, the OBO system shall store the earliest detected MIL-on fault codes as permanent fault codes. If additional MIL-on fault codes are stored when the maximum number of permanent fault codes is already stored in NVRAM, the OBO system may not replace any existing permanent fault code with the additional MIL-on fault codes.

(4.5) Test Results:

(4.5.1) Except as provided in section (h)(4.5.7), for all monitored components and systems identified in sections (e)(1) through (f)(9), results of the most recent monitoring of the components and systems and the test limits established for monitoring the respective cpmponents and systems shall be stored and available through the data link in accordance with the standardized format specified in SAE J1979 for the ISO 15765-4 protocol or SAE J1939.

(4.5.2) The test results shall be reported such that properly functioning components and systems (e.g., "passing" systems) do not store test values outside of the established test limits. Test limits shall include both minimum and maximum acceptable values and shall be defined so that a test result equal to either test limit is a "passing" value, not a "failing" value.

(4.5.3) The test results shall be standardized such that the name of the monitored component (e.g., catalyst bank 1) can be identified by a generic scan tool and the test results and limits can be scaled and reported with the appropriate engineering units by a generic scan tool.

(4.5.4) The test results shall be stored until updated by a more recent valid test result or the fault memory of the aBO system computer is cleared.

(4.5.5) Upon fault memory being cleared, test results reported for monitors that have not yet completed with valid test results since the last time the fault memory was cleared shall report values of zero for the test result and test limits. If the aBO system fault memory is cleared, all test results shall report values of zero for the test result and test limits. The test results shall be updated once the applicable monitor has run and has valid test results and limits to report.

(4.5.5)All test results and test limits shall always be reported and the test results shall be stored until updated by a more recent valid test result or the fault memory of the aBD system computer is cleared.

(4.5.6) All test results and test limits shall always be reported. The aBO system shall store and report unique test results for each separate diagnostic.

(4.5.7) The requirements of section (h)(4.5) do not apply to continuous gasoline fuel system monitoring specified under sections (f)(1.2.1)(A), (f)(1.2.1)(8), (f)(1.2.4), and (f)(1.2.5), gasoline exhaust gas sensor monitoring specified under sections (0(8.2.1)(C) and (f)(8.2.2)(E), cold start emission reduction strategy monitoring, and continuous circuit monitoring, continuous out-of-range monitoring, and diesel feedback control monitoring specified under sections (e)(1.2.4), (e)(3.2.4), (e)(4.2.5), (e)(6.2.2)(0), (e)(7.2.3), and (e)(8.2.7).

(4.6) Software Calibration Identification:

(4.6.1) Except as provided for in section (h)(4.6.3), GQn all vehicles, a single software calibration identification number (CAL 10) for each diagnostic or emission critical control unit(s) shall be made available through the standardized data link connector in accordance with the SAE J1979/J1939 specifications.

(4.6.2) A unique CAL 10 shall be used for every emission-related calibration and/or software set having at least one bit of different data from any other emission-related calibration and/or software set. Control units coded with multiple emission or diagnostic calibrations and/or software sets shall indicate a unique CAL 10 for each variant in a manner that enables an off-board device to determine which variant is being used by the vehicle. Control units that utilize a strategy that will result in MIL illumination if the incorrect variant is used (e.g., control units that contain variants for manual and automatic transmissions but will illuminate the MIL if the variant selected does not match the type of transmission on the vehicle) are not required to use unique CAL IDs.

(4.6.3) Manufacturers may request Executive Officer approval to respond with more than one CAL ID per diagnostic or emission critical powertrain control unit. Executive Officer approval of the request shall be based on the method used by the manufacturer to ensure each control unit will respond to a generic scan tool with the CAL IDs in order of highest to lowest priority with regards to areas of the software most "critical to emission and OBO system performance.

(4.7) Software Calibration Verification Number:

(4.7.1) All vehicles shall use an algorithm to calculate a single calibration verification number (CVN) that verifies the on-board computer software integrity for each diagnostic or emission critical ~~electronically~~ reprogrammabie control unit. The CVN shall be made available through the standardized data link connector in accordance with the SAE J1979/J1939 specifications. The CVN shall be capable of being used to determine if the emission-related software and/or calibration data are valid and applicable for that vehicle and CAL 10.

(4.7.2) One CVN shall be made available for each CAL 10 made available. For diagnostic or emission critical powertrain control units with more than one CAL 10, each CVN shall be output to a generic scan tool in the same order as the CAL IDs are output to the generic scan tool to allow the scan tool to match each CVN to the corresponding CAL 10.

(4.7.2)(4.7.3) Manufacturers shall submit information for Executive Officer approval ofthe algorithm used to calculate the CVN. Executive Officer approval of the algorithm shall be based on the complexity of the algorithm and the determination that the same CVN is difficult to achieve with modified calibration values.

(4.7.3)(4.7.4) The CVN shall be calculated at least once per driving ignition cycle and stored until the CVN is subsequently updated. Except for immediately after a reprogramming event or a non-volatile memory clear or for the first 30 seconds of engine operation after a volatile memory clear or battery disconnect, the stored value shall be made available through the data link connector to a generic scan tool in accordance with SAE J1979/J1939 specifications. The'stored CVN value may not be erased when fault memory is erased by a generic scan tool in accordance' with SAE J1979/J1939 specifications or during normal vehicle shutdown (Le., key off, engine off).

(4.7.4)(4.7.5) For purposes of Inspection and Mainten"ance (I/M) testing, manufacturers shall make the CVN and CAL 10 combination information available for all vehicles in a standardized electronic format that allows for off-board verification that the CVN is valid and appropriate for a specific vehicle and CAL 10. The standardized electronic format is detailed in Attachment XX of ARB Mail-Out #MSC XX-XX, Month Date, Year, incorporated by reference. Manufacturers shall submit the CVN and CAL ID information to the Executive Officer not more than 25 days after the close of a calendar quarter.

(4.8) Vehicle and Engine Identification Numbers:

(4.8.1) All vehicles shall have the vehicle identification number (VIN) available in a standardized format through the standardized data link connector in accordance with SAE J1979/J1939 specifications. Only one electronic control unit per vehicle shall report the VIN to an SAE J1978/J1939 scan tool.

(4.8.2) All 2013 and subsequent model year engines shall have the engine serial number (ESN) available in a standardized format through the standardized data link connector. Only one electronic-control unit per vehicle shall report the ESN to an SAE J1978/J1939 scan tool.

(4.8.2)(4.8.3) If the VIN or ESN is reprogrammable, all emission-related diagnostic information identified in section (h)(4.9.1) shall be erased in conjunction with reprogramming of the VIN or the ESN.

(4.9) ECU Name: For 2013 and subsequent model year engines, the name of each electronic control unit that responds to an SAE J1978/J1939 scan tool with a unique address or identifier shall be communicated in a standardized format in accordance with SAE J1979/J1939 (e.g., ECUNAME in Service/Mode $09, InfoType $OA in SAE J1979).

~~(4.9)~~(4.10) Erasure of Emission-Related Diagnostic Information:

(4.9.0(4.10.1) For purposes of section (h)(4.91 0), "emission-related diagnostic information" includes all the following:

(A) Readiness status (section (h)(4.1»

(B) Data stream information (section (h)(4.2» including number of stored confirmed/MIL-on fault codes, distance traveled while MIL activated, number of warm-up cycles since fault memory last cleared, and distance traveled since fault memory last cleared.

(C) Freeze frame information (section (h)(4.3»

(D) Pending, confirmed, MIL-on, and previously MIL-on fault codes (section (h)(4.4.»

(E) Test results (section (h)(4.5»

(4.9.2)(4.10.2) For all vehicles, the emission-related diagnostic information shall be erased if commanded by a scan tool (generic or enhanced) and may be erased if the power to the on-board computer is disconnected. If any of the emission-related diagnostic information is commanded to be erased by a scan tool (generic or enhanced), all emission-related diagnostic information from all diagnostic or emission critical control units shall be erased. The OBD system may not allow a scan tool to erase a subset of the emission-related diagnostic information (e.g., the aBO system may not allow a scan tool to erase only one of three stored fault codes or only information from one control unit without erasing information from the other control unit(s».

(5) *Tracking Requirements:*

(5.1) In-use Performance Ratio Tracking Requirements:

(5.1.1) For each monitor required in sections (e) through (g) to separately report an in-use performance ratio, manufacturers shall implement software algorithms to report a numerator and denominator in the standardized format specified below and in accordance with the SAE J1979/J1939 specifications.

(5.1.2) Numerical Value Specifications:

(A) For the numerator, denominator, general denominator, and ignition cycle counter:

(i) Each number shall have a minimum value of zero and a maximum value of 65,535 with a resolution of one.

(ii) Each number shall be reset to zero only when a non-volatile random access memory (NVRAM) reset occurs (e.g., reprogramming event) or, if the numbers are stored in keep-alive memory (KAM), when KAM is lost due to an interruption in electrical power to the control module (e.g., battery disconnect). Numbers may not be reset to zero under any other circumstances including when a scan tool command to clear fault codes or reset KAM is received.

(iii) If either the numerator or denominator for a specific component reaches the maximum value of 65,535 ±2, both numbers shall be divided by two before either is incremented again to avoid overflow problems.

(iv) If the ignition cycle counter reaches the maximum value of 65,535 ±2, the ignition cycle counter shall rollover and increment to zero on the next ignition cycle to avoid overflow problems.

(v) If the general denominator reaches the maximum value of 65,535 ±2, the general denominator shall rollover and increment to zero on the next driving cycle that meets the general denominator definition to avoid overflow problems.

(vi) If a vehicle is not equipped with a component (e.g., oxygen sensor bank 2, secondary air system), the corresponding numerator and denominator for that specific component shall always be reported as zero.

(8) For the ratio:

(i) The ratio shall have a minimum value of zero and a maximum value of 7.99527 with a resolution of 0.000122.

(ii) A ratio for a specific component shall be considered to be zero whenever the corresponding numerator is equal to zero and the corresponding denominator is not zero.

(iii) A ratio for a specific component shall be considered to be the maximum value of 7.99527 if the corresponding denominator is zero or if the actual value of the numerator divided by the denominator exceeds the maximum value of 7.99527.

(5.2) Engine Run Time Tracking Requirements:

(5.2.1) For all gasoline and diesel engines, manufacturers shall implement software algorithms to individually track and report in a standardized format the engine run time while being operated in the following conditions:

(A) Total engine run time;

(B) Total idle run time (with "idle" defined as accelerator pedal released by driver, vehicle speed less than or equal to one mile per hour, engine speed greater than or equal to 50 to 150 rpm below the normal, warmed-up idle speed (as determined in the drive position for vehicles equipped with an automatic transmission), and PTO not active), and either vehicle speed less than or equal to one mile per hour or engine speed less than or equal to 200 rpm above normal warmed-up idle, and;

(C) Total run time with PTa active.;

(D) For 2013 and subsequent model year diesel engines only,:

(i) total run time with EI-AECD #1 active;

(ii) total run time with EI-AECD #2 active; and so on up to

(iii) total run time with EI-AECD #n active.

(5,2.2) Numerical Value Specifications: For each counter specified in section (h)(5.2.1):

(I\)For each counter specified in section (h)(5.2.1):

(i)(A) Each number shall be a four byte value with a minimum value of zero, a resolution of one second per bit, and an accuracy of +/ ten seconds per driving cycle.conform to the standardized format specified in SAE J1979/J1939.

(ii)(B) Each number shall be reset to zero only when a non-volatile memory reset occurs (e.g,', reprogramming event). Numbers may not be reset to zero under any other circumstances including when a scan tool (generic or enhanced) command to clear fault codes or reset KAM is received.

(iii)(C) If any of the individual counters reach the maximum value, all counters shall be divided by two before any are incremented again to avoid overflow problems.

(iv)(D) The counters shall be made available to a generic scan tool in accordance with the SAE J1979/J1939 specifications and may be rescaled when transmitted, if required by the SAE specifications, from a resolution of one second per bit to no more than three minutes per bit.

(5.2.3) Specifications of EI-AECDs

(A) For purposes of section (h){5.2.3), the following terms shall be defined as follows:

(i) "Purpose" is defined as theobjective of the EI-AECD when it is activated (e.g., EGR valve protection);

(in "Action" is defined as a specific component/element act that is commanded when the EI-AECD is activated (e.g., EGR system is derated);

(iii) "Parameter" is defined as a component/element (e.g., ECT, oil temperature) used to determine when to activate the EI-AECD; and

(iv) "Condition" is defined as the specific characteristic/state exhibited by. the parameter (e.g., ECT above 100 degrees Celsius) that triggers activation of the EI-AECD.

(B) Each unique combination of action, parameter, and condition within a purpose shall be tracked as a separate EI-AECD and increment the timer(s) at all times the condition necessary to activate the EI-AECD is present.

(0 For EI-AECOs that implement an action of variable degree based on the varying characteristics of a parameter (e.g., derate EGR more aggressively as engine oil temperature continues to increase), the EI-AECO shall be tracked by incrementing two separate timers within a single EI-AECO (e.g., EI-AECO #1 timer 1 and EI-AECO #1 timer 2) as follows:

a. The first of the two timers shall be incremented whenever the EI-AECO is commanding some amount of reduced emission control effectiveness up to but not including 75 percent of the maximum reduced emission control effectiveness that the EI-AECO is capable of commanding during in-use vehicle or engine operation. For example, an overheat protection strategy that progressively derates EGR and eventually shuts off EGR as oil temperature increases would accumulate time for the first timer from the time derating of EGR begins up to the time that EGR is derated 75 percent. As a second example, an overheat protection strategy that advances fuel injection timing progressively up to a maximum advance of 15 degrees crank angle as the engine coolant temperature increases would accumulate time for the first timer from the time advance is applied up to the time that advance reaches 11.25 degrees (75 percent of the maximum 15 degrees).

b. The second of the two timers shall be in"cremented whenever the EI-AECO is commanding 75 percent or more of the maximum reduced emission control effectiveness that the EI-AECD is capable of commanding during in-use vehicle or engine operation. For example, the second timer for the first example EI-AECO identified in section (h)(5.2.3)(B)(i) would accumulate time from the time that EGR is derated 75 percent up to and including when EGR is completely shut off. For the second example EI-AECO identified in section (h)(5.2.3)(B)(i), the second timer would accumulate time from the time fuel injection timing advance is at 11.25 degrees up to and including the maximum advance of 15 degrees.

(C) A manufacturer may request Executive Officer approval to combine multiple unique actions, parameters, and/or conditions to be tracked within a single EI-AECO. The manufacturer shall submit a plan for combining, tracking. and incrementing the EI-AECO to the Executive Officer for approval. Executive Officer approval of the plan shall be based on the effectiveness and the equivalence of the incrementing plan to determine the amount of EI-AECO activity per condition relative to the measure of EI-AECO activity under section (h)(5.2.3)(B).

(0) For EI-AECOs that are activated solely due to elevation, the timer shall be incremented only for the portion of EI-AECO activation when the elevation is below 8000 feet (e.g., the timerfor an EI-AECO that is activated when the elevation is above 5000 feet shall be incremented only when the EI-AECD is active and the elevation is below 8000 feet).

(E) For EI-AECOs that are initially activated due to engine warm-up and are subsequently reactivated after the engine has warmed up, the timer shall be incremented only when the EI-AECD is active after the initial engine warm-up (e.g., an EI-AECD that turns off an emission control at low engine coolant temperature would not increment the timer during initial warm-up but would increment the timer if coolant temperature subsequently dropped below the low temperature and reactivated the EI-AECD later in the drive cycle).

(F) If more than one EI-AECD is currently active, the timers for both EI-AECDs shall accumulate time, regardless if there is overlap or redundancy in the commanded action (e.g., two different EI-AECDs independently but simultaneously commanding EGR off shall both accumulate time in their respective timers).

(6) *Service Information:*

(6.1) Engine manufacturers shall provide the aftermarket service and repair industry emission-related service information as set forth in sections (h)(6.3) through (6.5).

(6.2) The Executive Officer shall waive the requirements of sections (h)(6.3) through (6.5) upon determining that the ARB or U.S. EPA has adopted a service information regUlation or rule that is in effect and operative and requires engine manufacturers to provide emission-related service information:

(A) of comparable or greater scope than required under these provisions;

(B) in an easily accessible format and in a timeframe that is equivalent to or exceeds the timeframes set forth below; and

(C) at fair and reasonable cost.

(6.3) Manufacturers shall make readily available, at a fair and reasonable price to the automotive repair industry, vehicle repair procedures which allow effective emission-related diagnosis and .repairs to be performed using only the SAE J1978/J1939 generic scan tool and commonly available,. non-microprocessor based tools.

(6.4) As an alternative to publishing repair procedures required under section (h)(6.3), a manufacturer may publish repair procedures referencing the use of manufacturer-specific or enhanced equipment provided the manufacturer meets one of the following conditions:

(6.4.l) makes available to the aftermarket scan tool industry the information needed to manufacture scan tools to perform the same emission-related diagnosis and repair procedures (excluding any reprogramming) in a comparable manner as the manufacturer-specific diagnostic scan tool; or

(6.4.2) makes available for purchase, at a fair and reasonable price to the automotive repair industry, a manufacturer-specific or enhanced tool to perform the emission-related diagnosis and repair procedures (excluding any reprogramming).

(6.5) Manufacturers shall make available:

(6.5.1) Information to utilize the test results reported as required in section (h)(4.5). The information must include a description of the test and test result, typical passing and failing values; associated fault codes with the test result, and scaling, units, and conversion factors necessary to convert the results to engineering units.

(6.5.2) A generic description of each of the diagnostics used to meet the requirements of this regulation. The generic description must include a text description of how the diagnostic is performed, typical enable conditions, typical malfunction thresholds, typical monitoring time, fault codes associated with the diagnostic, and test results (section (h)(4.5» associated with the diagnostic. Vehicles that have diagnostics not adequately represented by the typical values identified above shall be specifically identified along with the appropriate typical values.

(6.5.3) Information necessary to execute each of the diagnostics used to meet the requiremeDts of sections *(e)(1)* through (f)(9). The information must include either a description of sample driving patterns designed to be operated in-use or a written description of the conditions the vehicle needs to operate in to execute each of the diagnostics necessary to change the readiness status from "not complete" to "complete" for all monitors. The information shall be able to be used to exercise all necessary monitors in a single driving cycle as well as be able to be used to exercise the monitors to individually change the readiness status for each specific monitor from "not complete" to "complete".

(7) ***Exceptions* to *Standardization Requirements.***

(7.1) For 2020 and subsequent model year alternate-fueled engines derived from a diesel-cycle engine, a manufacturer may meet the standardized requirements of section (h) that are applicable to diesel engines in lieu of the requirements applicable to gasoline engines.

(i) ***MONITORING SYSTEM DEMONSTRATION REQUIREMENTS FOR CERTIFICATION***

(1) ***General.***

(1.1) Certification requires that manufacturers submit emission test data from one or more durability demonstration test engines (test engines).

(1.2) The Executive Officer may approve other demonstration protocols if the manufacturer can provide comparable assurance that the malfunction criteria are chosen based on meeting the malfunction criteria requirements and that the timeliness of malfunction detection is within the constraints of the applicable monitoring requirements.

(1.3) For flexible flJel engines capable of operating on more than one fuel or fuel combinations, the manufacturer shall submit a plan for providing emission test data to the Executive Officer for approval. The Executive Officer shall approve the plan if it is determined to be representative of expected in-use fuel or fuel combinations and provides accurate and timely evaluation of the monitored systems.

(2) ***Selection of Test Engines:***

(2.1) Prior to submitting any applications for certificatio"n for a model year, a manufacturer shall notify the Executive Officer of the engine families and engine ratings within each family planned for that model year. The Executive Officer will then select the engine family(ies) and the specific engine rating . within the engine family(ies) that the manufacturer shall use as demonstration test engines to provide emission test data. The selection of test vehicles for pr:oduction vehicle evaluation, as specified in section (1)(2), may take place during this selection process.

(2.2) Number of test engines:

(2.2.1) For the 2010 model year, a manufacturer shall provide emission test data of a test engine from the OBO parent rating.

(2.2.2) For the 2011 and 2012 model years, a manufacturer certifying one to seven engine families in a model year shall provide emission test data of a test engine from one OBO child rating. A manufacturer certifying eight or more engine families in a model year shall provide emission test data of test engines from two OBO child ratings. The Executive Officer may waive the requirement for submittal of data of one or more of the test engines if data have been previously submitted for all of the OBO parent and OBO child ratings.

(2.2.3) For the 2013 and subsequent model years, a manufacturer certifying one to five engine families in a model year shall provide emission test data of a test engine from one engine rating. A manufacturer certifying six to ten engine families in a model year shall provide emission test data from test engines from two engine ratings. A manufacturer certifying eleven or more engine families in a model year shall provide emission test data of test engines from three engine ratings. The Executive Officer may waive the requirement for submittal of data of one. or more of the test engines if data have been previously submitted for all of the engine ratings.

(2.2.4) For a given model year, a manufacturer may elect to provide emission data of test engines from more engine ratings than required by section (i)(2.2.1) through (2.2.3). For each additional engine rating tested in that given model year, the Executive Officer shall reduce the number of engine ratings required for testing in one future model year under sections (i)(2.2.2) through '(2.2.3) by one.

(2.3) Aging and data collection of diesel test engines:

(2.3.1) For 2010 through 2012 model year test engines, For the test engine(s), a manufacturer shall use an engine~~(s)~~ aged for a minimum of 125 hours plus exhaust aftertreatment emission controls aged by an accelerated aging process to be representative of full useful life. Manufacturers are required to submit for Executive Officer approval a description of the accelerated aging process and/or supporting data. The Executive Officer shall approve the process upon determining that the submitted description and/or data demonstrate that the process ensures that deterioration of the exhaust aftertreatment emission controls is stabilized sufficiently such that it is representative of the manufacturer's best estimates for the performance of the emission control at the end of the useful life. The Executive Officer may not require manufacturers to provide actual in-use or high mileage data to verify or validate that the aging is equivalent to full useful life for purposes of section (i)(2.3.1).

(2.3.2) For 2013 through 2015 model year test engines:

(A) A manufacturer shall collect emission and deterioration data from an actual high mileage system(s) (consisting of the engine, engine emission controls, and aftertreatment) to validate its accelerated aging process. The manufacturer shall collect the data from a 2010 or newer model year system that is the most representative of system designs planned for the 2013 model year and has a minimum actual mileage of full useful life or 185,000 miles, whichever is lower. The manufacturer shall collect and report the data to ARB prior to the end of 2011. The manufacturer shall submit a plan for system selection, procurement, and data collection to the Executive Officer for approval prior to proceeding with the data collection. The Executive Officer shall approve the plan upon determining that the submitted description will result in the manufacturer gathering data necessary to quantify emission performance and deterioration of the system elements in a manner that will allow comparison to deterioration and performance levels achieved with the manufacturer's accelerated aging process.

(B) For testing of 2013 through 2015 model year engines, a manufacturer shall use a system (engine, engine emission controls, and attertreatment) aged by an accelerated aging process to be representative of full useful life. Manufacturers are required to submit for Executive Officer approval a description of the accelerated aging process and supporting data. The Executive Officer shall approve the process upon determining that the submitted description and data demonstrate that the aging process will result in a system representative of the manufacturer's best estimates of the system performance at full useful life and that the manufacturer has utilized the data collected under section (i)(2.3.2)(A) to validate the correlation of the aging process to actual high mileage systems up to a minimum of full useful life or .185,000 miles.

(2.3.3) For 2016 and subsequent model year test engines:

(A) A manufacturer shall collect emission and deterioration data from an actual high mileage system(s) (consisting of the engine, engine emission controls, and attertreatment) to vafidate its accelerated aging process. The manufacturer shall collect the data from a 2010 or newer model year system that is the most representative of system designs planned for the 2016 model year and has a minimum actual mileage of full useful life. The manufacturer shall collect and report the data to ARB prior to the end of 2014. The manufacturer shall submit a plan for system selection, procurement, and data collection to the Executive Officer for approval prior to proceeding with the data collection. The Executive Officer shall approve the plan upon determining that the submitted description will result in the manufacturer gathering data necessary to quantify emission performance and deterioration of the system elements in a manner that will allow comparison to deterioration and performance levels achieved with the manufacturer's accelerated aging process.

(B) For testing of 2016 and subsequent model year engines, a manufacturer shall use a system (engine, engine emission controls, and attertreatment) aged by an accelerated aging process to be representative of full useful life. Manufacturers are required to submit for Executive Officer approval a description of the accelerated aging process and supporting data. The Executive Officer shall approve the process upon determining that the submitted description and data demonstrate that the aging process will result in a system representative of the manufacturer;s best estimates of the system performance at full useful life and that the manufacturer has utilized the data collected under section (i)(2.3.3)(A) to validate the correlation of the aging process to actual high mileage systems up to a minimum of full useful life.

(2.4) Aging of gasoline engines: For the test engine(s), a manufacturer shall use a certification emission durability test engine(s) system (Le., consisting of the engine, engine emission controls, and aftertreatment), a representative high mileage engine(s) system, or an engine(s) system aged to the end of the full useful life using an ARB-approved alternative durability procedure (ADP).

(3) Required Testing:

Except as provided below, the manufacturer shall perform single-fault testing based on the applicable test with the following components/systems set"at their malfunction criteria limits as determined by the manufacturer for meeting the requirements of sections (e), (f), and (g) or sections (d)(7.1.2) and (d)(7.2.3) for extrapolated OBD systems.

(3.1) Required testing for Diesel/Compression Ignition Engines:

(3.1.1) Fuel System: The manufacturer shall perform a separate test for each malfunction limit established by the manufacturer for the fuel system parameters (e.g., fuel pressure, injection timing) specified in sections (e)(1.2.1) through (e)(1.2.3). When performing a test for a specific parameter, the fuel system shall be operating at the malfunction criteria limit for the applicable parameter only. All other parameters shall be with normal characteristics. In conducting the fuel system demonstration tests, the manufacturer may use computer modifications to cause the fuel system to operate at the malfunction limit if the manufacturercan demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction.

(3.1.2) Misfire Monitoring: For 2010 through 2012 model year engines, a misfire demonstration test is not required for diesel engines. For 2013 and subsequent model year engines, the manufacturer shall perform a test at the malfunction criteria limit specified in section (e)(2.2.2).

(3.1.3) EGR System: The manufacturer shall perform a test at each flow, slow ·response, and cooling limit calibrated to the malfunction criteria (e.g., 2.0 times the standard) in sections (e)(3.2.1) through (3.2.3) and (e)(3.2.5).ID. conducting the EGR cooler performance demonstration test, the EGR cooler(s) being evaluated shall be deteriorated to the applicable malfunction criteria using methods established by the manufacturer in accordance with section (e)(3.2.9). In conducting the EGR system slow response demonstration tests, the manufacturer may use computer modifications to cause the EGR system to operate at the malfunction limit if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction or that there is no reasonably feasible method to induce a hardware malfunction.

(3.1.4) Boost Pressure Control System: The manufacturer shall perform a test at each boost, response, and cooling limit calibrated to the malfunction criteria (e.g., 2.0 times the FTP standard) in sections (e)(4.2.1) through (4.2.3) and (e)(4.2.4). In conducting the charge air undercooling demonstration test, the charge air cooler(s) being evaluated shall be deteriorated to the applicable malfunction criteria established by the manufacturer in section (e)(4.2.4) using methods established by the manufacturer in accordance with section (e)(4.2.8).

(3.1.5) NMHC Catalyst: The manufacturer shall perform a separate test for each monitored NMHC catalyst(s) (e.g., oxidation catalyst) that is used for a different purpose (e.g., oxidation catalyst upstream of a PM filter, NMHC catalyst used downstream of an SCR catalyst). The catalyst(s) being evaluated shall be deteriorated to the applicable malfunction criteria established by the manufacturer in section (e)(5.2.2)(A) and (e)(5.2.2)(8) using methods established by the manufact.urer in accordance with section (e)(5.2.4). For each monitored NMHC catalyst(s), the manufacturer shall also demonstrate that the OBO system will detect a catalyst malfunction with the catalyst at its maximum level of deterioration (Le., the sUbstrate(s) completely removed from the catalyst container or "empty" can). Emission data are not required for the empty can demonstration.

(3.1.6) NOx Catalyst: The manufacturer shall perform a separate test for each monitored NOx catalyst(s) (e.g., SCR catalyst) that is used for a different purpose (e.g., passive lean NOx catalyst, SCR catalyst). The catalyst(s) being evaluated shall be deteriorated to the applicable malfunction criteria established by the manufacturer in sections (e)(6.2.1)(A)(i), (e)(6.2:1)(B)(i), and (e)(6.2.2)(A) using methods established by the manufacturer in accordance with section (e)(6.2.3). For each monitored NOx catalyst(s), the manufacturer shall also demonstrate that theOBO system will detect a catalyst malfunction with the catalyst at its maximum level of deterioration (Le., the substrate(s) completely removed from the catalyst container or "empty" can). Emission data are not required for the empty can demonstration.

(3.1.7) NOx Adsorber: The manufacturer shall perform a test using a NOx adsorber(s) deteriorated to the malfunction criteria in section (e)(7.2.1). The manufacturer shall also demonstrate that the OBO system will detect a NOx adsorber malfunction with the NOxadsorber at its maximum level of deterioration (Le., the substrate(s) completely removed from the container or "empty" can). Emission data are not required for the empty. can demonstration.

(3.1.8) PM Filter: The manufacturer shall perform a test using a PM filter(s) deteriorated to each applicable malfunction criteria in sections (e)(8.2.1), (e)(8.2.2),- and (e)(8.2.4). The manufacturer shall also demonstrate that the OBO system will detect a PM filter malfunction with the filter at its maximum level of deterioration (Le., the filter(s) completely removed from the filter container or "empty" can). Emission data are not required for the empty can demonstration.

(3.1.9) Exhaust Gas Sensor: The manufacturer shall perform a test for each exhaust gas sensor parameter calibrated to the malfunction criteria (e.g., 2.0 times the FTP standard) in sections (e)(9.2.1)(A)(i), (e)(9.2.1)(B)(i)a. through b., and (e)(9.2.2)(A)(i) through (ii). When performing a test, all exhaust gas sensors used for the same purpose (e.g., for the same feedback control loop, for the same control feature on parallel exhaust banks) shall be operating at the malfunction criteria limit for the applicable parameter only. All other exhaust gas sensor parameters shall be with normal characterrstics.

(3.1.10) WT System: The manufacturer shall perform a test at each target error limit and slow response limit calibrated to the malfunction criteria (e.g., 2.0 times the FTP standard) in sections (e)(10.2.1) and (e)(10.2.2). In conducting the WT system demonstration tests, the manufacturer may use computer modifications to cause the WT system to operate at the malfunction limit if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction.

(3.1.11) Cold Start Emission Reduction Strategy: The manufacturer shall perform a test at the malfunction criteria for the system or for each component monitored according to section (e)(11.2.2).

(3.1.11)(3.1.12) For each of the testing requirements of section (i)(3.1), if the manufacturer has established that only a functional check is required because no failure or deterioration of the specific tested system could result in an engine's emissions exceeding the emission malfunctiQn criteria (e.g., 2.0 times any of the applicable standards), the manufacturer is not required to perform a demonstration test; however the manufacturer is required to provide the data and/or engineering analysis used to determine that only a functional test of the system(s) is required.

(3.2) Required testing for Gasoline/Spark-Ignited Engines:

(3.2.1) Fuel System: .

(A) For engines with adaptive feedback based on the primary fuel control sensor(s), the manufacturer shall perform a test with the adaptive feedback based on the primary fuel control sensor(s) at the rich limit(s) and a test at the lean limit(s) established by the manufacturer in section (f)(1.2.1) to detect a malfunction before emisSions exceed 1.5 times the applicable standards.

(B) For engines with feedback based on a secondary fuel control sensor(s) and subject to the malfunction criteria in section (f)(1.2.1), the manufacturer shall perform a test with the feedback based on the secondary fuel cqntrol sensor(s) at the rich limit(s) and a test at the lean limit(s) established by the manufacturer in section (f)(1.2.1) to detect a malfunction before emissions exceed 1.5 times the applicable standards.

(C) For other fuel metering or control systems, the manufacturer shall perform a test at the criteria limit(s).

(D) For purposes of fuel system testing, the fault(s) induced may result in a uniform distribution of fuel and air among the cylinders. Non-uniform distribution of fuel and air used to induce a fault may not cause misfire. In conducting the fuel system demonstration tests, the manufacturer may use computer modifications to cause the fuel system to operate at the malfunction limit if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction.

(3.2.2) Misfire: The manufacturer shall perform a test at the malfunction criteria limit specified in section (f)(2.2.2).

(3.2.3) EGR System: The manufacturer shall perform a test at each flow limit calibrated to the malfunction criteria (e.g., 1.5 'times the standard) in sections (f)(3.2.1) and (f)(3.2.2).

(3.2.4) Cold Start Emission Reduction Strategy: The manufacturer shall perform a test at the malfunction criteria for each component monitored according to section (f)(4.2.1)(A) or (f)(4.2.2)(B).

(3.2.5) Secondary Air System: The manufacturer shall perform a test at each flow limit calibrated to the malfunction criteria in sections (f)(5.2.1) and (f)(5.2.2).

(3.2.6) Catalyst: The manufacturer shall perform a **test** using a catalyst system deteriorated to the malfunction criteria in section (f)(6.2.1) using methods established by the manufacturer in accordance with section (f)(6.2.2). The manufacturer shall also demonstrate that the OBO system will detect a catalyst system malfunction with the catalyst system at its maximum level of deterioration (Le., the substrate(s) completelyremoved from the catalyst container or "empty" can). Emission data are not required for the empty can demonstration.

(3.2.7) Exhaust Gas Sensor:

(A) The manufacturer shall perform ,a test with all primary exhaust gasoxygen sensors (conventional switching sensors and wide range or universal sensors) used for fuel control simultaneously possessing a response rate deteriorated to the malfunction criteria limit in section (f)(8.2.1)(A). Manufacturers shall also perform a test for any other primary or secondary exhaust gas oxygen sensor parameter under sections (f)(8.2.1)(A) and (f)(8.2.2)(A) that can cause engine emissions to exceed the malfunction threshold (e.g., 1.5 times the **applicable** standards ~~(e.g.,~~due to a shift in air/fuel ratio at which oxygen sensor switches,. decreased amplitude). When performing additional test(s), all primary and secondary (if applicable) exhaust gasoxygen sensors used for emission fuel control shall be operating at the malfunction criteria limit for the applicable parameter only. All other primary and secondary exhaust gasoxygen sensor parameters shall be with normal characteristics.

(8) For engines utilizing sensors other than oxygen sensors for primary fuel control (e.g., hydrocarbon sensors), the manufacturer shall submit, for Executive Officer approval, a demonstration test plan for performing testing of all of the sensor parameters that can cause engine emissions to exceed the malfunction threshold (e.g., 1.5 times the applicable standards). The Executive Officer shall approve the plan if it is determined that it will provide data that will assure proper performance of the diagnostics of the sensors, consistent with the intent of section (i).

(3.2.8) WT System: The manufacturer shall perform ,a test at each target error limit and slow response limit calibrated to the malfunction criteria (e.g., 1.5 times the FTP standard) in sections (f)(9.2.1) and (f)(9.2.2). In conducting the WT system demonstration tests, the manufacturer may **use** computer modifications to cause **the** WT system to operate at the malfunction limit if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction.

(3.2.9) For each of the testing requirements of section (i)(3.2), if the manufacturer has established that only a functional check is required because no failure or deterioration of the specific tested system could result in an engine's emissions exceeding the emission malfunction criteria (e.g., 1.5 times any of the applicable standards), the manufacturer is not required to perform a demonstration test; however the manufacturer is required to provide the data and/or engineering analysis used to determine that only a functional test of the system(s) is required.

(3.3) Required Testing for All Engines:

(3.3.1) Other Emission Control Systems: The manufacturer shall conduct demonstration tests for all other emission control components (e.g., hydrocarbon traps, adsorbers) designed and calibrated to an emission threshold malfunction criteria (e.g., 1.5 times the applicable emission standards) under the provisions of section (g)(4).

(3.3.2) For each of the testing requirements of section (i)(3.3), if the manufacturer has established that only a functional check is required because no failure or deterioration of the specific tested system could result in.an engine's emissions exceeding the emission malfunction criteria (e.g., 1.5 times any of the applicable standards), the manufacturer is not required to perform a demonstration test; however the manufacturer is required to provide the data and/or engineering analysis used to determine that only afunctional test of the system(s) is required.

(3.4) The manufacturer may electronically simulate deteriorated components if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction but may not make any engine control unit modifications (unless otherwise provided above or exempted pursuant to this section) when performing demonstration tests. All equipment necessary to duplicate the demonstration test must be made available to the ARB upon request. A manufacturer may request Executive Officer approval to electronically simulate a deteriorated component with engine control unit modifications. The Executive Officer shall approve the reguest upon determining the manufacturer has submitted data and/or engineering analysis demonstrating that is technically infeasible, very difficult, and/or resource intensive to implant the fault with modifications external to the engine control unit.

(3.5) For each of the testing requirements of (i)(3), when performing a test, all components or systems used in parallel for the same purpose (e.g., separate VVT actuators on the intake valves for Bank 1 and Bank 2, separate NOx converting catalysts on parallel exhaust banks) shall be simultaneously deteriorated to the malfunction criteria limit. Components or systems in series or used for different purposes (e.g., upstream and downstream exhaust gas sensors in a single exhaust bank, separate high pressure and low pressure EGR systems) may not be simultaneously deteriorated to the malfunction criteria limit.

(4) ***Testing Protocol:***

(4.1) Preconditioning:-.The manufacturer may request Executive Officer approval to ~~shall~~ use a ~~an~~ applicable cycle for preconditioning cycle test engines prior to conducting each of the above emission tests. The Executive Officer shall approve the request Uupon determining that a manufactl:lrer has provided data and/or engineering evaluation that demonstrate that additional the preconditioning is necessary to stabilize the emission control system. The manufacturer may also request Executive Officer approval to use an additional identical preconditioning cycle following a 20 minute hot soak after the initial preconditioning cycle. , tThe Executive Officer shall approve the request upon determining that a manufacturer has provided data and/or engineering evaluation that demonstrate that the additional preconditioning is necessary to stabilize the emission control systemallow the manufacturer to perform a single additional preconditioning cyole, identical to the initial preconditioning cycle following a 20 minute"hot soak after the initial preoonditioning oyole. . The manufacturer *may* not require the test engine to be cold soaked prior to conducting preconditioning cycles in order for the monitoring system testing to be successful. If a second preconditioning cycle is permitted, the manufacturer may adjust the system or component to be tested before conducting the second preconditioning cycle. The manufacturer may not replace, modify, or adjust the system or component after the last preconditioning cycle has taken place.

(4.2) Test Sequence:

(4.2.1) The manufacturer shall set the system or component on the test engine for which detection is to be tested at the criteria limit(s) prior to conducting the applicable preoonditioning oyole(s)emission test (or preconditioning, if approved). If a seoond preoonditioning cycle is permitted in aooordanoe with section 0)(4.1) above, the manufacturer may adjust the system or ' component to be tested before conducting the second preoonditioning cyole. The manufaoturer may not replaoe, modify, or adjust the system or component after the last preconditioning cycle has taken place.

(4.2.2) After preoonditioning, tThe test engine shall be operated over the first engine start of the applioable FTP emission test (i.e., the cold start) cycle or a SET cycle to allow for the initial detection of the tested system or component malfunction. If required by the designated monitoring strategy, an additional cold soak and first engine start of the FTP cycle (i.e., the cold start) may be performed prior to conducting this test cycle (e.g., for two-trip monitors that only run during cold starts). This test cycle may be omitted from the testing protocol if it is unneoessary. If req"uired by the designated monitoring strategy, a cold soak may be performed prior to oonducting this test oycle.

(4.2.3) The test engine shalf then be operated over the applioable second engine start of the FTP exhaust emission test (i.e., the hot start) or an SET emission test. The second SET cycle may be omitted from the testing protocol if it is unnecessary (e.g., one-trip fault detection strategies that run on the SET).

(4.3) Test Data Collection:

(4.3.1) During the test sequence of section (i)(4.2), the manufacturer shall collect data immediately prior to each engine shut-down (e.g.! the end of each preconditioning cycle in section (i)(4.2.1), the end of the cold start FTP cycle in section (i)(4.2.3), the end of the warm start FTP cycle in section (i)(4.2.3)). If the data cannot be collected immediately prior to engine shut-down, the data shall be collected immediately after engine shut-down.

(4.3.2) The manufacturer shall be required to collect the following data:

(A) Approximate time on the test cycle (in seconds after engine. start) when the MIL illuminates (e.g., MIL illuminated at 402 seconds into the cold start FTP cycle);

(B) All data required by sections (h)(4.1) through (h)(4.9) and (h)(5) including readiness status, current data stream values, fault code(s), freeze frame data, test results, CAL 10,' CVN, VIN, ESN, ECU Name, in-use performance ratios, and engine run time tracking data.

(4.4) A manufacturer required to test more than one test engine (section (i)(2.2» may utilize internal calibration sign-off test procedures (e.g., forced cool downs, less frequently calibrated emission analyzers) instead of official test procedures to obtain the emission test data required in section (i) for all but one of the required test engines. The manufacturer may elect this option if the data from the alternative test procedure are representative of official emission test results. Manufacturers using this option are still responsible for meeting the malfunction criteria specified in sections *(e)* through (g) when emission tests are performed in accordance with official test procedures.

~~(4.4)~~(4.5) A manufacturer may request Executive Officer approval to utilize an alternate testing protocol for demonstration of MIL illumination if the engine dynamometer emission test cycle does not allow all of a monitor's enable conditions to be satisfied. A manufacturer may request the use of an alternate engine dynamometer test cycle or the use of chassis testing to demonstrate proper MIL illumination. In evaluating the manufacturer's request, the Executive Officer shall consider the technical necessity for using an alternate test cycle and the degree to which the alternate test cycle demonstrates that in-use operation with the malfunctioning component will properly result in MIL illumination.

(5) ***Evaluation Protocol:***

(5.1) Full aBO engine ratings subject to sections (d)(7.1.1), (d)(7.2.2), or (d)(7.3) shall be evaluated according to the following protocol.

(5.1.1) For all tests conducted under section (i), the MIL shall be illuminated upon detection of the tested system or component malfunction before the end of the first engine start ~~portion~~ of the exhaust emission test specified in (i)(4.2.3)of the complete applicable test in accordance with the requirements of sections *(e)* through (g).

(5.1.2) If the MIL illuminates prior to emissions exceeding the applicable malfunction criteria specified in sections (e) through (g), no further demonstration is required. With respect to the misfire monitor demonstration test, if a manufacturer has elected to use the minimum misfire malfunction criteria of one percent as allowed in sections (e)(2.2.2)(A) and (f)(2.2.2)(A), no further demonstration is required if the MIL illuminates with misfire implanted at the malfunction criteria limit.

(5.1.3) If the MIL does not illuminate when the system or component is set at its limit(s), the criteria limit or the aBO system is not acceptable.

(A) Except for testing of the catalyst (Le., components monitored under sections (e)(5.2.2), (e)(6.2.1), (e)(7.2.1), and (f)(6.2.1)) or PM filter system (i.e., (e)(8.2.1) and (e){8.2.4)),if the MIL first illuminates after emissions exceed the applicable malfunction criteria specified in sections (e) through (g), the test engine shall be retested with the tested system·or component adjusted so that the MIL will illuminate before emissions exceed the applicable malfunction criteria specified in sections (e) through (g). If the component cannot be adjusted to meet this criterion because a default fuel or emission control strategy is used when a malfunction is detected (e.g., open loop fuel control used after an oxygen sensor malfunction is determined), the test engine shall be retested with the component adjusted to the worst acceptable limit (Le., the applicable monitor indicates the component is performing at or slightly better than the malfunction criteria). When tested with the component adjusted to the worst acceptable limit, the MIL must not illuminate during the test and the engine emissions must be below the applicable malfunction criteria specified in sections (e) through (g).

(B) In testing the catalyst (i.e., components monitored under sections (e)(5.2.2), (e)(6.2.1), (e)(7.2.1), and (f)(6.2.1))·or PM filter system (i.e., (e){8.2.1) and (e)(8.2.4», if the MIL first illuminates after emissions exceed the applicable emission threshold(s) specified in sections (e) and (f), the tested engine shall be retested with a less deteriorated catalyst/PM filter system (i.e., more of the applicable engine out pollutants are converted or trapped). For the aBO system to be approved, testing shall be continued until either of the following conditions are satisfied:

(i) The MIL is illuminated and emissions do not exceed the thresholds specified in sections (e) or (f); or

(ii) The manufacturer demonstrates that the MIL illuminates within the upper and lower limits of the threshold identified below. The manufacturer shall demonstrate acceptable limits by continuing testing until the test results show:

a. The MIL is illuminated and emissions exceed the thresholds specified in sections (e) or (f) by 10 percent or less of the applicable standard (e.g., emissions are less than 1.85 times the applicable standard for a malfunction criterion of 1.75 times the standard); and

b. The MIL is not illuminated and emissions are below the thresholds specified in sections (e) or (f) by no more than 20 percent of the standard (e.g., emissions are between 1.55 and 1.75 times the applicable standard for a malfunction criterion of 1.75 times the standard).

(5.1.4) If an aBO system is determined unacceptable by the above criteria, the manufacturer may recalibrate and retest the system on the same test engine. In such a case, the manufacturer must confirm, by retesting, that all systems and components that were tested prior to recalibration and are affected by the recalibration function properly under the aBO system as recalibrated.

(5.2) aBO child ratings subject to sections (d)(7.1.2) or (d)(7.2.3) (i.e., extrapolated aBO) shall be evaluated according to the following protocol.

(5.2.1) For all tests conducted under section (i), the MIL shall-be illuminated upon detection of the tested system or component malfunction before the end of the first engine start portion of the exhaust test emission test of-the complete applicable test specified in (i)(4.2.3) in accordance with the malfunction criteria established by the manufacturer under sections (d)(7.1.2) and (d)(7.2.3).

(5.2.2) Except for testing of the catalyst or PM filter system, if the MIL first illuminates after the tested component or system significantly exceeds the applicable malfunction, criteria established by the manufacturer, the test engine shall be retested with the tested system or component adjusted so that the MIL will illuminate at the applicable malfunction criteria established by the manufacturer.

(5.2.3) In testing the catalyst or PM filter system, if the MIL first illuminates after the tested component or system significantly exceeds the applicable malfunction criteria established by the manufacturer, the tested engine shall be retested with a less deteriorated catalyst/PM filter system (Le., more of the applicable engine out pollutants are converted or trapped). For the OBD system to be approved, testing shall be continued until either of the following conditions are satisfied:

(A) The MIL is illuminated and the tested component or system is at the applicable malfunction criteria established by the manufacturer; or

(B) The manufacturer demonstrates that the MIL illuminates within the upper and lower limits of the threshold identified below. The manufacturer shall demonstrate acceptable limits by continuing testing until the test results show:

(i) The MIL is illuminated and monitoring results indicate the tested component or system exceeds the malfunction criteria established by the manufacturer by 10 percent or less of the monitored parameter; and

(ii) The MIL is not illuminated and monitoring results indicate the tested component or. system is below the malfunction criteria established by the manufacturer by 10 percent or less of the monitored parameter.

(6) Confirmatory Testing:

(6.1) The ARB may perform confirmatory testing to verify the emission test data submitted by the manufacturer under the requirements of section (i) comply with the requirements of section (i) and the malfunction criteria identified in sections *(e)* through (g). This confirmatory testing is limited to the engine rating represented by the demonstration engine(s).

(6.2) The ARB or its designee may install appropriately deteriorated or malfunctioning components (or simulate a deteriorated or malfunctioning component) in an otherwise properly functioning test engine of an engine rating represented by the demonstration test engine(s) in order to test any of the components or systems required to be tested in section (i). Upon request by the Executive Officer, the manufacturer shall make available an engine and all test equipment (e.g., malfuncti.on simulators, deteriorated components) necessary to duplicate the manufacturer's testing. The Executive Officer shall make the request within six months of reviewing and approving the demonstration test engine data submitted by the manufacturer for the specific engine rating.

(j) *CERTIFICATION DOCUMENTATION*

(1) When submitting an application for certification of an engine, the manufacturer shall submit the following documentation. If any of the items listed below are standardized for all of a manufacturer's engines, the manufacturer may, for each model year, submit one set of documents covering the standardized items for all of its engines.

(1.1) For the required documentation not standardized across all engines, the manufacturer may propose to the Executive Officer that it be allowed to submit documentation for certification from one engine that is representative of other engines. The Executive Officer shall approve the engine as representative if the engine possesses the most stringent emission standards and OBD monitoring requirements and covers all of the emission control devices for the engines covered by the submitted documentation. Upon approval, this grouping shall be known as an "OBD certification documentation group".

(1.2) With Executive Officer approval, one or more of the documentation requirements of section (j) may be waived or modified if the information required would be redundant or unnecessarily burdensome to generate.

(1.3) To the extent possible, the certification documentation shall use SAE J1930 or J2403 terms, abbreviations, and acronyms.

(2) The following information shall be submitted as part of the certification application. Except as provided below for demonstration data, the Executive Officer will not issue an Executive Order certifying the covered engines without the information having been provided. The information must include:

(2.1) A description of the functional operation of the OBD system including a complete written description for each monitoring strategy that outlines every step in the decision-making process of the monitor. Algorithms, diagrams, samples of data, and/or other graphical representations of the monitoring strategy shall be included where necessary to adequately describe the information.

(2.2) A table, in the standardized format detailed in Attachment A-XX of ARB Mail-Out #95 20XX-XX, May 22, 1995 Month Date. Year, incorporated by reference.

(2.2.1) The table must include the following information for each monitored component or system (either computer-sensed or -controlled) of the emission control system:

(A) Corresponding fault code
(B) Monitoring method or procedure for malfunction detection
(C) Primary malfunction detection parameter and its type of output signal
(D) Fault criteria limits used to evaluate output signal of primary parameter
(E) Other monitored secondary parameters and conditions (in engineering units) necessary for malfunction detection
(F) Monitoring time length and frequency of checks
(G) Criteria for storing fault code
(H) Criteria for illuminating malfunction indicator light

(I) Criteria used for determining out-of-range values and input component rationality checks

(2.2.2) Wherever possibfe, the table shall use the following engineering units:

(A) Degrees Celsius (OC) for all temperature criteria

(B) KiloPascals (KPa) for all pressure criteria related to manifold or atmospheric pressure

(C) Grams (g) for all intake air mass criteria

(D) Pascals (Pa) for all pressure criteria related·to evaporative system vapor pressure

(E) Miles per hour (mph) for all vehicle speed criteria

(F) Relative percent (%) for all relative throttle position criteria (as defined in SAE *J1979fJ1939)*

(G) Voltage (V) for all absolute throttle position criteria (as defined in SAE *J1979fJ1939)*

(H) Per crankshaft revolution (frev) for all changes per ignition eveht based criteria (e.g., glrev instead of gfstroke or gffiring)

(I) Per second *(lsec)* for all changes per time based criteria (e.g., *gfsec)*

(J) Percent of nominal tank volume (%) for all fuel tank level criteria

(2.3) A logic flowchart describing the step-by-step evaluation of the enable criteria and malfunction criteria for each monitored emission-related component or system.

(2.4) Emission test data, a description ofthe testing sequence (e.g., the number and types of preconditioning cycles), approximate time (in seconds) of MIL illumination during the test, fault code(s) and freeze frame information stored at the time of detection, corresponding test results (e.g. 8/\6 J1 979 ModelService $06, ~~SAE~~ J1 ~~939~~ Diagnostic Message *B* (DMB)) stored during the testthe data required to be collected in section (i)(4.3), and a description of the modified or deteriorated components used for fault simulation with respect to the demonstration tests specified in section (i). The freeze frame data are not required for engines ~~subject~~ to sections (d)(7.1.2) or (d)(7.2.3). The Executive Officer may approve conditional certification qf an engine prior to the submittal of this data for ARB review and approval. Factors to be considered by the Executive Officer in approving the late submission of information identified in section (j)(2.4) shall include the reason for the delay in the data collection, the length of time until data will be available, and the demonstrated previous success of the manufacturer in submitting the data prior to certification.

(2.5) For gasoline engines, data supporting the misfire monitor, including:

(2.5.1) The established percentage of misfire that can be tolerated without damaging the catalyst over the full range of engine speed and load conditions.

(2.5.2) Data demonstrating the probability of detection of misfire events of the misfire monitoring system over the full engine speed and load operating range for the following misfire patterns: random cylinders misfiring at the malfunction criteria established in section (f)(2.2.2), one cylinder continuously misfiring, and paired cylinders continuously misfiring.

(2.5.3) Data identifying all disablement of misfire monitoring that occurs during the FTP. For every disablement that occurs during the cycles, the data should identify: when the disablement occurred relative to the driver's trace, the number of engine revolutions that each disablement was present for, and which disable condition documented in the certification application caused the disablement.

(2.5.4) Manufacturers are not required to use the durability demonstration engine to collect the misfire data for sections (j)(2.5.1) through (2.5.3).

(2.6) Data supporting the limit for the time between engine starting and attaining the designated heating temperature for after-start heated catalyst systems.

(2.7) Data supporting the criteria used to detect a malfunction of the fuel system, EGR system, boost pressure control system, catalyst, NOx adsorber, PM filter, cold start emission reduction strategy, secondary air, evaporative system, WT system, exhaust gas sensors, and other emission controls which causes emissions to exceed the applicable malfunction criteria specified in sections (e), (f), and (g). For diesel engine monitors in sections (e) and (g) that are required to indicate a malfunction before emissions exceed an emission threshold based on any applicable standard (e.g., 1.5 times any of the applicable standards), the test cycle and standard determined by the manufacturer to be the most stringent for each applicable monitor in accordance with section (d)(6.1) and the adjustment factors determined by the manufacturer for each applicable monitor in accordance with section (d)(6.2).

(2.8) A listing of all electronic powertrain input and output signals (including those not monitored by the 08D system) that identifies which signals are monitored by the 08D system. For input and output signals that are monitored as comprehensive components, the listing shall also identify the specific fault code for each malfunction criteria (e.g., out of range low, out of range high, open circuit, rationality low, rationality high).

(2.9) A written description of all parameters and conditions necessary to begin closed-loop/feedback control of emission control systems (e.g., fuel system, boost pressure, EGR flow, SCR reductant delivery, PM filter regeneration, fuel system pressure).

(2.10) A written identification of the communication protocol utilized by each engine for communication with an SAE J1978/J1939 scan tool.

(2.11) A pictorial representation or written description of the diagnostic connector location including any covers or labels.

(2.12) A written description of the method used by the manufacturer to meet the requirements of section (g)(2) for CV system monitoring including diagrams or pictures of valve and/or hose connections.

(2.13) A written description of each AECD utilized by the manufacturer including the sensor signals and/or calculated values used to invoke each AECD, the engineering data and/or analysis demonstrating the need for such an AECD, the actions taken when each AECD is activated, the expected in-use frequency of operation of each AECD, ~~and~~ the expected emission impact from each AECD activation, and , for diesel engines, the identification of each AECD that has been determined by the manufacturer to be an EI-AECD and the assignment by the manufacturer to the data required to be tracked and reported in the standardized format specified in section (h)(6) (e.g., the AECD of "engine overheat protection as determined by coolant temperature greater than ..." is an EI-AECD and is reported as EI-AECD #1 to a generic scan tool).

(2.14) A written description of each NOx and PM NTE deficiency and emission carve-out utilized by the manufacturer including the sensor signals and/or calculated values used to invoke each NTE deficiency or carve-out, the engineering data and/or analysis demonstrating the need for such an NTE deficiency or carve-out, the actions taken when each NTE deficiency or carve-out is activated, the expected in-use frequency of operation of each NTE deficiency or carve-out, and the expected emission impact from each NTE deficiency or carve-out activation.

(2.15) Build specifications provided to engine purchasers or chassis manufacturers detailing all specifications or limitations imposed on the engine purchaser relevant to OBD requirements or emission compliance (e.g., allowable MIL locations, connector 'location specifications, cooling system heat rejection' rates). A description of the method or copies of agreements used to ensure engine purchasers or chassis manufacturers will comply with the OBO and emission relevant build specifications (e.g.; signed agreements, required audit/evaluation procedures).

(2.16) A cover letter identifying all concerns and deficiencies applicable to the equivalent previous model year engine and the changes and/or resolution of each concern or deficiency for the current model year engine.

(2.17) A checklist of all the malfunction criteria in sections (e) or (0 and the corresponding diagnostic noted by fault code for each malfunction criterion. The formats of the checklists are detailed in Attachments XX and XX of ARB Mail-Out #MSC XX-XX, Month Date, Year, incorporated by reference.

(2.18) Any other information determined by the Executive Officer to be necessary to demonstrate compliance with the requirements of this regulation.

(k) *DEFICIENCIES*

(1) The Executive Officer, upon receipt of an application from the manufacturer, may certify OBO systems installed on engines even though the systems do not comply with one or more of the requirements of title 13, CCR section 1971.1. In granting the certification, the Executive Officer shall consider the following factors: the extent to which the requirements of section 1971.1 are satisfied overall based on a review of the engine applications in question, the relative performance of the resultant OBO system compared to systems fully compliant with the requirements of section 1971.1, and a demonstrated good-faith effort on the part of the manufacturer to: (1) meet the requirements in full by evaluating and considering the best available monitoring technology; and (2) come into compliance as expeditiously as possible.

(2) For 2013 and subsequent model year engines, manufacturers of OBO systems for which deficiencies have been granted are subject to fines pursuant to section 43016 of the California Health and Safety Code. The specified fines apply to: (1) the third and subsequently identified deficiency(ies), ordered according to section (k)(3), and (2) a monitoring system deficiency where a required monitoring strategy is completely absent from the OBO system.

(3) The fines for engines specified in section (k)(2) above are in the amount of $50 per deficiency per engine for non-compliance with any of the monitoring

requirements specified in sections (e), (f), and (g)(4), and $25 per deficiency per engine for non-compliance with any other requirement of section 1971,1. In determining the identified order of deficiencies, deficiencies subject to a $50 fine are identified first. Total fines per engine under section (k) may not exceed $500 per engine and are payable to the State Treasurer for deposit in the Air Pollution Control Fund.

(4) Manufacturers must re-apply for Executive Officer approval of a deficiency each model year. In considering the request to carry-over a deficiency, the Executive Officer shall consider the factors identified in section (k)(1) including the manufacturer's progress towards correcting the deficiency. The.Executive Officer may not allow manufacturers to carry over monitoring system deficiencies for more than two model years unless it can be demonstrated that substantial engine hardware modifications and additional lead time beyond two years would be necessary to correct the deficiency, in which case the Executive Officer shall allow the deficiency to be carried over for three model years.-

(5) Except as allowed in section (k)(6), deficiencies may not be retroactively granted after certification.

(6) Request for retroactive deficiencies

(6.1) During the first 6 months after commencement of normal production, manufacturers may request that the Executive Officer grant a deficiency and amend an engine's certification to conform to the granting of the deficiencies for each aspect of the monitoring system: (a) identified by the manufacturer (during testing required by section (1)(2) or any other testing) to be functioning different than the certified system or otherwise not meeting the requirements of any aspect of section 1971.1; and (b) reported to the Executive Officer. If the Executive Officer grants the deficiencies and amended certification, their approval would be retroactive to the start of production.

(6.2) Executive Officer approval of the request for a retroactive deficiency shall be granted provided that the conditions necessary for a pre-certification deficiency determination are satisfied (see section (k)(1» and the manufacturer could not have reasonably anticipated the identified problem before commencement of production.

(6.3) In granting the amended certification, the Executive Officer shall include any approved post-production deficiencies together with all previously approved deficiencies in computing fines in accordance with section (k)(2).

(I) *PRODUCTION ENGINENEHICLE EVALUATION TESTING*

(1) Verification of Standardized Requirements.

(1.1) Requirement: Manufacturers shall perform testing to verify that 2013 and subsequent model year production vehicles meet the requirements of section (h)(3) and (h)(4) relevant to proper communication of required emission-related messages to an SAE J1978/J1939 scan tool.

(1.2) Selection of Test Vehicles:

(1.2.1) Engine manufacturers shall perform this testing every model year on ten unique production vehicles (Le., engine rating and chassis application combination) per engine family. If there are less than ten unique production vehicles for a certain engine family, the manufacturer shall test each unique production vehicle in that engine family. Manufacturers shall perform this testing within either three months of the start of engine production or one month of the start of vehicle production, whichever is later. Manufacturers may request Executive Officer approval to group multiple production vehicles together and test one representative vehicle per group. The Executive Officer shall approve the request upon finding that the software and hardware designed to comply with the standardization requirements of section (h) (e.g., communication protocol message timing, number of supported data stream parameters, engine and vehicle communication network architecture) in the representative vehicle are identical to all others in the group and that any differences in the production vehicles are not relevant with respect to meeting the criteria in section (1)(1.4).

(1.2.2) For 2016 and subsequent model year engines, the Executive Officer shall reduce the maximum required number of vehicles to be tested from ten per engine family to five per engine family for a manufacturer based on the demonstrated previous success of the manufacturer to meet the requirements of section (1)(1). For purposes of this requirement, a manufacturer shall be determined to be successful in meeting the requirements of section (1)(1) if zero vehicles fail the testing required by section (I)(1) for two consecutive years.

(1.2.3) For 2019 and subsequent model year engines, the Executive Officer shall further reduce the maximum required number of yehicles to betested to three per engine family for a manufacturer based on the demonstrated previous success of the manufacturer to meet the requirements of section (1)(1). For purposes of this requirement, a manufacturer shall be determined to be successful in meeting the requirements of section (1)(1) if zero vehicles fail the testing required by section (1)(1) for three consecutive years.

(1.2.4) The Executive Officer may waive the requirement for submittal of data from one or more of the production vehicles if data have been previously submitted for all of the production vehicles. Manufacturers may request Executive Officer approval to carry over data collected in previous model years. The Executive Officer shall approve the request upon finding that the software and hardware designed to comply with the standardization requirements of section (h) are identical to the previous model year and no other hardware or software changes that affect compliance with the standardization requirements have been made.

(1.3) Test Equipment: For the testing required in section (1)(1), manufacturers shall utilize an off-board device to conduct the testing. Prior to conducting testing, manufacturers are required to request and receive Executive Officer approval of the off-board device that the manufacturer will use to perform the testing.

(1.3.1) For vehicles using the ISO 15765-4 protocol for the standardized functions required in section (h), the Executive Officer shall approve the request upon determining that the manufacturer has submitted data, specifications, and/or engineering analysis that demonstrate that the off-board device meets the minimum requirements to conduct testing according to SAE J1699-3 using the software developed and maintained for the SAE J1699-3 committee and available through www.sourceforge.net and SAE J2534 compliant hardware configured specifically for SAE J1699-3 testing.

(1.3.2) For vehicles using the SAE J1939 protocol for the standardized functions required in section (h), ~~T~~the Executive Officer shall approve the request upon determining that the manufacturer has s'ubmitted data, specifications, and/or engineering analysis that demonstrate that the off-board device is able to verify that vehicles tested are able to perform all of the required functions in section (1)(1.4) with any other off-board device designed and built in accordance with the SAE J1978/J1939 generic scan tool specifications.

(1.4) Required Testing:

(1.4.1) The testing shall verify that communication can be properly established between all emission-related on-board computers and any SAE J1978/J1939 scan tool designed to adhere strictly to the communication protocols allowed in section (h)(3);

(1.4.2) The testing shall verify that all emission-related information is properly communicated between all emission-related on-board computers and any SAE J1978/J1939 scan tool in accordance with the requirements of section (h) and the applicable ISO and SAE specifications including specifications for physical layer, network layer, message structure, and message content.

(1.4.3) The testing s.hall further verify that the follbwing information can be properly communicated to any SAE J1978/J1939 scan tool:

(A) The current readiness status from all on-board computers required to support readiness status in accordance with SAE J1979/J1939-73 and section (h)(4.1) in the key on, engine off position and while the engine is running;

(8) The MIL command status while the MIL is commanded off and while the MIL is commanded on in accordance with SAE J1979/J1939 and section (h)(4.2) in the key on, engine off position and while the engine is running, and in accordance with SAE J1979/J1939 and sections (d)(2.1.2) during the MIL functional check and, if applicable, (h)(4.1.3) during the MIL readiness status check while the engine is off;

(C) All data stream parameters required in section (h)(4.2) in accordance with SAE J1979/J1939 including, if applicable, the proper identification of each data stream parameter as supported in SAE J1979 (e.g., Mode/Service $01, PID $00);

(D) The CAL ID, CVN, ESN, and VIN in accordance with SAE J1979/J1939 and sections (h)(4.6) through (4.8);

(E) An emission-related fault code (permanent, confirmed, pending, MIL-on, and previously MIL-on) in accordance with SAE J1979/J1939-73 (including correctly indicating the number of stored fault codes (e.g., Mode/Service $01, PID $01, Data A for SAE J1979» and section (h)(4.4);

(1.4.4) The testing shall also verify that the on-board.computer(s) can properly respond to any SAE J1978/J1939 stan tool request to clear emission-related fault codes and reset readiness status in accordance with section (h)(4.~~9~~10).

(1.5) Reporting of Results:

(1.5.1) The manufacturer shall submit to the Executive Officer the following, based on the results of testing:

(A) If a *variant* meets all the requirements of section (1}(1.4), a statement specifying that the variant passed all the tests, or

(B) If any variant does not meet the requirements of section (1}(1.4), a written report to the Executive Officer for approval within one month of testing the specific variant. The written report shall include the problem(s) identified and the manufacturer's proposed corrective action (if any) to remedy the problem(s). Factors to be considered by the Executive Officer in approving the proposed corrective action shall include the *severity* of the problem(s}, the ability of the vehicle to be tested in a California inspection program (e.g., roadside inspection, fleet self-inspection program), the ability of service technicians to access the required diagnostic information, the impact on equipment and tool manufacturers, and the amount of time prior to implementation of the proposed corrective action.

(1.5.2) Upon request of the Executive Officer, a manufacturer shall submit a report of the results of any testing conducted pursuant to section (1}(1) to the Executive Officer for *review.*

(1.5.3) In accordance with section (k}(6), manufacturers may request Executive Officer approval for a retroactive deficiency to be granted for items identified during this testing.

(1.6) Alternative Testing Protocols. Manufacturers may request Executive Officer approval to use other testing protocols. The Executive Officer shall approve the protocol if the manufacturer-can demonstrate that the alternate testing methods and equipment provide an equivalent level of verification of compliance with the standardized requirements to the requirements of section (1)(1).

(2) ***Verification of Monitoring Requirements.***

(2.1) Within either the first six months of the start of engine production or the first three months of the start of vehicle production, whichever is later, manufacturers shall conduct a complete evaluation of the OBO system of one or more production vehicles (test vehicles) and submit the results of the evaluation to the Executive Officer.

(2.2) Selection'of test vehicles:

(2.2.1) For each engine selected for monitoring system demonstration in section (j), the manufacturer shall *evaluate* one production vehicle equipped with an engine from the same engine family and rating as the demonstration engine. The Executive Officer shall select the specific production vehicle(s) to be tested.

(2.2.2) A manufacturer required to test more than .one test vehicle may test an engine in lieu of a vehicle for all but one of the required test vehicles.

(2.2.3) The Executive Officer may *waive* the requirements for submittal of evaluation results from one or more of the test vehicles if data *have* been previously submitted for all of the engine ratings and variants.

(2.3) Evaluation requirements:

(2.3.1) The evaluation shall demonstrate the ability of the OBO system on the selected production vehicle to detect a malfunction, illuminate the MIL, and, where applicable, store an appropriate fault code readable by a scan tool conforming to SAE J1978/J1939 when a malfunction is present and the monitoring conditions have been satisfied for each individual diagnostic required by title 13, CCR section 1971.1.

(2.3.2) The evaluation shall verify that malfunctions detected by non-MIL illuminating diagnostics of components used to enable any other OBO system diagnostic (e.g., 'fuel level sensor) will not inhibit the ability of other OBO system diagnostics to properly detect malfunctions.

(2.3.3) The evaluation shall verify that the software used to track the numerator and denominator for purposes of determining in-use monitoring frequency correctly increments as required in section (d)(4).

(2.3.4) Malfunctions may be mechanically implanted or electronically simulated but internal on-board computer hardware or software changes may not be used to simulate malfunctions. For monitors that are required to indicate a malfunction before emissions exceed an emission threshold based on any applicable standard (e.g., 2.0 times any of the applicable standards), manufacturers are not required to use malfunctioning components/systems set exactly at their malfunction criteria limits. Emission testing to confirm that the malfunction is detected before the appropriate emission standards are exceeded is not required.

(2.3.5) Manufacturers shall 'submit a proposed test plan for Executive Office'r , approval prior to evaluation testing being performed. The test plan shall identify the method used to induce a'malfunction for each diagnostic. If the Executive Officer determines that the requirements of section (1)(2) are satisfied, the proposed test plan shall be approved.

(2.3.6) Subject to Executive Officer approval, manufacturers may omit demonstration of specific diagnostics. The Executive Officer shall approve a manufacturer's request if the demonstration cannot be reasonably performed without causing physical damage to the vehicle (e.g., on-board computer internal circuit faults).

(2.3.7) For evaluation of test vehicles selected in accordance with section (1)(2.2), manufacturers are not required to demonstrate diagnostics that were previously demonstrated prior to certification as required in section (i).

(2.4) Manufacturers shall submit a report of the results of all testing conducted pursuantto section (1)(2) to the Executive Officer for review. This report shall identify the method used to induce a malfunction in each diagnostic, the MIL illumination status, and the fault code(s) stored.

(2.5) In accordance with section (k)(6), manufacturers may request Executive. Officer approval for a retroactive deficiency to be granted for items identified during this testing.

(3) Verification and Reporting of *In-use Monitoring Performance.*

(3.1) Manufacturers are required to collect and report,in-use monitoring performance data representative of production vehicles (Le., engine rating and chassis application combination). Manufacturers shall collect and report the data to the ARB within twelve months after the production vehicles were first introduced into commerce.

(3.2) Manufacturers shall separate production vehicles into monitoring performance groups, as defined by sections (1)(3.2.1) and (3.2.2) below, and submit data representative of each group:

(3.2.1) Emission architecture. Engines shall be separated by emission architecture. All engines that use the same or similar emission control architecture and monitoring system shall be in the same emission architecture category.

(3.2.2) Monitoring performance group. Within an emission architecture category, engines shall be separated by vehicle application. The separate monitoring performance groups shall be based on three classifications: engines intended primarily for line-haul chassis applications, engines intended primarily for urban delivery chassis applications, and all other engines.

(3.3) Manufacturers may request Executive Officer approval to use an alternate grouping method to collect representative data. Executive Officer approval shall be granted upon determining that the proposed groupings include production vehicles using similar emission controls, OBO strategies, monitoring condition calibrations, and vehicle application driving/usage patterns such that they are expected to have similar in-use monitoring performance. If approved by the Executive Officer, the manufacturer may submit one set of data for each of the approved groupings.

(3.4) For each group, the data must include all of the in-use performance tracking data reported through SAE J1979/J1939 (Le., all numerators, denominators, the general denominator, and the ignition cycle counter), the date the data were collected, the odometer reading, the VIN, and the ECM software calibration identification number.

(3.5) Manufacturers shall submit a plan to the Executive Officer for review and approval that details the types of production vehicles in each group, the number of vehicles per group to be sampled, the sampling method, the time line to collect the data, and the reporting format. The Executive Officer shall approve the plan upon determining that it provides for effective collection of data from a sample of vehicles that, at a minimum, is fifteen vehicles per group, will likely result in the collection and submittal of data within the required time frame, will generate data that are representative of California drivers and temperatures, and does not, by design, exclude or include specific vehicles in an attempt to collect data only from vehicles with the highest in-use performance ratios.

(3.6) Upon request of the manufacturer, the Executive Officer may for good cause extend the twelve month time requirement set forth in section (1)(3.1) up to a maximum of eighteen months. In granting additional time, the Executive Officer shall consider, among other things, information submitted by the manufacturer to justify the delay, sales volume of the group(s), and the sampling mechanism utilized by the manufacturer to procure vehicles for data collection. If an extension beyond twelve months is granted, the manufacturer shall additionally be required to submit an interim report within twelve months for data collected up to the time of the interim report.

(4) Verification of In-Use Compliance

(4.1) As a condition for certification, manufacturers are required to perform compliance testing on in-use engines as specified in California Code of Regulations, title 13, section 1971.5(c).

(m)*INTERMEDIATE IN USE COMPLIANCE STANDARDS.*

(l)For 2010 through 2012 model year engines:

(1.1)For monitors that are required to indicate a malfunction before emissions exceed a certain emission threshold (e.g.! 2.5 times any of the applicable standards):

(1.1.1)On the OBD parent rating (Le., the engine rating subject to the "full 080" requirement under section (d)(7.1.1)), the Executiv€ Officer may not consider an OBD system noncompliant unless a representative sample indicates emissions exceed 2.0 times the malfunction criteria (e.g., 5.0 times the standard if the malfunction criterion is 2.5 times the standard) without MIL illumination on either of the applicable standards (Le., FTP or SET).

(1.1.2)On the OBD child ratings (i.e., the engine ratings subject to the "extrapolated 080" requirement under section (d)(7.1.2)), the Executive Officer may not consider an aBO system noncompliant based on emission levels.

,(l.2)The Executive Officer shall use only the test cycle and standard determined and identified by the manufacturer at the time of certification in accordance with section (d)(6.1) as the most stringent for purposes of determining aBO system noncompliance in section (m)(1.1..1).

The Executive Officer shall use the adjustment factors determined by the manufacturer at the time of certification in accordance with section (d)(6.2) for purposes of determining OBO system noncompliance in section (m)(1.1.1).

(2)For 2013 through 2015 model year engines:

(2.1)For monitors that are required to indicate a malfunction before emissions . exceed a certain emission threshold (e.g., 2.0 times any of the applicable standards):

(2.1.1)On all OBD parent ratings and aBO child ratings subject to section (d)(7:2.2), the Executive Officer may not consider an OBD system noncompliant unless a representative sample indicates emissions exceed 2.0 times the malfunction criteria (e.g., 4.0 times the standard if the malfunction criterion is 2.0 times the standard) without MIL illumination on either of the applicable standards (i.e., FTP or SET).

(2.1.2)On all other engine ratings, the Executive Officer may not consider an aBO system noncompliant based on emission levels.

(2.2)The Executive Officer shall use only the test cycle and standard determined and identified by the manufacturer at the time of certifi'Cation in accordance \Nith section (d)(6.1) as the most stringent for purposes of determining aBO system noncompliance in section (m)(2.1.1).

(2.3)For monitors subject to meeting the minimum in use monitor performance ratio of 0.100 in section (d)(3.2.2), the Executive Officer may not consider an aBO syste'm noncompliant unless a representative sample indicates the in use ratio is below 0.050.

(3)For 2016 through 2019 model year engines:

(3.1)For monitors of the PM filter subject to the malfunction criteria of section (e)(8.2.1)(B), the Executive Officer may not consider the PM filter monitor noncompliant with the malfunction threshold of section (e)(8.2.1)(B) unless a representative sample indicates emissions exceed 2.0 times the malfunction criteria (e.g., PM emission level of 0.06 g/bhp hr if the malfunction criterion is 0.03 glbhp hr) without MIL illumination on either of the applicable standards· (i.e., FTP or SET).

(3.2)For all engine ratings subject to section (d)(7.2.3) for extrapolated aBO in 2013 through 2015, the Executive Officer may not consider an aBO system noncompliant unless a representative sample indicates emissions exceed 2.0 times the malfunction criteria (e.g., 4.0 times the standard if the malfunction criterion is 2.0 times ~~the~~ standard) without MIL illumination on either of the applicable standards (Le., FTP or SET),

(4)For 2010 and subsequent model year engines, the Executive Officer may not consider an aBO system noncompliant solely due to a failure or deterioration mode of a monitored component or system that could not have been reasonably foreseen to occur by the manufacturer.

NOTE: Authority cited: Sections 39600,39601,43000.5,43013,43018,43100,43101, 43104,43105,43105.5, and 43106, Health and Safety Code. Reference: Sections 39002,39003,39010-39060,39515,39600-39601,43000,43000.5,43004,43006, 43013,43016,43018,43100,43101,43102, 43104, 43105,43105.5, 43106,43150-43156,43204,43211, and 43212, Health and Safety Code.

ATTACHMENT B

California Code of Regulations, Title 13, section 1968.2, Malfunction and Diagnostic System Requirements for 2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines (OBD II)

Set forth below are proposed amendments to California Code of Regulations, Title 13, §1968.2. The proposed amendments are shown in single underline to indicate additions and single strikeout to indicate deletions.

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§1968.2. Malfunction and Diagnostic System Requirements--2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines

(a) *PURPOSE.*

The purpose of this regulation is to establish emission standards and other requirements for onboard diagnostic systems (OBO II systems) that are installed on 2004 and subsequent model-year passenger cars, light-duty trucks, and medium-duty vehicles and engines certified for sale in California. The OBO II systems, through the use of an onboard computer(s), shall monitor emission systems in-use for the actual life of the vehicle and shall be capable of detecting malfunctions of the monitored emission systems, illuminating a malfunction indicator light (MIL) to notify the vehicle operator of detected malfunctions, and storing fault codes identifying the detected malfunctions.

(b) *APPLICABILITY.*

Except as specified elsewhere in this regulation (title 13, CCR section 1968.2), all 2004 and subsequent model-yearvehicles, defined as passenger cars, light-duty trucks, and medium-duty vehicles, including medium-duty vehicles with engines certified on an engine dynamometer and medium-duty passenger vehicles, shall be equipped with an OBO II system and shall meet all applicable requirements of this regulation (title 13, CCR section 1968.2). Except as specified in section (d)(2.2.5), medium-duty vehicles with engines certified on an engine dynamometer may comply with these requirements on-an engine model year certification basis rather than a vehicle model year basis.

(c) *DEFINITIONS.*

"Actual life" refers to the entire period that a vehicle is operated on public roads in California up to the time a vehicle is retired from use.

"Alternate phase-in" is a phase-in schedule that achieves equivalent compliance volume by the end of the last year of a scheduled phase-in provided in this regulation. The compliance volume is the number calculated by multiplying the percent of vehicles (based on the manufacturer's projected sales volume of all vehicles) meeting the new requirements per year by the number of years implemented prior to and including the last year of the scheduled phase-in 'and then summing these yearly results to determine a cumulative total (e.g., a three year, 30/60/100 percent scheduled phase-in would be calculated as (30*3 years) + (60*2 years) + (100*1 year) = 310). On phase-ins scheduled to begin prior to the 2004 model year, manufacturers are allowed to include vehicles introduced before the first year of the scheduled phase-in (e.g., in the previous example, 10 percent introduced one year before the scheduled phase-in begins would be calculated as (10*4 years) and added to the cumulative total). However, on phase-ins scheduJed to begin in 2004 or subseqLient model years, manufacturers are only allowed to include vehicles introduced up to one model year before the first year of the scheduled phase-in. The Executive Officer shall consider acceptable any alternate phase-in that results in an equal or larger cumulative total by the end of the last year of the scheduled phase-in and ensures that all vehicles subject to the phase-in will

comply with the respective requirements no later than two model years following the last year of the scheduled phase-in.

For alternate phase-in schedules resulting in all vehicles complying one model year following the last year of the scheduled phase-in, the compliance volume shall be calculated as described directly above. For example, a *30/60/100* percent scheduled phase-in during the 2010-2012 model years would have a cumulative total of 310. If the manufacturer's planned alternate phase-in schedule is *40/50/80/100* percent during the 2010-2013 model years, the final compliance volume calculation would be (40*3 years) + (50*2 years) + (80*1 year) = 300, which is less than 310 and therefore would not be acceptable as an alternate phase-in schedule.

For alternate phase-in schedules resulting in all vehicles complying two model years following the last year of the scheduled phase-in, the compliance volume calculation shall be calculated as described directly above and shall also include a negative calculation for vehicles not complying until one or two model years following the last year of the scheduled phase-in. The negative calculation shall be calculated by mUltiplying the percent of vehicles not meeting the new requirements in the final year of the phase-in by negative one and the percent of vehicles not meeting the new requirements in the one year after the final year of the phase-in by negative two. For example, if 10 percent of a manufacturer's vehicles did not comply by the final year of the scheduled phase-in and 5 percent did not comply by the end of the first year after the final year of the scheduled phase-in, the negative calculation result would be (10*(-1 years)) + (5*(-2 years)) = -20. The final compliance volume calculation is the sum of the original compliance volume calculation and the negative calculation. For example, a *30/60/100* percent scheduled phase-in during the 2010-2012 model years would have a cumulative total of 310. If a manufacturer's planned alternate phase-in schedule is *40/70/80/90/100* percent during the 2010-2014 model years, the final compliance volume calculation would be (40*3 years) + (70*2 years) + (80*1 year) + (20*(-1 year)) + (10*(-2 years)) = 300, which is less than 310 and therefore would not be acceptable as an alternate phase-in schedule.

"Applicable standards" refers to the specific exhaust emission standards or family emission limits (FEL) of the Federal Test Procedure (FTP) to which the vehicle or engine is certified. For 2010 and subsequent model year diesel engines, "applicable standards" shall also refer to the specific exhaust emission standards or family emission limits (FEL) of either the FTP or the Supplemental Emission Test (SET) to which the engine is certified, as determined according to section (d)(6).

"Auxiliary Emission Control Device (AECD)" refers to any approved AECD (as defined by 40 Code of Federal Regulations (CFR) 86.082-2 and 86.094-2).

"Emission Increasing Auxiliary Emission Control Device (EI-AECD)" refers to any approved AECD that: reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and' use; and the need for the AECD is justified in terms of protecting the vehicle against damage or accident. For medium-duty vehicles certified to an engine dynamometer tailpipe emission standard, an AECD that is certified as an NTE deficiency shall not be considered an EI-AECD. An AECD that does not sense, measure, or calculate any parameter or command or trigger any action, algorithm,. or alternate strategy shall not be

considered an EI-AECD. An AECO that is activated solely due to any of the following conditions operation of the vehicle above 8000 feet in elevation shall not be considered an EI-AECD: (1) operation of the vehicle above 8000 feet in elevation; (2) ambient temperature; (3) when the engine is warming up and is not reactivated once the engine has warmed up in the same driving cycle; (4) failure detection (storage of a fault code) by the aBO system; (5) execution of an aBO monitor; or (6) execution of an infrequent regeneration event.

"Base fuel schedule" refers to the fuel calibration schedule programmed into the Powertrain Control Module or PROM when manufactured or when updated by some off·board source, prior to any learned on-board correction.

"Calculated load value" refers to an indication of the percent engine capacity that is being used and is defined in Society of Automotive Engineers (SAE) J1979 "E/E Oiagnostic Test Modes - Equivalent to ISO/OIS 15031-5:April30, 2002", April 2002 (SAE J1979), incorporated by reference (section (g)(1.4)[1]). For diesel applications, the calculated load value is determined by the ratio of current output torque to maximum output torque at current engine speed as defined by suspect parameter number (SPN) 92 of SAE J1939 "Recommended Practice for a Serial Control and Communications Vehicle Network" (SAE J1939), incorporated by reference.

"Confirmed fault code" is defined as the diagnostic trouble code stored when an aBO II system has confirmed that a malfunction exists (e.g., typically on the second driving cycle that the malfunction is detected) in accordance with the requirements of sections (e), (f), and (g)(4.4).

"Continuously," if used in the context of monitoring conditions for circuit continUity, lack of circuit continuity, circuit faults, and out-of-range values, means monitoring is always enabled, unless alternate enable conditions have been approved by the Executive Officer in accordance with section (d)(3.1.1), and sampling of the signal used for monitoring occurs at a rate no less than two samples per second. If for control purposes, a computer input component is sampled less frequently, the signal of the ,component may instead be evaluated each time sampling occurs.

"Deactivate" means to turn-off, shutdown, desensitize, or otherwise make inoperable through software programming or other means during the actual life of the vehicle.

"Diagnostic or emission critical" electronic powertrain control unit refers to the engine and transmission control unites). For the 2005 and subsequent model years, it also includes any other on-board electronic powertrain control unit containing software that: (1) has primary control over any of the monitors required by sections· (e)(1.0) through (e)(14.0), (e)(16.0), (f)(1) through (f)(14), and (f)(16) or, (2) excluding anti-lock brake system (ABS) control units or stability/traction control units, has primary control over the diagnostics for more than two of the components required to be monitored by sections (e)(15.0) and (f)(15). For purposes of criterion (2) above, all glow plugs in an engine shall be considered "one" component in lieu of each glow plug being considered a separate component.

"Diesel engines" refers to engines using a compression ignition thermodynamic cycle.·

[1] Unless otherwise noted, all section references refer to section 1968.2 of title 13,. CCR.

"Driving cycle" consists of engine startup and engine shutoff and includes the period of engine off time up to the next engine startup. For vehicles that employ engine shutoff strategies (e.g., engine shutoff at idle), the manufacturer may request Executive Officer approval to use an alternate definition for driving cycle (e.g., key on and key off). Executive Officer approval of the alternate definition shall be based on equivalence to engine startup and engine shutoff signaling the beginning and ending of a single driving event for a conventional vehicie. For applications that are used in both medium-duty and heavy-duty classes, the manufacturer may use the driving cycle definition of title 13, CCR, section 1971.1 in lieu of this definition. Engine restarts following an engine shut-off that has been neither commanded by the vehicle operator nor by the engine control strategy but caused by an event such as an engine stall may be considered.a new driving cycle or a continuation of the existing driving cycle.

"Engine misfire" means lack of combustion in the cyli.nder due to absence of spark, poor fuel metering, poor compression, or any other cause. This does not include lack of combustion events in non-active cylinders due to default fuel shut-off or cylinder deactivation strategies.

"Engine start" is defined as the point when the engine reaches a speed 150 rpm below the normal, warmed-up idle speed (as determined in the drive position for vehicles equipped with an automatic transmission). For hybrid vehicles or for engines employing alternate engine start hardware or strategies (e.g., integrated starter and generators, etc.), the manufacturer may request Executive Officer approval to use an alternate definition for engine start (e.g., ignition key "on"). Executive Officer approval of the alternate definition shall be based on equivalence to an engine start for a conventional vehicle.

"Family Emission Limit (FEL)" refers to the exhaust emission levels to which an engine family is certified under the averaging, banking, and trading program incorporated by reference in title 13, CCR section 1956.8.

"Fault memory" means information pertaining to malfunctions stored in the onboard computer, including fault codes, stored engine conditions, and MIL status.

"Federal Test Procedure (FTP) test" refers to an exhaust emission test conducted according to the test procedures incorporated by reference in title 13, CCR section 1961(d) that is used to determine compliance with the FTP standard to which a vehicle is certified.

"FTP cycle". For passenger vehicles, light-duty trucks, and medium-duty vehicles certified on a chassis dynamometer, FTP cycle refers to the driving schedule in Code of Federal Regulations (CFR) 40, Appendix 1, Part 86, section (a) entitled, "EPA Urban Dynamometer Driving Schedule for Light-Duty Vehicles and Light-Duty Trucks." For medium-duty engines certified on an engine dynamometer, FTP cycle refers to the engine dynamometer schedule in CFR 40, Appendix 1, Part 86, section (f)(1), entitled, "EPA Engine Dynamometer Schedule for Heavy-Duty Otto-Cycle Engines," or section (f)(2), entitled, "EPA Engine Dynamometer Schedule for Heavy-Duty Diesel Engines."

"FTP standard" refers to the certification tailpipe exhaust emission full useful life standards and test procedures applicable to the FTP cycle and to the class to which the.vehicle is certified.

"FTP full useful life standard" refers to the FTP standard applicable when the vehicle reaches the end of its full useful life as defined in the certification

requirements and test procedures incorporated by reference in title 13, CCR section 1961 (d).

"Fuel trim" refers to feedback adjustments to the base fuel schedule. Short-term fuel trim refers to dynamic or instantaneous adjustments. Long-term fuel trim refers to much more gradual adjustments to the fuel calibration schedule than short-term trim adjustments.

"Functional check" for an output component or system means verification of proper response of the component and system to a computer command.

"Gasoline engine" refers to an Otto-cycle engine or an alternate-fueled engine.

"Keep-alive memory (KAM)," for the purposes of this regulation, is defined as a type of memory that retains its contents as long as power is provided to the on-board control unit. KAM is not erased upon shutting off the engine but may be erased if power to the on-board control unit is interrupted (e.g., vehicle battery disconnected, fuse to control unit removed). In some cases, portions of KAM may be erased with a scan tool command to reset KAM.

"Key on, engine off position" refers to a vehicle with the ignition key in the engine run position (not engine crank or accessory position) but with the engine not running.

"Light-duty truck" is defined in title 13, CCR section 1900 (b).

"Low Emission Vehicle I application" refers to a vehicle or engine certified in California to the exhaust emission standards defined in title 13, CCR sections' 1956.8(g), 1960.1 (g)(1), and 1960.1 (h)(1) for any of the following vehicle emission categories: Transitional Low Emission Vehicle (TLEV), Low Emission Vehicle (LEV), Ultra Low Emission Vehicle (ULEV), or Super Ultra Low Emission Vehicle (SULEV). Additionally, vehicles certifi.ed to Federal emission standards (bins) in California but categorized in a Low Emission Vehicle I vehicle emission category for purposes of calculating NMOG fleet average in accordance with the certification requirements and test procedures incorporated by reference in title 13, CCR section 1961 (d) are subject to all monitoring requirements applicable to Low Emission Vehicle I applications but shall use the Federal tailpipe emission standard (Le., the Federal bin) for purposes of determining the malfunction thresholds in sections (e) and (f).

"MDV SULEV vehicles" refer only to medium-duty Low Emission Vehicle I applications certified to the SULEV vehicle emission category.

"TLEV vehicles" refer only to Low Emission Vehicle I applications certified to the TLEV vehicle emission category.

"LEV vehicles" refer only to Low Emission Vehicle I applications certified to the LEV vehicle emission category.

"ULEV vehicles" refer only to Low Emission Vehicle I applications certified to the ULEV vehicle emission category.

"Low Emission Vehicle II application" refers to a vehicle or engine certified in California to the exhaust emission standards defined in title 13, CCR section 1961, or optionally certified to the exhaust emission standards defined in title 13, CCR section 1956.8, for any of the following emission categories: LEV, ULEV, or SULEV. Additionally, except as provided for in sections (e)(17.1.3) and (f)(17.1.2), vehicles certified to Federal emission standards (bins) in California but categorized in a Low Emission Vehicle II vehicle emission category for purposes of calculating NMOG fleet average in accordance with the certification requirements and test procedures

incorporated by'reference in title 13, CCR section 1961 (d) are subject to all monitoring requirements applicable to Low Emission Vehicle II applications but shall use the Federal tailpipe emission standard (Le., the Federal bin) for purposes of determining the malfunction thresholds in sections (e) and (f).

"PC/LOT SULEV /l vehicles" refer only to passenger car and light-duty truck Low Emission Vehicle II applications certified to the SULEV vehicle emission category.

"MOV SULEV /l vehicles" refer only to medium-duty Low Emission Vehicle II applications certified to the SULEV vehicle emission category.

"LEV /l vehicles" refer only to Low Emission Vehicle II applications certified to the LEV vehicle emission category.

"ULEV /l vehicles" refer only to Low Emission Vehicle II applications certified to the ULEV vehicle emission category.

"Malfunction" means any deterioration or failure of a component that causes the performance to be outside of the applicable limits in sections,(ej and (f).

"Medium-duty vehicle" is defined in title 13, CCR section 1900 (b).

"Medium-duty passenger vehicle" or *"MOPV"* is defined in Title 40, Section 86.1803-01, Code of Federal Regulations.

"Non-volatile random access memory (NVRAM)," for,the purposes of this regulation, is defined as a type of memory that retains its contents even when power to the on-board control unit is interrupted (e.g., vehicle battery disconnected, fuse to control unit removed). NVRAM is typically made non-volatile either by use of a back-up battery within the control unit or through the use of an electrically erasable and programmable read-only memory'(EEPROM) chip.

"Not-To-Exceed (NTE) control area" refers to the bounded region of the engine's torque and speed map, as defined in 40 CFR 86.1370-2007, where emissions must not exceed a specific emission cap for a given pollutant under the NTE requirement.

"Manufacturer-specific NOx NTE carve-out area" refers to regions within the NTE control area for NOx where the manufacturer has limited NTE testing as allowed by 40 CFR 86.1370-2007(b)(7).

"Manufacturer-specific PM NTE carve-out area" refers to regions within the NTE control area for PM where the manufacturer has limited NTE testing as allowed by 40 CFR 86.1370-2007(b)(7).

"NTE deficiency" refers to regions or conditions within the NTE control area for NOx or PM where the manufacturer has received' a deficiency as allowed by 40 CFR 86.007-11(a)(4)(iv).

"Normal production" is the time after the start of production when the manufacturer has produced two percent of the projected volume for the test group or calibration, whichever is being evaluated in accordance with section (j).

"Passenger car" is defined in title 13, CCR section 1900 (b).

"Pending fault code" is defined as the diagnostic trouble code stored upon the initial detection of a malfunction (e.g., typically on a single driving cycle) prior to illumination of the MIL in accordance with the requirements of sections (e), (f), and (g)(4.4).

"Percentage of misfire" as used in (e)(3.2) and (f)(3.2) means the percentage of misfires out of the total number of firing events for the specified interval.

"Permanent fault code" is defined as a confirmed fault code that is currently commanding the MIL on and is stored in NVRAM as specified in sections (d)(2) and (g)(4.4).

"Power Take-Off (PTO) unit" refers to an engine driven output provision for the purposes of powering auxiliary equipment (e.g:, a dump-truck bed, aerial bucket, or tow-truck winch).'

"Rationality fault diagnostic" for an input component means verification of the accuracy of the input signal while in the range of normal operation and when compared to all other available information.

"Redline engine speed" shall be defined by the manufacturer as either the recommended maximum engine speed as normally displayed on instrument panel tachometers or the engine speed at which fuel shutoff occurs.

"Response rate" for exhaust gas sensors refers to the delay from when the sensor is exposed to a different make-up of exhaust gas constituents until it outputs a signal reflecting the different make-up of exhaust gas constituents. For example, for oxygen sensors, response rate is the delay from when the oxygen sensor is exposed to a change in exhaust gas from richer/leaner than stoichiometric to leaner/richer than stoichiometric to the time when the oxygen sensor indicates the lean/rich condition. Similarly, for wide-range air-fuel (AIF) sensors, response rate is the delay from when the sensor is exposed to a different AIF ratio to the time it indicates the different AIF ratio. For NOx and PM sensors, response rate is the delay from when the sensor is exposed to a different NOx or PM exhaust gas level until it indicates the different NOx or PM exhaust gas level.

"SC03 emission standards" refers to the certification tailpipe exhaust emission standards for the 'air conditioning *(AIC)* test of the Supplemental Federal Test Procedure Off-Cycle Emission Standards specified in title 13, CCR section 1961(a) applicable to the class to which the vehicle is certified.

"Secondary air" refers to air introduced into the exhaust system by means of a pump or aspirator valve or other. means that is intended to aid in the oxidation of HC and CO contained in the exhaust gas stream.

"Similar conditions" as used in sections (e)(3), (e)(6), (f)(3), and (f)(4) means engine conditions having an engine speed within 375 rpm, load conditions within 20 percent, and the same warm-up status (Le., cold or hot) as the engine conditions stored pursuant to (e)(3.4.4), (e)(6.4.5), (f)(3.4.2)(C), and (f)(4.4.2)(E). The Executive Officer may approve other definitidns of similar conditions based on comparable timeliness and reliability in detecting similar engine operation.

"Small volume manufacturer" is defined in title 13, CCR section 1900(b). However, for a manufacturer that transitions from a small volume manufacturer to a non-small volume manufacturer, the manufacturer is still considered a small volume manufacturer for the first three model years that it no longer meets the definition in title 13, CCR section 1900(b).

"Supplemental EmIssion Test (SET) cycle" refers to the driving schedule defined as the "supplemental steady state emission test" in 40 CFR 86.1360-2007, as amended July 13, 2005.

"SET standard" refers to the certification exhaust emission standards and test procedures applicable to the SET cycle incorporated by reference in title 13, CCR sections 1956.8(b) and (d) to which the engine is certified.

"Unified cycle" is defined in "Speed Versus Time Data for California's Unified Driving *Cycle",* dated December 12, 1996, incorporated by reference.

"US06 cycle"refers to the driving schedule in 40 CFR 86, Appendix 1, section (g), as amended July 13, 2005, entitled, "EPA US06 Driving Schedule for Light-Duty Vehicles and Light-Duty Trucks."

'Warm-up cycle" means sufficient vehicle operation such that the coolant temperature has risen by at least 40 degrees Fahrenheit from engine starting and reaches a minimum temperature of at least 160 degrees Fahrenheit (140 degrees Fahrenheit for applications with diesel engines).

(d) *GENERAL REQUIREMENTS.*

Section (d) sets forth the general requirements of the aBO II system. Specific performance requirements for components and systems that shall be monitored are set forth in sections (e) and (f) below.

(1) The OBD /I System.

(1.1) If a malfunction is present as specified in sections (e) and (f), the aBO II system shall detect the malfunction, store a pending or confirmed fault code in the onboard computer's memory, and illuminate the MIL as required.

(1.2) The aBO II system shall be equipped with a standardized data link connector to provide access to the stored fault codes as specified in section (g).

(1.3) The aBO II system shall be designed to ·operate, without any required scheduled maintenance, for the actual life of the vehicle in which it is installed and may not be programmed. or otherwise designed to deactivate based on age and/or mileage of the vehicle during the actual life of the vehicle. This section is not intended to alter existing law and enforcement practice regarding a manufacturer's liability for a vehicle beyond its useful life, except where a vehicle has been programmed or otherwise designed so that an OBD·II system deactivates based on age and/or mileage of the vehicle.

(1.4) Computer-coded engine operating parameters may not be changeable without the use of specialized tools and procedures (e.g. soldered or potted computer components or sealed (or soldered) computer enclosures). Subject to Executive Officer approval, manufacturers may exempt from this requirement those product lines that are unlikely to require protection. Criteria to be evaluated in making an exemption include current availability of performance chips, high performance capability of the vehicle, and sales volume.

(2) MIL and Fault Code Requirements.

(2.1) MIL Specifications.

(2.1.1) The MIL shall be located on the driver's side instrument panel and be of sufficient illumination and location to be readily visible under all lighting conditions and shall be amber in color when illuminated. The MIL, when illuminated, shall display the pnrase "Check Engine" or "Service Engine Soon". The word "Powertrain" may be substituted for "Engine" in the previous phrases. Alternatively, the International Standards Organization (ISO) engine symbol may be substituted for the word "Engine" or for the entire phrase.

(2.1.2) The MIL shall illuminate in the key on, engine off position before engine cranking to indicate that the MIL is functional. For all 2005 and subsequent model year vehicles, the MIL shall continuously illuminate during this functional check for a minimum of 15-20 seconds. During this functional check of the MIL, the data stream value for MIL status shall indicate commanded off (see section (g)(4.2)) unless the MIL has also been commanded on for a detected malfunction. This functional check of the MIL is not required during vehicle operation in the key on, engine off position subsequent to the initial engine cranking of each driving cycle (e.g., due to an engine stall or other non-commanded engine shutoff).

(2.1.3) At the manufacturer's option, the MIL may be used to indicate readiness status in a standardized format (see section (g)(4.1.3)) in the key on, engine off position.

(2.1.4) A manufacturer may request Executive Officer approval to also use the MIL to indicate which, if any, fault codes are currently stored (e.g., to "blink" the stored codes). The Executive Officer shall approve the request upon determining that the manufacturer has demonstrated that the method used to indicate the fault codes will not be activated during a California Inspection and Maintenance test or during routine driver operation.

(2.1.5) The MIL may not be used for any purpose other than specified in this regulation.

(2.2) MIL Illumination and Fault Code Storage Protocol.

(2.2.1) Upon detection of a malfunction, the OBD system shall store a pending fault code within ten seconds indicating the likely area of the malfunction.

(2.2.2) After storage of a pending fault code, if the identified malfunction is again detected before the end of the next driving cycle in which monitoring occurs, the MIL shall illuminate continuously and a confirmed fault code shall be stored within 10 seconds. If a malfunction is not detected before the end of the next driving cycle in which monitoring occurs (i.e., there is no indication of the malfunction at any time during the driving cycle), the corresponding pending fault code set according to section (d)(2.2.1) shall be erased at the end of the driving cycle.

(2.2.3) The OBD system shall illuminate the MIL and store a fault code within 10 seconds to inform the vehicle operator whenever the powertrain enters a default or "limp home" mode of operation that can affect emissions or the performance of the OBD II system or in the event of a malfunction of an on-board computer(s) itself that can affect the performance of the OBD II system.

(A) If the default or "limp home" mode of operation is recoverable (i.e., the diagnostic or control strategy that caused the default or "limp home" mode of operation can run on the next driving cycle and confirm the presence of the condition that caused the default or "limp home" operation), the OBD II system may, in lieu of illuminating the MIL within 10 seconds on the first driving cycle where the default or "limp home" mode of operation is entered, delay illumination of the MIL until the condition causing the default or "limp home" mode of operation is again detected before the end of the next driving cycle.

(B) MIL illumination and fault code storage is not required for engine overtemperature default strategies that are only initiated after the temperature gauge indicates a temperature in. the red zone, or after an overtemperature "hot" light is illuminated, or due to the verified occurrence of severe operating conditions (e.g., extended trailer towing up a grade).

(2.2.4) For all 2010 and subsequent model year vehicles, the OBO II system shaH default to a MIL on state if the instrument panel receives and/or processes instructions or commands from other diagnostic or emission critical electronic powertrain control units to illuminate the MIL and a malfunction occurs (e.g., communication is lost) such that the instrument panel is no longer able to properly receive the MIL illumination requests. Storage of a fault code is not required for this malfunction.

(2.2.5) For 50 percent of all 2010, 75 percent of all 2011, and 100 percent of all 2012 and subsequent model year vehicles (including 2012 model year medium-duty vehicles with 2011 model year engines certified on an engine dynamometer), before the end of an ignition cycle, the OBO II system shall store confirmed fault codes that are currently causing the MIL to be illuminated in NVRAM as permanent fault codes (as defined in section (g)(4.4.6».

(2.2.6) A manufacturer may request Executive Officer approval to employ . alternate statistical MIL illumination and fault code storage protocols to those specified in· these requirements. The Executive Officer shall grant approval upon determining that the manufacturer has provided data and/or engineering evaluation that demonstrate that the alternative . protocols can evaluate system performance and detect malfunctions in a manner that is equally effective and timely. Except as otherwise provided in section (e) for evaporative system malfunctions, strategies requiring on average more than six driving cycles for MIL illumination may not be accepted. .

(2.2.7) A manufacturer shall store and erase "freeze frame" conditions (as defined in section (g)(4.3» present at the time a malfunction is detected. A manufacturer shall store and erase freeze frame conditions in conjunction with storage and erasure of either pending or confirmed fault codes as required elsewhere in section (d)(2.2).

(2.3) Extinguishing the MIL.

Except as otherwise provided in sections (e)(3.4.5), (e)(4.4.2), (e)(6.4.6), (f)(3.4.2)(O), and (f)(4.4.2)(F) for misfire, evaporative system, and fuel system malfunctions, once the MIL has been illuminated it may be extinguished after three subsequent sequential driving cycles during which the monitoring system responsible for illuminating t.he MIL functions and the previously detected malfunction is no longer present provided no other malfunction has been detected that would independently illuminate the MIL according to the requirements outlined above.

(2.4) Erasing a confirmed fault code.

The OBD II system may erase a confirmed fault code if the identified malfunction has not been again detected in at least 40 engine warm-up cycles, and the MIL is presently not illuminated for that malfunction.

(2.5) Erasing a permanent fault code.

(2.5.1) If the OBO II system is commanding the MIL on, the OBO II system shall erase a permanent fault code only if the OBO II system itself determines that the malfunction that caused the permanent fault code to be stored is no longer present and is not commanding the MIL on, pursuant to the requirements of s.ection (d)(2.3) (which for purposes of this section shall apply to all monitors).

(2.5.2) If all fault information in the on-board computer other than the permanent fault code has been cleared (Le., through the use of a scan tool or battery disconnect) and the OBO II system is not commanding the MIL on:

(A) Except as provided for in sections (d)(2.5.2)(C) through (E), if the monitor of the malfunction that caused the permanent fault code to be stored is subject to the minimum ratio requirements of section (d)(3.2) (e.g., catalyst monitor, comprehensive component input component rationality monitors), the OBO II system shall erase the permanent fault code at the end of a driving cycle' if the monitor has run and made one or more determinations during a driving cycle that the malfunction of the component or the system is not present and has not made any determinations within the same driving cycle that the malfunction is present.

(B) Except as provided for in sections (d)(2.5.2)(O) and (E), if the monitor of the malfunction that caused the permanent fault code to be stored is not subject to the minimum ratio requirements of section (d)(3.2) (e.g., gasoline misfire monitor, fuel system monitor, comprehensive component circuit continuity monitors), the OBO II system shall erase the permanent fault code at the end of a driving cycle if:

(i) The monitor has run and made one or more determinations during a driving cycle that the malfunction of the component or the system is not present and has not made any determinations within the same driving cycle that the malfunction is present;

(ii) The monitor has not made any determinations that the malfunction is present subsequent to the most recent driving cycle in which the criteria of section (d)(2.5.2)(B)(i) are met; and

(iii) The following criteria are satisfied on any single driving cycle (which may be a different driving cycle than that in which the criteria of section (d)(2.5.2)(B)(t) are satisfied):

a. Cumulative time since engine start is greater than or equal to 600 seconds; .

b. Except as provided in section (d)(2.5.2)(B)(iii)e. below, ~~C~~cumulative vehicle operation at or above 25 miles per hour occurs for greater than or equal to 300 seconds (medium-duty vehicles with diesel engines certified on an engine dynamometer may use cumulative operation at or above 15% calculated load 1150 rpm in lieu of at or above 25 miles per hour for purposes of this criteria); ~~and~~ '

c. Continuous vehicle operation at idle (Le., accelerator pedal released by driver and either vehicle speed less than or equal to one mile per hour or engine speed less than or equal to 200 rpm above normal warmed-up idle (as determined in the drive position for vehicles equipped with an automatic transmission») for greater than or equal to 30 seconds; and

d. The monitor has not made any determination that the malfunction is present.

e. For 2004 through 2012 model year medium-duty vehicles with diesel engines certified on an enqine dynamometer, manufacturers may use diesel engine operation at or above 15 percent calculated load in lieu of 1150 rpm for the criterion in section (d)(2.5.2)(B)(iii)b. above.

(iv) Monitors required to use "similar conditions" as defined in section (c) to store and erase pending and confirmed fault codes may not require that the similar conditions be met prior to erasure of the permanent fault code.

(C) For monitors subject to section (d)(2.5.2)(A), the manufacturer may choose to erase the permanent fault code using the criteria under section (d)(2.5.2)(B) in lieu of the criteria under sectioh (d)(2.5.2)(A).

(D) For 2009 and 2010 model year vehicles meeting the permanent fault code requirements of section (d)(2.2.5), manufact.urers may request Executive Officer approval to use alternate criteria to erase the permanent fault code. The Executive Officer shall approve alternate criteria that:

(i) Will not likely require driving conditions that are longer and more difficult to meet than those required under section (d)(2.5.2)(B), and

(ii) Do not require access to ·enhanced scan tools (Le., tools that are not generic SAE J1978 scan 1001s) to determine conditions necessary to erase the permanent fault code.

(E) If alternate criteria to erase the permanent fault code are approved by the Executive Officer under section (d)(2.5.2)(D), a manufacturer may continue to use the approved alternate criteria for 2011 model year vehicles previously certified in the 2009 or 2010 model year to the alternate criteria and carried over to the 2011 model year.

(3) Monitoring Conditions.

Section (d)(3) sets forth the general monitoring requirements while sections (e) and (f) set forth the specific monitoring requirements as well as identify which of the following general monitoring requirements in section (d)(3) are applicable for each monitored component or system identified in sections (e) and (f).

(3.1) For all 2004 and subsequent model year vehicles:

(3.1.1) As specifically provided for in sections (e) and (f), manufacturers shall define monitoring conditions, subject to Executive Officer approval, for detecting malfunctions identified in sections (e) and (f). The Executive Officer shall approve manufacturer defined monitoring conditions that are determined (based on manufacturer submitted data and/or other engineering documentation) to be: technically necessary to ensure robust detection of malfunctions (e.g., avoid false passes and false indications of malfunctions), designed to ensure monitoring will occur under conditions which may reasonably be expected to be encountered in normal urban vehicle operation and use, and designed to ensure monitoring will occur during the FTP cycle or Unified cycle.

(3.1.2) Monitoring shall occur at least once per driving cycle in which the monitoring conditions are met.

(3.1.3) Manufacturers may request Executive Officer approval to define monitoring conditions that are not encountered during the FTP cycle or Unified cycle as required in section (d)(3.1.1). In evaluating the manufacturer's request, the Executive Officer shall consider the degree to which the requirement to run during the FTP or Unified cycle restricts in-use monitoring, the technical necessity for defining monitoring conditions that are not encountered during the FTP or Unified cycle, data and/or an engineering evaluation submitted by the manufacturer which demonstrate that the component/system does not normally function, or monitoring is otherwise not feasible, during the FTP or Unified cycle, and, where applicable in section (d)(3.2), the ability of the manufacturer to demonstrate the monitoring conditions will satisfy the minimum acceptable in-use monitor performance ratio requirement as defined in section (d)(3.2) (e.g., data which show in-use driving meets the minimum requirements).

(3.2) As specifically provided for in sections (e) and (f), manufacturers shall define monitoring conditions in accordance with the criteria in sections (d)(3.2.1) through (3.2.3). The requirements of section (d)(3.2) shall be phased in as follows: 30 percent of all 2005 model year vehicles, 60 percent of all 2006 model year vehicles, and 100 percent of all 2007 and subsequent model year vehicles. Manufacturers may use an alternate phase-in schedule. in lieu of the required phase-in schedule if the alternate phase-in schedule provides for equivalent compliance volume as defined in section (c) with the exception that 100 percent of 2007 and subsequent model year vehicles shall comply with the requirements. Small volume manufacturers shall meet the requirements on 100 percent of 2007 and subsequent model year vehicles but shall not be required to meet the specific phase-in requirements for the 2005 and 2006 model years.

(3.2.1) Manufacturers shall define monitoring conditions that, in addition to meeting the criteria in section (d)(3.1), ensure that the monitor yields an in-use performance ratio (as defined in section (d)(4» that meets or exceeds the minimum acceptable in-use monitor performance ratio on in-use vehicles: For purposes of this regulation, except as provided below in section (d)(3.2.1)(D), the minimum acceptable in-use monitor performance ratio is:

(A) 0.260 for secondary air system monitors and other cold start related monitors utilizing a denominator incremented in accordance with section (d)(4.3.2)(E);

(8) For evaporative system monitors:

(i) 0.260 for monitors designed to detect malfunctions identified in section (e)(4.2.2)(C) (Le., 0.020 inch leak detection); and

(ii) 0.520 for monitors designed to detect malfunctions identified in section (e)(4.2.2)(A) and (8) (Le., purge flow and 0.040 inch leak detection);

(C) 0.336 for catalyst, oxygen sensor, EGR, VVT system, and all other monitors specifically required in sections (e) and (f) to meet the monitoring condition requirements of section (d)(3.2);

(D) For introductory years:

(i) through the 2007 model year, for the first three years a vehicle is certified to the in-use performance ratio monitoring requirements of section (d){3.2), 0.100 for all monitors specified in section {d){3.2.1)(A) through (C) above. For example, the 0.100 ratio shall apply to the 2004, 2005, and 2006 model years for vehicles first certified in the 2004 ,model year and to the 2007, 2008, and 2009 model years for vehicles first certified in the 2007 model year.

(ii) through the 2014 model year, for fuel system air-fuel ratio cylinder imbala'nce monitors, 0.100;

(iii) through the 2011 model year, for secondary exhaust gas sensor monitors specified in (e){7.2.2){C), 0.100;

(iv) through the 2012 model year, for vehicles ,subject to the monitoring requirements of section (f), 0.100 for all monitors specified in section (d){3.2.1)(C) above.

(3.2.2) In addition to meeting the requirements of section (d){3.2.1), manufacturers shall impfement software algorithms in the OBD II system to individually track and report in-use performance of the following monitors in the standardized format specified in section (d){5):

a. Catalyst {section (e){1.3) or, where applicable, (f){1.3»;

b. Oxygen/exhaust gas sensor {section (eX7.3.1){A) or, where applicable, {f){5.3.1)(A»;

c. Evaporative system {section (e){4.3.2»;

d. EGR system {section (e){8.3.1» and WT system {section (e){13.3) or, where applicable, {f){6.3.1)(A), (f){6.3.2), (f){6.3.4), and, (f){13.3»;

e. Secondary air system {section (e){5.3.2){B»;

f. PM filter. {section (f){9.3»;

g. NOx adsorber (section (f){8.3.1» and NOx catalyst {section (f){2.3.1 »;

h. Secondary oxygen sensor {section (e){7.3.2){A»; ~~and~~

i. Boost pressure control system {sections (f){7.3.2) and (f){7.3.3»; and

j. Fuel system (section (f)(4.3.3)).

The OBD II system is not required to track and report in-use performance for monitors other than those specifically identified above.

(3.2.3) Manufacturers may not use the calculated ratio (or any element thereof) or any other indication of monitor frequency as a monitoring condition for any monitor (e.g., using a,low ratio to enable more frequent monitoring through diagnostic executive priority or modification of other monitoring conditions, or using a high ratio to enable less frequent monitoring).

(4) In-Use Monitor Performance Ratio Definition.

(4.1) For monitors required to meet the minimum in-use monitor performance ratio in section (d){3.2.1), the ratio shall be calculated in accordance with the following specifications for the numerator, denominator, and ratio.

(4.2) Numerator Specifications

(4.2.1) Definition: The numerator is defined as a measure of the number of times a vehicle has been operated such that all monitoring conditions necessary for a specific monitor to detect a malfunction have been encountered.

(4.2.2) Specifications for incrementing:

(A) Except as provided for in sections (d)(4.2.2)(E) and (F), the numerator, when incremented, shall be incremented by an integer of one. The numerator may not be incremented more than once per driving cycle.

(B) The numerator for a specific monitor shall be incremented within ten seconds if and only if the following criteria are satisfied on a single driving cycle: "

(i) Every monitoring condition necessary for the monitor of the specific component to detect a malfunction and store a pending fault code has been satisfied, including enable criteria, presence or absence of related fault codes, sufficient length of monitoring time, and diagnostic executive priority assignments (e.g., diagnostic "A" must execute prior to diagnostic "B", etc.). For the purpose of incrementing the numerator, satisfying all the monitoring conditions necessary for a monitor to determine the component is passing may not, by itself, be sufficient to meet this criteria;

(ii) For monitors that require multiple stages or events in a single driving cycle to detect a malfunction, every monitoring condition necessary for all events to have completed must be satisfied;

(iii) For monitors that require intrusive operation of components to detect a malfunction, a manufacturer shall request Executive Officer approval of the strategy used to determine that, had a malfunction been present, the monitor would have detected the malfunction. Executive Officer approval of the request shall be based on the equivalence of the strategy to actual intrusive operation and the ability of the strategy to accurately determine if every monitoring condition necessary for the intrusive event to occur was satisfied.

(iv) In addition to the requirements of section (d)(4.2.2)(B)(i) through (iii) above, the secondary air system monitor numerator(s) shall be incremented if and only if the 'criteria in section (B) above have been satisfied during normal operation of the secondary air system for vehicles that require"monitoring during normal operation (sections *(e)(5.2.2)* through (5.2.4)). Monitoring during intrusive operation of the secondary air system later in the same driving cycle solely for the purpose of monitoring may not, by itself, be sufficient to meet this criteria.

(C) For monitors that can generate results in a "gray zone" or "non-detection zone" (Le., results that indicate neither a passing system nor a malfunctioning system) or in a "non-decision zone" (e.g., monitors that increment and decrement counters until a pass or fail threshold is reached), the manufacturer shall submit a plan for appropriate incrementing of the numerator to the Executive Officer for review and approval. In general, the Executive Officer shall not approve plans that allow the numerator to be incremented when the monitor indicates a result in the "non-detection zone" or prior to the monitor reaching a decision. In reviewing the plan for approval, the Executive Officer shall consider data and/or engineering evaluation submitted by the manufacturer demonstrating the expected frequency of results in the "non-detection zone" and the ability of the monitor to accurately determine if a monitor would have detected a malfunction instead of a result in the "non-detection zone" had an actual malfunction been present.

(D) For monitors that run or complete during engine off operation, the numerator shall be incremented within 10 seconds after the monitor has completed during engine off operation or during the first 10 seconds of engine start on the subsequent driving cycle.

(E) Except as specified in section (d)(4.2.2)(F) for exponentially weighted moving averages, manufacturers utilizing alternate statistical MIL illumination protocols as allowed in section (d)(2.2.6) for any of the monitors requiring a numerator shall submit a plan for appropriate incrementing of the numerator to the Executive Officer for review and approval. Executive Officer approval of the plan shall be conditioned upon the manufacturer providing supporting data and/or engineering evaluation for the proposed plan, the equivalence of the incrementing in the manufacturer's plan to the incrementing specified in section (d)(4.2.2) for monitors using the standard MIL illumination protocol, and the overall equivalence of the manufacturer's plan in determining that the minimum acceptable in-use performance ratio in section (d)(3.2.1) is satisfied.

(F) Manufacturers using an exponentially weighted moving average (EWMA) as the alternate statistical MIL illumination protocol approved in accordance with section (d)(2.2.6) shall increment the numerator as follows:

(i) Following a reset or erasure of the EWMA result, the numerator may not be incremented until after the requisite number of decisions necessary for MIL illumination have been fully executed.

(ii) After the number of decisions required in section (d)(4.2.2)(F)(i) above, the numerator, when incremented, shall be incremented by an integer of one and may not be incremented more than once per driving cycle. Incrementing of the numerator shall also be in accordance with sections (d)(4.2.2)(B), (C), and (D).

(4.3) Denominator Specifications

(4.3.1) Definition: The denominator is defined as a measure of the number of times a vehicle has been operated as defined in (d)(4.3.2).

(4.3.2) Specifications for incrementing:

(A) The denominator, when incremented, shall be incremented by an integer of one. The denominator may not be incremented more than once per driving cycle.

(B) The denominator for each monitor shall be incremented within ten seconds if and only if the following criteria are satisfied on a single driving cycle:

(i) Cumulative time since engine start is greater than or equal to 600 seconds while at an elevation of less than 8,000 feet above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit;

(ii) Except as provided in section (d)(4.3.2)(B)(iv) below, ~~C~~cumulative vehicle operation at or above 25 miles per hour occurs for greater than or equal to 300 seconds while at an elevation of less than 8,000 feet above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit (medium-duty vehicles with diesel engines certified on an engine dynamometer may use cumulative operation at or above 15% calculated load1150 rpm in lieu of at or above 25 miles per hour for purposes of this criteria);

(iii) Continuous vehicle operation at idle (Le., accelerator pedal released by driver and either vehicle speed less than or equal to one mile per hour or engine speed less than or equal to 200 rpm above normal warmed-up idle (as determined in the drive position for vehicles equipped with' an automatic transmission)) for greater than or equal to 30 seconds while at an elevation of less than 8,000 feet above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit;.

(iv) For 2004 through 2012 model year medium-duty vehicles with diesel engines certified on an engine dynamometer, manufacturers may use diesel engine operation at or above 15 percent calculated load in lieu of 1150 rpm for the criterion in section (d)(4.3.2)(B)(ii) above.

(C) In addition to the'requirements of section (d)(4.3.2)(B) above, the secondary air system monitor denominator(s) shall be incremented if and only if commanded "on" operation of the secondary air system occurs for a time greater than or equal to· ten seconds. For purposes of determining this commanded "on" time, the aBO II system may not include time during intrusive operation of the secondary air system solely for the purposes of monitoring;

(0) In addition to the requirements of section (d)(4.3.2)(B) above, the evaporative system monitor denominator(s) shall be incremented if and only if:

(i) Cumulative time since engine start is greater than or equal to 600, seconds while at an ambient temperature of greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit; and

(ii) Engine cold start occurs with engine coolant temperature at engine start greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit and less than or equal to 12 degrees Fahrenheit higher than ambient temperature at engine start.

(E) In addition to the requirements of section (d)(4.3.2)(B) above, the denominator(s) for the following monitors shall be incremented if and only if the component or strategy is commanded "on" for a time greater than or equal to ten seconds: '

(i) Heated catalyst (section (e)(2))

(ii) Cold Start Em!ssion Reduction Strategy (sections (e)(11) and (f)(12))

(iii) Components or systems that operate only at engine start-up (e.g., glow plugs, intake air heaters, etc.) and are SUbject to monitoring under "other emission control or source devices" (sections (e)(16) and (f)(16)) or comprehensive component output components (sections (e)(15) and (f)(15))

For purposes of determining this commanded "on" time, the aBO II system may not include time during intrusive operation of any of the components or strategies later in the same driving cycle solely for the purposes of monitoring.

(F) In addition to th'e requirements of section (d)(4.3.2)(B) above, the denominator(s) for the following monitor's of output components (except those operated only at engine start-up and subject to the requirements of the previous section (d)(4.3.2)(E)) shall be incremented if and only if the component is commanded to function (e.g., commanded "on", "open", "closed", "locked", etc.) on two or more occasions for greater than two seconds during the driving cycle or for a cumulative time greater than or equal to ten seconds, whichever occurs first:

(i) Air conditioning system (section (e)(12))

(ii) Variable valve timing and/or control system (sections (e)(13) and (f)(13))

(iii) "Other emission control or source device" (sections (e)(16) and (f)(16))

(iv) Comprehensive component output component (sections (e)(15) and (f)(15)) (e.g., turbocharger waste-gates, variable length manifold runners, torque converter clutch lock-up solenoids, etc.)

(G) For the following monitors, the denominator(s) shall be incremented by one if and only if, in addition to meeting the requirements of section (d)(4.3.2)(B) on at least one driving cycle, at least 500 cumulative miles of vehicle operation have been experienced since the last time the denominator was incremented:

(i) Diesel NMHC converting catalyst (section- (f)(1))

(ii) Diesel PM filter (section (f)(9))

(H) For monitors ,of the following'components, the manufacturer may request Executive Officer approval to use alternate or additional criteria to that set forth in section (d)(4.3.2)(B) above for incrementingthe denominator. Executive Officer approval of the proposed criteria shall be based on the equivalence of the proposed criteria in measuring the frequency of monitor operation relative to the amount of vehicle operation in accordance with the criteria in section (d)(4.3.2)(B) above:

(i) Engine cooling system input components {sections (e)(10) and (f)(11))

(ii) Air conditioning system input components (section (e)(12))

-(iii) Direct ozone reduction systems (section (e)(14))

(iv) "Other emission control or source devices" (sections (e)(16) and (f)(16))

(v) Comprehensive component input components that require extended monitoring evaluation (sections (e)(15) and (f)(15)) (e.g., stuck fuel level sensor rationality)

(vi) Comprehensive component input component temperature sensor rationality monitors (sections (e)(15) and (f)(15)) (e.g, intake air temperature sensor, ambient temperature sensor, fuel temperature sensor)

(vii) PM filter frequent regeneration (section (f)(9.2.2))

(I) In addition to the requirements of section (d)(4.3.2)(B) above, the denominator(s) for the following monitors -shall be incremented if and only if a regeneration event is commanded for a time greater than or equal to ten seconds:

(i) PM filter incomplete regeneration (section (f)(9.2.3))

(ii) PM filter active/intrusive injection (section (f)(9.2.6))

~~(I)~~(J) For hybrid vehicles, vehicles that employalternate engine start hardware or strategies (e.g., integrated starter and generators), or alternate fuel vehicles (e.g., dedicated, bi-fuel, or dual-fuel applications), the manufacturer may request Executive Officer approval to use alternate criteria to that set forth in section (d)(4.3.2)(B) above for incrementing the denominator. In general, the Executive Officer shall not approve alternate criteria for vehicles that only employ engine shut off at or near idle/vehicle stop conditions. Executive Officer approval of the alternate criteria shall be based on the equivalence of the alternate criteria to determine the amount of vehicle operation relative to the measure of conventional vehicle operation·in accordance with the criteria in section (d)(4.3.2)(8) above.

(4.4) Ratio Specifications

(4.4.1) Definition: The ratio is defined as the numerator divided by the denominator.

(4.5) Disablement of Numerators and Denominators

(45.1) Within ten seconds of a malfunction that disables a monitor required to meet the monitoring conditions in section (d)(3.2.1) being detected (Le., a pending or confirmed code is stored), the 080 " system shall disable further incrementing of the corresponding numerator and denominator for each monitor that is disabled. When the malfunction is no longer detected (Le., the pending code is erased through self-clearing or through a scan tool command), incrementing of all corresponding numerators and denominators shall resume within ten seconds.

(4.5.2) Within ten seconds of the start of a PTO (see section (c)) operation that disables a monitor required to meetthe monitoring conditions in section (d)(3.2.1), the 080 II system shall disable further incrementing of the corresponding numerator and denominator for each monitor that is disabled. When the PTO operation ends, incrementing of all corresponding numerators and denominators shall resume within ten seconds.

(45.3) The 080 " system shall disable further incrementing of all numerators and denominators within ten seconds if a malfunction of any component used to determine. if the criteria in sections (d)(4.3.2)(8) through (D) are satisfied (Le., vehicle speed, ambient temperature, elevation, idle operation, engine cold start, or time of operation) has been detected (i.e., a pending or confirmed fault code has been stored)and the corresponding pending fault code has been stored. Incrementing of all numerators and denominators shall resume within ten seconds when the malfunction is no longer present (e.g., pending code erased through self-clearing or by a scan tool command).

(5) Standardized tracking and reporting of monitor performance.

(5.1) For monitors requirea to track and report in-use monitor performance in section (d)(3.2.2), the performance data shall be tracked and reported in accordance with the specifications in sections (d)(4), (d)(5), and (g)(5). The 080 II system shall separately report an in-use monitor performance numerator and denominator for each of the following components: catalyst bank 1, catalyst bank 2, primaryoxygen/exhaustgas sensor bank 1, primary *oxygen/exhaust* gas sensor bank 2, evaporative 0.020 inch leak detection system, EGRNVT system, secondary air system, diesel fuel system, PM filter, NOx aftertreatment (e.g., NOx adsorber, NOx catalyst), secondary oxygen sensor, and boost pressure control system. The OBO II system shall also report a general denominator and an ignition cycle counter in the standardized format specified in sections (d)(5.5), (d)(5.6) and (g)(5).

(5.2) Numerator

(5.2.1) The OBD II system shall report a separate numerator for each of the components listed in section (d)(5.1).

(5.2.2) For specific components or systems that have multiple monitors that are required to be reported under sections (e) or (f) (e.g., oxygen sensor bank 1 may have multiple monitors for sensor response or other seOnsor characteristics), the OBO II system shall separately track numerators and denominators for each of the specific monitors and report only the corresponding numerator and denominator for the specific monitor that has the lowest numerical ratio. If two or more specific monitors have identical ratios, the corresponding numerator and denominator for the specific monitor that has the highest denominator shall be reported for the specific component.

(5.2.3) The numerator(s) shall be reported in accordance with the specifications. in section (g)(5.2.1).

(5.3) Denominator

(5.3.1) The OBO II system shall report a separate denominator for each of the components listed in section (d)(5.1).

(5.3.2) The denominator(s) shall be reported in accordance with the specifications in section (g)(5.2.1).

(5.4) Ratio

(5.4.1) For purposes of determining which corresponding numerator and denominator to report as required in section (d)(5.2.2), the ratio shall be calculated in accordance with the specifications in section (g)(5.2.2).

(5.5) Ignition. cycle counter

(5.5.1) Definition:

(A) The ignition cycle counter is defined as a counter that indicates the number of ignition cycles a vehicle has experienced as defined in section (d)(5.5.2)(B).

(B) The ignition cycle counter shall be reported in accordance with the specifications in section (g)(5.2.1).

(5.5.2) Specifications for incrementing:

(A) The ignition cycle counter, when incremented; shall be incremented by an integer of one. The ignition cycle counter may not be incremented more than once per driving cycle.

(B) The ignition cycle counter shall be incremented within ten seconds if and only if the vehicle meets the engine start definition (see section (c)) for at least two seconds plus or minus one second.

(C) The OBD II system shall disable further incrementing of the ignition cycle counter within ten seconds if a malfunction of any component used to determine.if the criteria in section (d)(5.5.2)(B) are satisfied (Le., engine speed or time of operation) has been detected and the corresponding pending fault code has been stored. The ignition cycle counter may not be disabled from incrementing for any other condition. Incrementing of the ignition cycle counter shall resume within ten seconds when the malfunction is no longer present (e.g., pending code erased through self-clearing or by a scan tool command).

(5.6) General Denominator

(5.6.1) Definition: .

(A) The general denominator is defined as a measure of the number of times a vehicle has been operated as defined in section (d)(5.6.2)(B)..

(B) The general denominator shall be reported in accordance with the specifications in section (g)(5.2.1).

(5.6.2) Specifications for incrementing: .

(A) The general denominator, when incremented, shall be incremented by an integer of one. The general denominator may not be incremented more than once per driving cycle. .

(B) The general denominator shall be incremented within ten seconds if and only if the criteria identified in section (d)(4.3.2)(B) are satisfied on a single driving cycle.

(C) The OBD II system shall disable further incrementing of the general denominator within ten seconds if a malfunction of any component used to determine if the criteria in section (d)(4.3.2)(B) are satisfied (Le., vehicle speed, ambient temperature,' elevation, idle operation, or time of operation) has been detected and the corresponding pending fault code has been stored. The general denominator may not be disabled from incrementing for any other condition (e.g., the disablement criteria in sections (d)(4.5.1) and (d)(4.5.2) may not disable the general denominator). Incrementing of the general denominator shall resume within ten seconds when the malfunction is no longer present (e.g., pending code erased through self-clearing or by a scan tool command).

(6) Malfunction Criteria Determination for Diesel Vehicles.

(6.1) For 2010 and subsequent model year medium-duty vehicles certified to an . engine dynamometer exhaust emission standard, in determining the malfunction criteria for diesel engine monitors in section (f) that are required to indicate a malfunction before emissions exceed an emission threshold based on the applicable standard, the manufacturer shall:

(6.1.1) Use the emission test cycle and standard (Le., FTP or SET) determined by the manufacturer, through use of data and/or engineering analysis, to be more stringent (Le., to result in higher emissions with the same level of monitored component malfunction) as the "applicable standard".

(6.1.2) Identify in the certification documentation required under section (i) the test cycle and standard determined by the manufacturer to be more stringent for each applicable monitor.

(6.1.3) If the Executive Officer reasonably believes that a manufacturer has incorrectly determined the test cycle and standard that is more stringent, the Executive Officer shall require the manufacturer to provide emission data and/or engineering analysis showing that the other test cycle 'and standard are less stringent. '

(6.2) For 2007 and subsequent model year light-duty and medium-duty vehicles equipped with emission controls that experience infrequent regeneration events (e.g., active PM filter regeneration, NOx adsorber desulfation), a manufacturer shall adjust the emission test results that are used to determine the malfunction criterion for monitors that are required to indicate a malfunction before emissions exceed a certain emission threshold. Except as provided in section (d)(6.2.7), Ffor each monitor on medium-dutyvehicles using engines certified on an engine dynamometer, the manufacturer shall adjust the emission result using the procedure described in CFR title 40, part 86.004-28(i) with the component for which the malfunction criteria is being established deteriorated to the malfunction threshold. For light-duty and medium-duty vehicles certified on a chassis dynamometer, the manufacturer shall submit a plan for Executive Officer approval to adjust the emission results using an approach similar to th.e procedure. described in CFR title 40, part 86.004-28(i). Executive Officer approval shall be based on the effectiveness of the proposed plan to quantify the emission impact and frequency of regeneration events. The adjusted emission value shall be used for purposes of determining whether or not the specified emission threshold is exceeded (e.g., a malfunction must be detected before the adjusted emission value exceeds. 1.5 times any applicable standard).'

(6.2.1) For purposes of section (d)(6.2), "regeneration" means an event during which emission levels change while the emission control performance is being restored by design.

(6.2.2) For purposes ,of section (d)(6.2), "infrequent" means having an expected frequency of less than once per FTP cycle. `

(6.2.3) Except as specified in section (d)(6.2.4) for NMHC catalyst monitoring, for 2007 through 2009 model year vehicles, in lieu of establishing the adjustment factor for each monitor with the component for which the malfunction criteria is being established deteriorated to the malfunction threshold as required in section (d)(6.2), the manufacturer may use the adjustment factor established for certification (e.g., without components deteriorated to the malfunction threshold).

(6.2.4) For NMHC catalyst monitoring (section (f)(1» on 2008 and subsequent model year vehicles, a manufacturer shall establish the adjustment factor for the NMHC catalyst monitor with the NMHC catalyst deteriorated to the malfunction threshold as required in section (d)(6.2). In Heu of establishing this adjustment factor for 2008 and 2009 model year vehicles, a manufacturer may provide emission data demonstrating that the worst case emission levels from a deteriorated NMHC catalyst are below the malfunction threshold specified in section (f)(1.2.2). The demonstration shall include emission testing with a NMHC catalyst deteriorated to the malfunction threshold or worse and with both the infrequent regeneration event occurring and without it occurring. The manufacturer shall calculate the worst case emission level by applying the frequency factor ("F" as calculated according to CFR, title 40, part 86.004-28(i» of the infrequent regeneration event used for tailpipe certification to the measured emissions with the infrequent regeneration event occurring and adding that result to the measured emissions without the infrequent regeneration event occurring. This calculated final sum shall be used as the adjusted emission level and compared to the malfunction threshold for purposes of determining compliance with the monitoring requirements. The manufacturer shall submit a test plan for Executive Officer approval describing the emission testing procedure and how the worst case components will be established. The Executive Officer shall approve it upon finding the test procedure and components used will likely generate a worst case emission level.

(6.2.5) For purposes of determining the adjustment factors for each monitor, the manufacturer shall submit engineering data, analysis, and/or emission data to the Executive Officer for approval. The Executive Officer shall approve the factors upon finding the submitted information supports the adjustment factors.

(6.2.6) For purposes of enforcement testing in accordance with section (d)(7) and title 13, CCR section 1968.5, the adjustment factors established for each monitor by the manufacturer according to section (d)(6.2) shall be used when determining compliance with emission thresholds.

(6.2.7) In lieu of using the procedure described in CFR title 40, part 86.004-28{i), the manufacturer may submit an alternate plan to calculate the adjustment factors for determining the adjusted emission values to the Executive Officer for review and approval. Executive Officer approval of the plan sha'll be conditioned' upon the manufacturer providing data and/or engineering evaluation demonstrating the procedure is consistent with good engineering jUdgment in determining appropriate modifications to the tailpipe certification adjustment factors.

(6.3) For every 2007 through 2012 model year light-duty vehicle test group certified to the higher allowable emission thresholds specified in section (f) (e.g., 5.0 or 3.0 times the applicable standards for NMHC converting catalyst monitoring) for vehicles prior to the 2013 model year:

(6.3.1) The manufacturer shall conduct in-use enforcement testing for compliance with the tailpipe emission standards in accordance with title 13, CCR sections 2136 through 2140. Within six months after OBD II certification of a test group, the manufacturer shall submit a plan for conducting the testing to the Executive Officer for approval. The Executive Officer shall approve the plan upon determining that the testing will be done in accordance with the procedures used by ARB when conducting such testing, that the plan will allow for a valid sample of at least 10 vehicles in the mileage range of 30,000 to 40,000 miles for comparison to the FTP intermediate (e.g., 50,000 mile) useful life standard and at least 10 vehicles in the mileage range of 90,000 to 100,000 miles for comparison to the FTP full useful life standard, and that copies of all records and data collected during the program will be provided to ARB. Manufacturers may also submit testing plans and supporting data for Executive Officer approval that differ from compliance testing under title 13, CCR, sections 2136 through 2140. The Executive Officer shall also approve the plans upon determining that the plan provides equivalent assurance in verifying vehicles are meeting the tailpipe emission standards within the useful life. The Executive Officer may use the submitted data in lieu of or in addition to data collected pursuant to title 13, CCR section 2139 for purposes of the notification, and use of test results described in title 13, CCR section 2140; and

(6.3.2) The certification shall be conditioned upon the manufacturer agreeing that, for any test group(s) determined to be noncompliant in accordance with title .13, CCR section 2140 or title 13, CCR section 1968.5, the Executive Officer shall determine the excess emissions caused by the noncompliance and the manufacturer shall fund a program(s) that will offset any such excess emissions.

(7) Enforcement Testing.

(7.1) The procedures used to assure compliance with the requirements of title 13, CCR section 1968.2 are set forth in title 13, CCR section 1968.5.

(7.2) Consistent with the requirements of title 13, CCR section' 1968.5(b)(4)(A) for enforcement OBO " emission testing, the manufacturer shall make available upon request by the Executive Officer all test equipment (e.g., malfunction simulators, deteriorated "threshold" components, etc.) necessary to determine the malfunction criteria in sections (e) and (f) for major monitors subject to OBO " emission testingas defined in title 13, CCR section 1968.5. To meet the requirements of this section, the manufacturers shall only be required to make available test equipment necessary to duplicate "threshold" testing performed by the manufacturer. This test equipment shall include, but is not limited to, aged "threshold" catalyst systems and computer equipment used to simulate misfire, oxygen sensor, fuel system; WT system, and cold start reduction strategy system faults. The manufacturer is not required to make available test equipment for vehicles that exceed the applicable full useful life age (e.g., 10 years for vehicles certified to a full useful life of 10, years and 100,000 miles).

(e) *MONITORING REQUIREMENTS FOR GASOLINE/SPARK-IGNITED ENGINES.*

(1) CATALYST MONITORING

(1.1) Requirement: The OBO " system shall monitor the catalyst system for proper conversion capability.

(1.2) Malfunction Criteria:

(1.2.1) Low Emission Vehicle I applications: The OBO " system shall detect a catalyst system malfunction when the catalyst system's conversion capability decreases to the point that either of the following occurs:

'(A) Non-Methane Organic Gas (NMOG) emissions exceed 1.75 times the FTP full useful life standards to which the vehicle has been certified with NMOG emissions multiplied by the certification reactivity adjustment factor for the vehicle;

(B) The average FTP test Non-Methane Hydrocarbon (NMHC) conversion efficiency of the monitored portion of the catalyst system falls below 50 percent (Le., the cumulative NMHC emissions measured at the outlet of the monitored catalyst(s) are more than 50 percent of the cumulative engine-out emissions measured at the inlet of the catalyst(s)). With Executive Officer approval, manufacturers may use a conversion efficiency malfunction criteria of less than 50 percent if the catalyst system is designed such that the monitored portion of the catalyst system must be replaced along with an adjacent portion of the catalyst system sufficient to ensure that the total portion replaced will meet the 50 percent conversion efficiency criteria. Executive Officer approval shall be based on data and/or engineering evaluation demonstrating the conversion efficiency of the monitored portion and the total portion designed to be replaced, and the likelihood of the catalyst system design to ensure replacement of the monitored and adjacent portions of the catalyst system.

(1.2.2) Low Emission Vehicle II applications and all 2009 and subsequent model year vehicles:

(A) 2004 model year vehicles.

(i) All LEV II, ULEV II, and MOV SULEV II vehicles shall use the malfunction criteria specified for Low Emission Vehicle I applications in section (e)(1.2.1).

(ii) All PC/LOT SULEV II vehicles shall use the malfunction criteria specified for Low Emission Vehicle I applications in section (e)(1.2.1) except the malfunction criterion in paragraph (e)(1.2.1)(A) shall be 2.5 times the applicable FTP full useful life NMOG standard.

(B) Except as provided below in section (e)(1.2.4), for 2005 through 2008 model years, the OBO II system shall detect a catalyst system malfunction when the catalyst system's conversion capability decreases to the point that any of the following occurs:

(i) For all vehicles other than 'PC/LOT SULEV II vehicles.

a. NMOG emissions exceed the criteria specifiec! for Low Emission Vehicle I applications in section (e)(1.2.1)(A).

b. The average FTP test NMHC conversion efficiency is below the criteria specified for Low Emission Vehicle I applications in section (e)(1.2.1)(B).

c. Oxides of nitrogen (NOx) emissions exceed 3.5 times the FTP full useful life NOx standard to which the vehicle has been certified.

(ii) PC/LOT SULEV II vehicles shall use the same malfunction criteria as 2005 through 2008 model year LEV II, ULEV II, and MOV SULEV II vehicles (section (e)(1.2.2)(B)(i)) except the malfunction criteria in paragraph a.shall be 2.5 times the applicable FTP full useful life NMOG standard.

(C) Except as provided below in section (e)(1.2.5), for 2009 and subsequent model years, the OBO II system shall detect a catalyst system malfunction when the catalyst system's conversion capability decreases to the point that any of the following occurs.

(i) For all vehicles other than PC/LOT SULEV II vehicles.

a. NMOG emissions exceed the criteria specified for Low Emission Vehicle I applications in section (e)(1.2.1)(A).

b. The average FTP test NMHC conversion efficiency is below the criteria specified for Low Emission Vehicle I applications in section (e)(1.2.1)(B).

c. NOx emissions exceed 1.75 times the FTP full useful life NOx standard to which the vehicle has been certified.

(ii) For PC/LOT SULEV II vehicles.
a. NMOG emissions exceed 2.5 times the applicable FTP full useful life NMOG standard to which the vehicle has been certified.
b. The average FTP test NMHC conversion efficiency is below the criteria specified for Low Emission Vehicle I applications in section (e)(1.2.1)(B).
c. NOx emissions exceed 2.5 times the applicable FTP full useful life NOx standard to which the vehicle has been certified.

(1.2.3) 2004 through 2008 model year non-Low Emission Vehicle I or II applications: The OBO II system shall detect a catalyst system malfunction when the catalyst system's conversion capability decreases to the point that NMHC emissions increase by more than 1.5 times the applicable FTP full useful life standards over an FTP test performed with a representative 4000 mile catalyst system.

(1.2.4) In lieu of using the malfunction criteria in section (e)(1.2.2)(B) for all 2005 and 2006 model year Low Emission Vehicle II applications, a manufacturer may phase-in the malfunction criteria on a portion of its Low Emission Vehicle II applications as long as that portion of Low Emission Vehicle II applications comprises at least 30 percent of all 2005 model year vehicles and 60 percent of all 2006 model year vehicles. For 2005 and 2006 model year Low Emission Vehicle II applications not included in the phase-in, the malfunction criteria in section (e)(1.2.2)(A) shall be used.

(1.2.5) In lieu of using the malfunction criteria in section (e)(1.2.2)(C) for all 2009 model year vehicles, for the 2009 model year only, a manufacturer may continue to use the malfunction criteria in section (e)(1.2.2)(B) for any vehicles previously certified in the 2005, 2006, 2007, or 2008 model year to the malfunction criteria in section (e)(1.2.2.)(B) and carried over to the 2009 model year.

(1.2.6) For purposes of determining the catalyst system malfunction criteria in sections (e)(1.2.1), (1.2.2)(A), and (1.2.3), the malfunction criteria shall be established by using a catalyst system with all monitored catalysts simultaneously deteriorated to the malfunction criteria while unmonitored catalysts shall be deteriorated to the end of the vehicle's full useful life.

(1.2.7) For purposes of determining the catalyst system malfunction criteria in sections (e)(1.2.2)(B) and (C):
(A) The manufacturer shall use a catalyst system deteriorated to the malfunction criteria using methods established by the manufacturer to represent real world catalyst deterioration under normal and malfunctioning operating conditions.
(B) Except as provided below in section (e)(1.2.7)(C), the malfunction criteria shall be established by using a catalyst system with all monitored and unmonitored (downstream of the sensor utilized for catalyst monitoring) catalysts simultaneously deteriorated to the malfunction criteria.
(C) For vehicles using fuel shutoff to prevent over-fueling during misfire conditions (see section (e)(3.4.1)(0», the malfunction criteria shall be established by using a catalyst system with all monitored catalysts simultaneously deteriorated to the malfunction criteria while unmonitored catalysts shall be deteriorated to the end of the vehicle's full useful life.

(1.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section *(e)(1.2)* in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in section *(e)(1.2)* shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(1.4) MIL Illumination and Fault Code Storage:

(1.4.1) General requirements for MIL illumination and fault code storage are set) forth in section (d)(2).

(1.4.2) The monitoring method for the catalyst(s) shall be capable of detecting when a catalyst fault code has been cleared (except OBO II system self-clearing), but the catalyst has not been replaced (e.g., catalyst overtemperature approaches may not be acceptable).

(2) HEATED CATALYST MONITORING

(2.1) Requirement:

(2.1.1) The OBD II system shall monitor all heated catalyst systems for proper heating.

(2.1.2) The efficiency of heated catalysts shall be monitored in conjunction with the requirements of section *(e)(1).*

(2.2) Malfunction Criteria:

(2.2.1) The aBO II system shall detect a catalyst heating system malfunction when the catalyst does not reach its designated heating temperature within a requisite time period 'after engine starting. The manufacturer shall determine the requisite time period, but the time period may not exceed the time that would cause emissions from a vehicle eqUipped with the heated catalyst system to exceed 1.75 times any of the applicable FTP full useful life standards.

(2.2.2) Manufacturers may use other monitoring strategies for the heated catalyst but must submit the alternate plan to the Executive Officer for approval. The Executive Officer shall approve alternate strategies for monitoring heated catalyst systems based on comparable reliability and timeliness to these requirements in detecting a catalyst heating malfunction.

(2.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section *(e)(2.2)* in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(2.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(3) MISFIRE MONITORING

(3.1) Requirement:

(3.1.1) The aBO II system shall mohitor the engine for misfire causing catalyst damage and misfire causing excess emissions.

(3.1.2) The aBO II system shall identify the specific cylinder that is experiencing misfire. Manufacturers may request Executive Officer approval to store a general misfire fault code instead of a cylinder specific fault code under certain operating conditions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that the misfiring cylinder cannot be reliably identified when the conditions occur.

(3.1.3) If more than one cylinder is misfiring, a separate fault code shall be stored indicating that multiple cylinders are misfiring except as allowed below. When identifying multiple cylinder misfire, the manufacturer is not required to also identify each of the misfiring cylinders individually through separate fault codes. For 2005 and subsequent model year vehicles, if more than 90 percent of the detected misfires occur in a single cylinder, the manufacturer may elect to store the appropriate fault code indicating the specific misfiring cylinder in lieu of the multiple cylinder misfire fault code. If, *however,* two or more cylinders individually *have* more than 10 percent of the total number of detected misfires, a multiple cylinder fault code must be stored.

(3.2) Malfunction Criteria: The OBD II system shall detect a misfire malfunction pursuant to the following:

(3.2.1) Misfire causing catalyst damage: .

(A) Manufacturers shall determine the percentage of misfire evaluated in 200 revolution increments for each engine speed and load condition that would result in a temperature that causes catalyst damage. The manufacturer shall submit documentation to support this percentage of misfire as required in section (i)(2.5). For *every* engine speed and load condition that this percentage of misfire is determined to be lower than *five* percent, the manufacturer may set the malfunction criteria at *five* percent.

(B) SUbject to Executive Officer approval, a manufacturer may employ a longer interval than 200 revolutions but only for determining: on a given driving cycle, the first misfire exceedance as provided in section (e)(3.4.1)(A) below. Executive Officer approval shall be granted upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that catalyst damage would not occur due to unacceptably high catalyst temperatures before the interval has elapsed.

(C) A misfire malfunction shall be detected if the percentage of misfire established in section (e)(3.2.1)(A) is exceeded.

(D) For purposes of establishing the temperature at which catalyst damage occurs as required in section (e)(3.2.1)(A), on 2005 and subsequent model year vehicles, manufaeturers may not define catalyst damage at a temperature more *severe* than what the catalyst system could be operated at for ten consecutive hours and still meet the applicable FTP full useful life standards.

(3.2.2) Misfire causing emissions to exceed 1.5 times' the FTP standards:

(A) Manufacturers shall determine the percentage of misfire evaluated in 1000 revolution increments that would cause emissions from an emission durability demonstration vehicle to exceed 1.5 times any of the applicable FTP standards if the percentage of misfire were present from the beginning of the test. To establish this percentage of misfire, the manufacturer shall utilize misfire *events* occurring at equally spaced, complete engine cycle intervals, across randomly selected cylinders throughout each 1000-revolution increment. If this percentage of misfire is determined to be lower than one percent, the manufacturer may set the malfunction criteria at one percent.

(8) Subject to Executive Officer approval, a manufacturer may employ other revolution increments. The Executive Officer shall grant approval upon determining that the manufacturer has demonstrated that the strategy would be equally effective and timely in detecting misfire.

(C) A malfunction shall be detected if the percentage of misfire established in section (3.2.2)(A) is exceeded regardless of the pattern of misfire events (e.g., random, equally spaced, continuous, etc.).

(3.3) Monitoring Conditions:

(3.3.1) Manufacturers shall continuously monitor for misfire under the following conditions:

(A) From no later than the end of the second crankshaft revolution after engine start,

. (8) While under positive torque conditions during the rise time and settling time for engine speed to reach the desired idle engine speed at engine start-up (Le., "flare-up" and "flare-down"), and

(C) Under all positive torque engine speeds and load conditions except within the following range: the engine operating region bound by the positive torque line (Le., engine load with the transmission in neutral), and the two following engine operating points: an engine speed of 3000 rpm with the engine load at the positive torque line, and the redline engine speed (defined in section (c» with the engine's manifold vacuum at four inches of mercury lower than that at the positive torque line.

(3.3.2) If a monitoring system cannot detect all misfire patterns under all required engine speed and load conditions as required in section (e)(3.3.1) above, the manufacturer may request Executive Officer approval to accept the monitoring system. In evaluating the manufacturer's request, the Executive Officer shall consider the following factors: the magnitude of the region(s) in which misfire detection is limited, the degree to which misfire detection is limited in the region(s) (i.e., the probability of detection of misfire events), the frequency with which said region(s) are expected to be encountered in-use, the type of misfire patterns for which misfire detection is troublesome, and demonstration that the monitoring technology employed is not inherently incapable of detecting misfire under required conditions (Le., compliance can be achieved on other engines). The evaluation shaH be based on the following misfire patterns: equally spaced misfire occurring on randomly selected cylinders, single cyl.inder continuous misfire, and paired cylinder (cylinders firing at the same crank angle) continuous misfire.

(3.3.3) A manufacturer may request Executive Officer approval of a monitoring system that has reduced misfire detection capability during the portion of the first 1000 revolutions after engine start that a cold start emission . reduction strategy that reduces engine torque (e.g., spark retard strategies) is active. The Executive Officer shall approve the request upon determining that the manufacturer has demonstrated that the probability of detection is greater than or equal to 75 percent during the worst case condition (Le., lowest generated torque) for a vehicle operated continuously at idle (park/neutral idle) on a cold start between 50-86 degrees Fahrenheit and that the technology cannot reliably detect a higher percentage of the misfire events during the conditions.

(3.3.4) A manufacturer may request Executive Officer approval to disable misfire monitoring or employ an alternate malfunction criterion when misfire cannot be distinguished from other effects.

(A) Upon determining that the manufacturer has presented documentation that demonstrates the disablement interval or period of use of an alternate malfunction criterion is limited only to that necessary for avoiding false detection, the Executive Officer shall approve the disablement or use of the alternate malfunction criterion for conditions involving:

(i) rough road,

(ii) fuel cut,

(iii) gear changes for manual transmission vehicles,

(iv) traction control or other vehicle stability control activation such as anti-lock braking or other engine torque modifications to enhance vehicle stability,

(v) off-board control or intrusive activation of vehicle components or diagnostics during service or assembly plant testing,

(vi) portions of intrusive evaporative system or EGR diagnostics that can significantly affect engine stability (Le., while the purge valve is open during the vacuum pull-down of a evaporative system leak check but not while the purge valve is closed and the evaporative'system is sealed or while an EGR diagnostic causes the EGR valve to be intrusively cycled on and off during positive torque conditions), or

(vii) engine speed, load, or torque transients due to throttle movements more rapid than occurs over the US06 cycle for the worst case vehicle within each test group.

(B) Additionally, the Executive Officer will approve a manufacturer's request in accordance with sections (e)(17.3), (17.4), and (17.6) to disable misfire monitoring when fuel level is 15 percent or less of the nominal capacity of the fuel tank, when PTO units are active, or while engine coolant temperature is below 20 degrees Fahrenheit. The Executive Officer will approve a request to continue disablement on engine starts when engine coolant temperature is below 20 degrees Fahrenheit at engine start until engine coolant temperature exceeds 70 degrees Fahrenheit.

(C) In general, for 2005 and subsequent model year vehicles, the Executive Officer shall not approve disablement for conditions involving normal air conditioning compressor cycling fromon-to-off oroff-to-on, automatic transmission gear shifts (except for shifts occurring during wide open throttle operation), transitions from idle to off-idle, normal engine'speed or load changes that occur during the engine speed rise time and settling time (Le., "flare-up" and "flare-down") immediately after engine starting without any vehicle operator-induced actions (e.g., throttle stabs), or excess acceleration (except for acceleration rates that exceed the maximum acceleration rate obtainable at wide open throttle while the vehicle is in gear due to abnormal conditions such as slipping of a clutch).

(D) The Executive Officer may approve misfire monitoring disablement or use of an alternate malfunction criterion for any other condition on a case by case basis upon determining that the manufacturer has demonstrated that the request is based on an unusual or unforeseen circumstance and that it is applying the best available computer and monitoring technology.

(3.3.5) For engines with more than eight cylinders that cannot meet the requirements of section (e)(3.3.1), a manufacturer may request Executive Officer approval to use alternative misfire monitoring conditions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that misfire detection throughout the required operating region cannot be achieved when employing proven monitoring technology (Le., a technology that provides for compliance with these requirements on other engines) and provided misfire is detected to the fullest extent permitted by the technology. However, the Executive Officer may not grant the request if the misfire detection system is unable to monitor during all positive torque operating conditions encountered during an FTP cycle.

(3.4) MIL Illumination and Fault Code Storage:

(3.4.1) Misfire causing catalyst damage. Upon detection of.the percentage of misfire specified in section (e)(3.2.1) above, the following criteria shall apply for MIL illumination and fault code storage:

(A) Pending fault codes

(i) A pending fault code shall be stored immediately if, during a single driving cycle, the specified percentage of misfire is exceeded three times when operating in the positive torque region encountered during an FTP cycle or is exceeded on a single occasion when operating at any other engine speed and load condition in the positive torque region defined in section *(e)(3.3.1).*

(ii) Immediately after a pending fault code is stored as specified in section *(e)(3.4.1*)(A)(i) above, the MIL shall blink once per second at all times while misfire is occurring during the driving cycle.

a. The MIL may be extinguished during those times when misfire is not occurring during the driving cycle.

b. If, at the time a misfire malfunction occurs, the MIL is already illuminated for a malfunction other than misfire, the MIL shall blink as previously specified in section (e)(3.4.1)(A)(ii) while misfire is occurring. If misfiring ceases, the MIL shall stop blinking but remain illuminated as required by the other malfunction.

(B) Confirmed fault codes

(i) If a pending fault code for exceeding the percentage of misfire set forth in section *(e)(3.2.1)* is stored, the OBO II system shall immediately store a confirmed fault code if the percentage of misfire specified in section *(e)(3.2.1)* is again exceeded one or more times during either: (a) the driving cycle immediately following the storage of the pending fault code, regardless of the conditions encountered during the driving cycle; or (b) on the next driving cycle in which similar conditions (see section (c)) to the engine conditions that occurred when the pending fault code was stored are encountered. .

(ii) If a pending fault code for exceeding the percentage of misfire set forth in section (e)(3.2.2) is stored from a previous drive cycle, the OBD II system shall immediately store a confirmed fault code if the percentage of misfire specified in section (e)(3.2.1) is exceeded one or more times regardless of the conditions encountered.

(iii) Upon storage of a confirmed fault code, the MIL shall blink as' specified in subparagraph (e)(3.4.1)(A)(ii) above as long as misfire is occurring and the MIL shall remain continuously illuminated if the misfiring ceases.

(C) Erasure of pending fault codes

Pending fault codes shall be erased at the end of the next driving cycle in which similar conditions to the engine conditions that occurred when the pending fault code was stored have been encountered without any exceedance of the specified percentage of misfire. The pendin.g code may also be erased if similar driving .conditions are not encountered during the next 80 driving cycles subsequent to the initial detection of a malfunction.

(D) Exemptions for vehicles with fuel shutoff and default fuel control.

Notwithstanding sections *(e)(3.4.1*)(A) and (B) above, in vehicles that provide for fuel shutoff and default fuel control to prevent over fueling during catalyst damage misfire conditions, the MIL need not blink. Instead, the MIL may illuminate continuously in accordance with the requirements for continuous MIL illumination in sections *(e)(3.4.1*)(B)(iii) above, upon detection of misfire, provided that the fuel shutoff and default control are activated as soon as misfire is detected. Fuel shutoff and default fuel control may be deactivated only to permit fueling outside of the misfire range. Manufacturers may also periodically, but not more than once every 30 seco.nds, deactivate fuel shutoff and default fuel control to determine if the specified percentage of misfire for catalyst damage is still being exceeded. Normal fueling and fuel control may be resumed if the specified percentage of misfire for catalyst damage is no longer being exceeded. .

(E) Manufacturers may request Executive Officer approval of strategies that continuously illuminate the MIL in lieu of blinking the MIL during extreme catalyst damage misfire conditions (I.e., catalyst damage misfire occurring at all engine speeds and loads). Executive Officer approval shall be granted upon determining that the manufacturer employs the strategy only when catalyst damage misfire levels cannot be avoided during reasonable driving conditions and the manufacturer has demonstrated that the strategy will encourage operation ofthe vehide in conditions that will minimize catalyst damage (e.g., at low engine speeds and loads).

(304.2) Misfire causing emissions to exceed 1.5 times the FTP standards. Upon detection of the percentage of misfire specified in section *(e)(3.2.2),* the following criteria shall apply for MIL illumination and fault code storage:

(A) Misfire within the first 1000 revolutions after engine start.

(i) A pending fault code shall be stored no later than after the first exceedance of the specified percentage of misfire during a single driving cycle if the exceedance occurs within the first 1000 revolutions after engi.ne start (defined in section (c» during which misfire detection is active.

(ii) If a pending fault code is stored, the aBO" system shall illuminate the MIL and store a confirmed fault code within ten seconds if an exceedance of the specified percen.tage of misfire is again detected in the first 1000" revolutions during any subsequent driving cycle, regardless of the conditions encountered during the driving cycle.

(iii) The pending fault code shall be erased at the end of the next driving cycle in which· similar conditions to the engine conditions that occurred when the pending fault code was stored have been encountered without an exceedance of the specified percentage of misfire. The pending code may also be erased if similar conditions are not encountered during the next 80 driving cycles immediately following the initial detection of the malfunction.

(B) Exceedances after the first 1000 revolutions after engine start.

(i) A pending fault code shall be stored no later than after the fourth exceedance of the percentage of misfire specified in section (e)(3.2.2) during a single driVing cycle.

(ii) If a pending fault code is stored, the aBO" system shall illuminate the MIL and store a confirmetl fault code within ten seconds if the percentage of misfire specified in section (e)(3.2.2) is again exceeded four times during: (a) the driving cycle immediately following the storage of the pending fault code, regardless of the conditions encountered during the driving cycle; or (b) on the next driving" cycle in which similar conditions (see section (c» to the engine conditions that occurred when the pending fault code was stored are encountered.

(iii) The pending fault code may be erased at the end of the next driving cycle in which similar conditions to the engine conditions that occurred when the pending fault code was stored have been encountered without an exceedance of the specified percentage of misfire. The pending code may also be erased if similar conditions are not encountered during the next 80 driving cycles immediately following initial detection of the malfunction.

(3.4.3) Storage of freeze frame conditions.

(A) A manufacturer shall store and erase freeze frame conditions either in conjunction with storing and erasing a pending fault code or in conjunction with storing and erasing a confirmed fault code.

(B) If freeze frame conditions are stored for a malfunction other than misfire or fuel system malfunction (see section (e)(6» when a fault code is stored as specified in section (e)(3.4) above, the stored freeze frame information shall be replaced' with freeze frame information regarding the misfire malfunction.

(3.4.4) Storage of misfire conditions for similar conditions determination. Upon detection of misfire under sections (e)(3.4.1) or (3.4.2), manufacturers shall store the following engine conditions: engine speed, load, and warm-up status 'of the first misfire event that resulted in the storage of the pending fault code.

(3.4.5) Extinguishing the MIL. The MIL may be extinguished after three sequential driving cycles in which similar conditions have been encountered without an exceedance of the specified percentage of misfire.

(4) EVAPORATIVE SYSTEM MONITORING

(4.1) Requirement: The 080 II system shall verify purge flow from the evaporative system and shall monitor the complete evaporative system, excluding the tubing and connections between the purge valve and the intake manifold, for vapor leaks to the atmosphere. Individual components of the evaporative system (e.g. valves, sensors, etc.) shall be monitored in accordance with the comprehensive components requirements in section (e)(15) (e.g., for circuit continuity, out of range values, rationality, proper"functional response, etc.). Vehicles not required to be equipped with evaporative emission systems shall be exempt from monitoring of the evaporative system.

(4.2) Malfunction Criteria:

(4.2.1) For purposes of section (e)(4), an orifice shall be defined as an O'Keefe Controls Co. precision metal "Type 8" orifice with NPT connections with a diameter of the specified dimension (e.g., part number 8-20-88 for a stainless steel 0.020 inch diameter orifice). "

(4.2.2) The 080 II system shall detect an evaporative system malfunction when any of the following conditions exist:

(A) No purge flow from the evaporative system to the engine can be detected by the 080 II system;

(8) The.complete evaporative system contains a leak or leaks that cumulatively are greater than or equal to a leak caused by a 0.040 inch diameter orifice; or

(C) The complete evaporative system contains a Jeak or leaks that cumulatively are greater than or equal to a leak caused by a 0.020 inch diameter orifice.

(4.2.3) On vehicles with fuel tank capacity greater than 25.0 gallons, a manufacturer may request the Executive Officer to revise the orifice size in sections (e)(4.2.2)(8) and/or (C) if the most reliable monitoring method available cannot reliably detect a system leak of the magnitudes specified.. The Executive Officer shall approve the request upon determining that the manufacturer has provided data and/or engineering analysis that demonstrate the need for the request.

(4.2.4) Upon request by the manufacturer and upon determining that the manufacturer has submitted data and/or engineering evaluation which support the request, the Executive Officer shall revise the orifice size in sections (e)(4.2.2)(8) and/or (C) upward to exclude detection of leaks that cannot cause evaporative or running loss emissions to exceed 1.5 times the applicable standards.

(4.2.5) A manufacturer may request Executive Officer approval to revise the orifice size in section (e)(4.2.2)(6) to a 0.090 inch diameter orifice. The

Executive Officer'shall approve the request upon the manufacturer submitting data and/or engineering analysis and the Executive Officer finding that:

(A) the monitoring strategy for detecting orifices specified in section (e)(4.2.2)(C) meets the monitoring conditions requirements of section (e)(4.3.2); and

(B) the monitoring strategy for detecting 0.090 inch diameter orifices yields an in-use monitor performance ratio (as defined in section (d)(4)) that meets or exceeds 0.620.

(4.2.6) For the 2004 and 2005 model years only, manufacturers that use separate monitors to identify leaks (as specified in (e)(4.2.2.)(B) or (C)) in different portions of the complete evaporative system (e.g., separate monitors for the fuel tank to canister portion and for the canister to purge valve portion of the system) may request Executive Officer approval to revise the malfunction criteria in sections (e)(4.2.2)(B) and (C) to identify a malfunction when the separately monitored portion of the evaporative system (e.g., the fuel tank to canister portion) has a leak (or leaks) that is greater than or equal to the specified size in lieu of when the complete evaporative system has a leak (or leaks) that is greater than or equal to the specified size. The Executive Officer shall approve the request upon determining that the manufacturer utilized the same monitoring strategy (e.g., monitoring portions of the complete system with separate monitors) on vehicles prior to the 2004 model year and that the monitoring strategy provides further isolation of the malfunction for repair technicians by utilizing separate 'fault codes for each monitored portion of the evaporative system.

(4.2.7) For vehicres that utilize more than one purge flow path (e.g., a turbo-charged engine with a low pressure purge line and a high pressure purge line), theOBD II system shall verify the criteria of (e)(4.2.2)(A) (Le., purge flow to the engine) for both purge flow paths. If a manufacturer demonstrates that blockage, leakage, or disconnection of one of the purge flow paths cannot cause a measurable emission increase during any reasonable in-use driving conditions, monitoring of that flow path is not required.

(4.3) Monitoring Conditions:

(4.3.1) Man.ufacturers shall define the monitoring conditions for malfunctions identified in sections (e)(4.2.2)(A) and (B) (Le., purge flow and 0.040 inch leak detection) in accordance with· sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(4.3.2) Manufacturers sh.all define the monitoring conditions for malfunctions identified in section (e)(4.2.2)(C) (Le., 0.020 inch leak detection) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in section (e)(4.2.2)(C) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(4.3.3) Manufacturers may disable or abort an evaporative system monitor when the fuel tank level is over 85 percent of nominal tank. capacity or during a refueling event.

(4.3.4) Manufacturers may request Executive Officer approval to execute the evaporative system monitor only on driving cycles determined by the manufacturer to be cold starts if the condition is needed to ensure reliable monitoring. The Executive Officer may not approve criteria that exclude engine starts from being considered as cold starts solely on the basis that ambient temperature exceeds (Le., indicates a higher temperature than) engine coolant temperature at engine start. The Executive Officer shall approve the request upon determining that data and/or an engineering evaluation submitted by the manufacturer demonstrate that a reliable check can only be made on driving cycles when the cold start criteria are satisfied. '

(4.3.5) Manufacturers may temporarily disable the evaporative purge system to perform an evaporative system leak check.

(4.4) MIL Illumination and Fault Code Storage:

(4.4.1) Except as provided below for fuel cap leaks and alternate statistical MIL illumination protocols, general requirements for MIL illumination and, fault code storage are set forth in section (d)(2).

(4.4.2) If the OBO II system is capable of discerning that a system leak is being caused by a missing or improperly secured fuel cap:

(A) The manufacturer is not required to illuminate the MIL or store a fault code if the vehicle is equipped with an alternative indicator for notifying the vehicle operator of the malfunction. The alternative indicator shall be of sufficient illumination and location to be readily visible under all lighting conditions.

(B) If the vehicle is not equipped with an alternative indicator and the MIL illuminates, the MIL may be extinguished a'nd the corresponding fault codes erased once the 'OBD II system has verified that the fuel cap has been securely fastened and the MIL has not been illuminated for any other type of malfunction.

(C) The Executive Officer may approve other strategies that provide equivalent assurance that a vehicle operator will be promptly notified of a missing or improperly secured fuel cap and that corrective action will be undertaken. .

(4.4.3) Notwithstanding section (d)(2.2.6), manufacturers may request Executive Officer approval to use alternative statistical MIL illumination and fault code storage protocols that require up to twelve driving cycles on average for monitoring strategies designed to detect malfunctions specified by section (e)(4.2.2)(C). Executive Officer approval shall be granted in accordance with the bases identified in section (d)(2.2.6) and upon determination that the manufacturer has submitted data and/or an engine'ering analysis demonstrating that the most reliable monitoring method available cannot reliably detect a malfunction of the specified size without the additional driving cycles and that the monitoring system will still meet the monitoring conditions requirements specified in sections (d)(3.1) and (3.2).

(5) SECONDARY AIR SYSTEM MONITORING

(5.1) Requirement: The OBO II system on vehicles equipped with any form of secondary air delivery system shall monitor the proper functioning of the secondary air delivery system including all air switching valve(s). The individual electronic components (e.g., actuators, valves, sensors, etc.) in the secondary air system shall be monitored in accordance with the comprehensive component requirements in section (e)(1S).

(5.2) Malfunction Criteria:

(5.2.1) For purposes of section (e)(S), "air flow" is defined as the air flow delivered by the secondary air system to the exhaust system. For vehicles using secondary air systems with multiple air flow paths/distribution points, the air flow to each bank (Le., a group of cylinders that share a common exhaust manifold, catalyst, and control sensor) shall be monitored in accordance with the malfunction criteria in sections (e}(S.2.3) and (S.2.4) unless complete blocking of air delivery to one bank does not cause a measurable increase in emissions.

(5.2.2) For all Low Emission Vehicle I applications:

(A) Except as provided in sections (e)(S.2.2)(B) and (e)(S.2.4), the OBO II system shall detect a secondary air system malfunction prior to a decrease from the manufacturer's specified air flow that would cause a vehicle's emissions to exceed 1.S times any of the applicable FTP standards.

(B) Manufacturers may request Executive Officer approval to detect a malfunction when no detectable amount of air flow is delivered in lieu of the malfunction criteria in section (e)(S.2.2)(A). The Executive Office shall grant approval upon determining that deterioration of the secondary air system is unlikely based on data and/or engineering evaluation submitted by the manufacturer demonstrating that the materials used for the secondary air system (e.g., air hoses, tubing, valves, connectors, etc.) are inherently resistant to disconnection, corrosion, or other deterioration.

(5.2.3) For all Low Emission Vehicle II applications and all 2009 and subsequent model year vehicles:

(A) For 2004 and 200S model year vehicles, manufacturers shall use the malfunction criteria specified for Low Emission Vehicle I applications in section (e)(S.2.2):

(B) For 2006 and subsequent model year vehicles, except as provided in sections (e)(S.2.3)(C) and (e)(S·.2.4), the OBO II system shall detect a secondary air system malfunction prior to a decrease from the' manufacturer's specified air flow during normal operation that would cause a vehicle's emissions to exceed 1.S times any of the applicable FTP standards. For purposes of sections (e)(S.2) and (S.3), "normal operation" shall be defined as the condition when the secondary air system is activated during catalyst and/or engine warm-up following engine start and may not include the condition when the secondary air system is intrusively turned on solely for the purpose of monitoring.

(C) For 2006 and 2007 model year vehicles only, a manufacturer may request Executive Officer approval to detect a malfunction when no detectable amount of air flow is delivered during normal operation in lieu of the malfunction criteria in section (e)(5.2.3)(B) (e.g., 1.5 times the standard) during normal operation. Executive Officer approval shall be granted upon determining that the manufacturer has submitted data and/or engineering analysis that demonstrate that the monitoring system is capable of detecting malfunctions prior to a decrease from the manufacturer's specified air flow that would cause a vehicle's emissions to exceed 1.5 times any of the applicable FTP standards during an intrusive operation of the secondary air system later in the same driving cycle.

(5.2.4) For vehicles in which no deterioration or failure of the secondary air system would result in a vehicle's emissions exceeding 1.5 times any of the applicable standards, the aBO II system shall detect a malfunction when no detectable amount of air flow is delivered. For vehicles subject to the malfunction criteria in section (e)(5.2.3)(B), this monitoring for no detectable amount of air flow shall occur during normal operation of the secondary air system.

(5.3) Monitoring Conditions:

(5.3.1) For all Low Emission Vehicle I applications: Manufacturers shall define the monitoring conditions in accordance with section (d)(3.1).

(5.3.2) For all Low Emission Vehicle II applications and all 2009 and subsequent model year vehicles:

(A) For 2004 and 2005 model year vehicles, manufacturers shall define the monitoring conditions in accqrdance with section (d)(3.1).

(B) For 2006 and subsequent model year vehicles, manufacturers shall define the monitoring conditions in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in section (e)(5.2) during normal operation of the secondary air system shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(5.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(6) FUEL SYSTEM MONITORING

(6.1) Requirement:

(6.1.1) The aBO II system shall monitor the fuel delivery system to determine its ability to provide compliance with emission standards.

(6.2) Malfunction Criteria:

(6.2.1) The aBO" system shall detect a malfunction of the fuel delivery system when:

(A) The fuel delivery system is unable to maintain a vehicle's emissions at or below 1.5 times any of the applicable FTP standards; or

(B) If equipped, the feedback control based on a secondary oxygen or exhaust gas sensor is unable to maintain a vehicle's emissions (except as a result of a malfunction specified in section (e)(6.2.1)(C)) at or below 1.5 times any of the applicable FTP standards; or

(C) Except as required in section (e)(6.2.6), for 25 percent of all 2011 model year vehicles, 50 percent of all 2012 model year vehicles, 75 percent of all

2013 model year vehicles, and 100 percent of all 2014 model year vehicles, an air-fuel ratio cylinder imbalance (e.g., the air-fuel ratio in one or more cylinders is different than the other cylinders due to a cylinder specific malfunction such as an intake manifold leak at a particular cylinder, fuel injector problem, an individual cylinder EGR runner flow delivery problem, an individual variable cam lift malfunction such that an individual cylinder is operating on the wrong cam lift profile, or other similar problems) occurs in one or more cylinders such that the fuel delivery system is unable to maintain a vehicle's emissions at or below: 4.0 times the applicable FTP standards for PC/LOT SULEV II vehicles and 3.0 times the applicable FTP standards for all other vehicles for the 2011 through 2013 model years; and 1.5 times the applicable FTP standards for all 2014 and subsequent model year vehicles. In lieu of using 1.5 times the applicable FTP standards for all 2014 model year applications, for the 2014 model year only, a manufacturer may continue to use 4.0 times the applicable FTP standards for PC/LOT SULEV II vehicles and 3.0 times the applicable FTP standards for other applications previously certified in the 2011,2012, or 2013 model year to 4.0 times or 3.0 times the applicable FTP standards and carried over to the 2014 model year.

(6.2.2) Except as provided for in section *(e)(6.2.3)* below, if the vehicle is equipped with adaptive feedback control, the OBO II system shall detect a malfunction when the adaptive feedback control has used up all of the adjustment allowed by the manufacturer.

(6.2.3) If the vehicle is equipped with feedback control that is based on a secondary oxygen (or equivalent) sensor, the OBO II system is not required to detect a malfunction of the fuel system solely when the feedback control based on a secondary oxygen sensor has used up all of the adjustment allowed by the manufacturer. However, if a failure or deterioration results in vehicle emissions that exceed the malfunction criteria in section (e)(6.2.1), the OBO II system is required to detect a malfunction.

(6.2.4) The OBO II system shall detect a malfunction whenever the fuel control system fails to enter closed-loop operation (if employed) within a manufacturer specified time interval.

(6.2.5) Manufacturers may adjust the criteria and/or limit(s) to compensate for changes in altitude, for temporary introduction of large amounts of purge vapor, or for other similar identifiable operating conditions when they occur.

(6.2.6) Notwithstanding the phase-in specified in section *(e)(6.2.1*)(C), if a vehicle is equipped with separate EGR flow delivery passageways (internal or external) that deliver EGR flow to individual cylinders (e.g., an EGR system with individual delivery pipes to each cylinder), the OBO II system shall monitor the fuel delivery system for malfunctions specified in section *(e)(6.2.1*)(C) on all 2011 and subsequent model year vehicles so equipped.

(6.3) Monitoring Conditions:

(6.3.1) Except as provided in section *(e)(6.3.2),* the fuel system shall be monitored continuously for the presence of a malfunction.

(6.3.2) Manufacturers shall define monitoring conditions for malfunctions identified in section (e)(6.2.1)(C) (Le., air-fuel ratio cylinder imbalance malfunctions) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(6.4) MIL Illumination and Fault Code Storage: For malfunctions described under section (6.2.1)(C) (Le., air-fuel ratio cylinder imbalance malfunctions), general requirements for MIL illumination and fault code storage are set forth in section (d)(2). For all other fuel system malfunctions, the MIL illumination and fault code storage requirements are set forth in sections (e)(6.4.1) through (6.4.6) below.

(6.4.1) A pending fault code shall be stored immediately upon the fuel system exceeding the malfunction criteria established pursuant to section (e)(6.2).

(6.4.2) Except as provided below, if a pending fault code is stored, the OBO II system shall immediately illuminate the MIL and store a confirmed fault code if a malfunction is again detected during either of the following two events: (a) the driving cycle immediately follbwing the storage of the pending fault code, regardless of the conditions encountered during the driving cycle; or (b) on the next driving cycle in which similar conditions (see section (c» to those that occurred when the pending fault code was stored are encountered.

(6.4.3) The pending fault code may be erased at the end of the next driving cycle in which similar conditions have been encountered.without an exceedance of the specified fuel system malfunction criteria. The pending code may also be erased if similar conditions are not encountered during the 80 driving cycles immediately after the initial detection of a malfunction for which the pending code was set.

(6.4.4) Storage of freeze frame conditions.

(A) The OBO II system shall store and erase freeze frame conditions either in conjunction with storing and erasing a pending fault code or in conjunction with storing and erasing a confirmed fault code.

(B) If freeze frame conditions are stored for a malfunction other than misfire (see section (e)(3» or fuel system malfunction when a fault code is stored as specified in section (e)(6.4) above, the stored freeze frame information shall be replaced with freeze frame information regarding the fuel system malfunction.

(6.4.5) Storage of fuel system conditions for determining similar conditions of operation.

(A) Upon detection of a fuel system malfunction under section (e)(6.2), the OBO II system shall store the engine speed, load, and warm-up status of the first fuel system malfunction that resulted in the storage of the pending fault code.

(B) For fuel system faUlts detected using feedback control that is based on a secondary oxygen (or equivalent) sensor, the manufacturer may request Executive Officer approval to use an alternate definition of similar conditions in lieu of the definition specified in section (c). The Executive Officer shall approve the alternate definition upon the manufacturer providing data or analysis demonstrating that the alternate definition provides for equivalent robustness in detection of fuel system faults that vary in severity depending on engine speed, load, and/or warm-up status.

(6.4.6) ExtingUishing the MIL. The MIL may be extinguished after three sequential drivingcycles in which similar conditions have been encountered without a malfunction of the fuel system.

(7) *EXHAUST GAS SENSOR MONITORING*

(7.1) Requirement:

(7.1.1) The aBO II system shall monitor the output voltage, response rate, and any other parameter which can affect emissions of all primary (fuel control) oxygen sensors (conventional switching sensors and wide range or universal sensors) for malfunction.

(7.1.2) The aBO II system shall also monitor all secondary oxygen sensors (those used for fuel trim control or as a monitoring device) for proper output voltage, activity, and/or response rate. -

(7.1.3) For vehicles equipped with heated oxygen sensors, the aBO II system shall monitor the heater for proper performance.

(7.1.4) For other types of sensors (e.g., hydrocarbon sensors, NOx sensors), the manufacturer shall submit a monitoring plan to the Executive Officer for approval. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and an engineering evaluation that demonstrate that the monitoring plan is as reliable and· effective as the monitoring plan required for conventional sensors under section (e)(7).

(7.2) Malfunction Criteria:

(7.2.1) Primary Sensors:

(A) The aBO II system shall detect a malfunction prior to any failure or deterioration of the oxygen sensor voltage, response rate, amplitude, or other characteristic(s) (including drift or bias corrected for by secondary sensors) that would cause a vehicle's emissions to exceed 1.5 times any of the applicable FTP standards. For response rate (see section (c», the aBO II system shall detect asymmetric malfunctions (Le., malfunctions that primarily affect only the lean-to-rich response rate or only the rich-to-Iean response rate) and symmetric malfunctions (Le., malfunctions that affect both the lean-to-rich and rich-to-Iean response rates). As defined in section (c), response rate includes delays in the sensor to initially react to a change in exhaust gas composition as well as delays during the transition from a rich-to-Iean (or lean-to-rich) sensor output. For 25 percent of ~~2010~~2011, 50 percent of ~~2011~~2012, and 100 percent of ~~2012~~ 2013 and subsequent model year vehicles, the manufacturer shall submit data and/or engineering analysis to demonstrate that the calibration method used ensures proper detection of all symmetric and asymmetric response rate malfunctions as part of the certification application.

(B) The aBO II system shall detect malfunctions of the oxygen sensor caused by either a lack of circuit continuity or out-of-range values.

(C) The aBO II system shall detect a malfunction of the oxygen sensor when a sensor failure or deterioration .causes the fuel system to stop using that sensor as a feedback input (e.g., causes defa.ult or open loop operation) or causes the fuel system to fail to enter closed-loop operation within a manufacturer-specified time interval.

(D) The OBO " system shall detect a malfunction of the oxygen sensor when the sensor output voltage, amplitude, activity, or other characteristics are no longer sufficient for use as an OBO " system monitoring device (e.g., for catalyst monitoring).

(7.2.2) Secondary Sensors: .

(A) The OBO " system shall detect a malfunction. prior to any failure or deterioration ofthe oxygen sensor voltage, response rate, amplitude, or other characteristic(s) that would cause a vehicle's emissions to exceed 1.5 times any of the applicable FTP standards.

(B) The OBO " system shall detect malfunctions of the oxygen sensor caused by a lack of circuit continuity.

(C) Sufficient sensor performance for other monitors.

(i) The OBO " system shall detect a malfunction of the oxygen sensor when the sensor output voltage, amplitude, activity, or other. characteristics are no longer sufficient for use as an OBO II system monitoring device (e.g., for catalyst monitoring). For this requirement, "sufficient" is defined as the capability of the worst performing acceptable sensor to detect the best performing unacceptable other monitored system or component (e.g., catalyst).

(ii) For systems where it is not technically feasible to satisfy the criteria of section (e)(7.2.2)(C)(i) completely, the OBO " system shall, at a minimum, detect a slow rich-to-Iean response malfunction during a fuel shut-off event (e.g., deceleration fuel cut event). The rich-to-Iean response check shall monitor both the sensor response time from a rich condition (e.g., 0.7 Volts) prior to the start offuel shut-off to a lean condition (e.g., 0.1 Volts) expected during fuel shut-off conditions and the sensor transition time in the intermediate sensor range (e.g., from 0.55 Volts to 0.3 Volts). Monitoring of the rich-to-Iean response shall be phased in on at least 25 percent of the 2009, 50 percent of the 2010, and 100 percent of the 2011 model year vehicles. For purposes of this phase-in, vehicles meeting the criteria of section (e)(7.2.2)(C)(i) shall be counted as vehicles meeting the rich-to-Iean response rate monitoring requirement of section (e)(7.2.2)(C)(ii).

(iii) Additionally, for systems where it is not technically feasible to satisfy the criteria in section (e)(7.2.2)(C)(i), prior to certification of2009 model year vehicles; the manufacturer must submit a comprehensive plan to the Executive Officer demonstrating the manufacturer's efforts to minimize any gap remaining between the worst performing acceptable sensor and a sufficient sensor. The plan should include quantification of the gap and supporting documentation for efforts to close the gap including sensor monitoring improvements, other system component monitor improvements (e.g., changes to make the catalyst monitor less sensitive to oxygen sensor response), and sensor specification changes, if any. The Executive Officer shall approve the plan upon determining the submitted information supports the necessity of the gap and the plan demonstrates that the manufacturer is taking reasonable efforts to minimize or eliminate the gap in a timely manner.

(0) The OBO II system shall detect malfunctions of the oxygen sensor caused by out-of-range values.

(7.2.3) Sensor Heaters: .

(A) The OBO II system shall detect a malfunction of the heater performance when the current or voltage drop in the heater circuit is no longer within the manufacturer's specified limits for normal operation (Le., within the criteria required to be met by the component vendor for heater circuit performance at high mileage). Subject to Executive Officer approval, other malfunction criteria for heater performance malfunctions may be used upon the Executive Officer determining that the manufacturer has submittedqata and/or an. engineering evaluation that demonstrate the monitoring reliability and timeliness to be equivalent to the stated criteria in section (e)(7.2.3)(A).

(B) The OBO II system shall detect malfunctions of the heater circuit including open or short circuits that conflict with the commanded state of the heater (e.g., shorted to 12 Volts when commanded to 0 Volts (ground), etc.).

(7.3) Monitoring Conditions:

(7.3.1) Primary Sensors

(A) Manufacturers shall define the monitoring conditions for malfunctions' identified in sections (e)(7.2.1J(A) and (0) (e.g., proper response rate) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in sections (e)(7.2.1)(A) and (0) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(B) Except as provided in section *(e)(7.3.1*)(C), monitoring for malfunctions identified in sections *(e)(7.2.1*)(B) and (C) (Le., circuit continuity, out-of-range, and open-loop malfunctions) shall be:

(i) Conducted in accordance with title 13, CCR section 1968.1 for Low Emission Vehicle I applications and 2004 and 2005 model year Low Emission Vehicle II applications;

(ii) Conducted continuously for all 2006 through 2008 model year Low Emission Vehicle II applications and all 2009 and subsequent model year vehicles.

(C) A manufacturer may request Executive Officer approval to disable continuous oxygen sensor monitoring when an oxygen sensor malfunction cannot be distinguished from other effects (e.g., disable out-of-range low monitoring during fuel cut conditions). The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(7.3.2) Secondary Sensors

(A) Manufacturers shall define monitoring conditions for malfunctions identified in sections (e)(7.2.2)(A) and (C) (e.g., proper sensor activity) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For all 2010 and subsequent model year vehicles meeting the monitoring requirements of section (e)(7.2.2)(C)(i) or (ii), for purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in sections (e)(7.2.2)(A) and (C) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(B) Except as provided in section (e)(7.3.2)(C), monitoring for malfunctions· identified in sections (e)(7.2.2)(B) and (D) (Le., open circuit, out-of-range malfunctions) shall be:

(i) Conducted in accordance with title 13, CCR section 1968.1 for Low Emission Vehicle I applications and 2004 and 2005 model year Low Emission Vehicle" applications; .

(ii) Conducted continuously for all 2006 through 2008 model year Low Emission Vehicle" applications and all 2009 and subsequent model year vehicles. .

(C) A manufacturer may request Executive Officer approval to disable continuous oxygen sensor monitoring when an oxygen sensor malfunction cannot be distinguished from other effects (e.g., disable out-of-range low monitoring during fuel cut conditions). The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning sensor cannot be'distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection. '

(7.3.3) Sensor Heaters

(A) Manufacturers shall define monitoring conditions for malfunctions identified in section *(e)* (7.2.3)(A) (e.g., sensor heater performance) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(B) Monitoring for malfunctions identified in section (e)(7.2.3)(B) (e.g., circuit malfunctions) shall be:

(i) Conducted in accordance with title 13, CCR section 1968.1 for 2004 and 2005 model year vehicles;

. (ii) Conducted continuously for all 2006 and subsequent model year vehicles.

(7.4)' MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage'are set forth in section (d)(2).

(8) EXHAUST GAS RECIRCULATION (EGR) SYSTEM MONITORING

(8.1) Requirement: The OBD " system shall monitor the EGR system on vehicles so-equipped for low and high flow rate malfunctions. The individual electronic components (e.g., actuators, valves, sensors, etc.) that are used in the EGR system shall be monitored in accordance with the comprehensive component requirements in section *(e)(15).*

(8.2) Malfunction Criteria: '

(8.2.1) The OBD II system shall detect a malfunction of the EGR system prior to an increase or decrease from the manufacturer's specified EGR flow rate that would cause a vehicle's emissions to exceed 1.5 times any of the applicable FTP standards. '

(8.2.2) For vehicles in which no failure or deterioration of the EGR system could result in a vehicle's emissions exceeding 1.5 times any of the applicable standards, the OBD II system shall detect a malfunction when the system has no detectable amount of EGR flow.

(8.3) Monitoring Conditions:

(8.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in section (e}(8.2) (e.g., flow rate) in accordance with sections (d}(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d}(3.2.2), all monitors used to detect malfunctions identified in section (e)(8.2) shall be tracked separately but reported as a single set of values as specified in section (d}(5.2.2).

(8.3.2) Manufacturers may request Executive Officer approval to temporarily disable the EGR system check under specific conditions (e.g., when freezing may affect performance of the system). The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a reliable check cannot be made when these conditions exist.

(8.4) MIL Illumination and Fault Code,Storage: General requirements for MIL illumination and fault code storage are set forth in section (d}(2). '

(9) POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM MONITORING

(9.1) Requirement:

(9.1.1) On all 2004 and subsequent model year vehicles, manufacturers shall monitor the PCV system on vehicles so-equipped for system integrity. A manufacturer may use an alternate phase-in schedule in lieu of meeting the requirements of section (e}(9) on all 2004 model year vehicles if the alternate phase-in schedule provides for equivalent compliance volume (as defined in section (c}) to the phase-in schedule specified in title 13, CCR section 1968.1 (b}(1 0.1). Vehicles, not required to be equipped with PCV systems shall be exempt from monitoring of the PCV system.

(9.2) Malfunction Criteria:

(9.2.1) For the purposes of section (e}(9), "PCV system" is defined as any form of crankcase ventilation system, regardless of whether it utilizes positive pressure. "PCV valve" is defined as any form of valve or orifice used to restrict or control 'crankcase vapor flow. Further, any additional external PCV system tubing or hoses used to equalize crankcase pressure or to provide a ventilation path between various areas of the engine (e.g., crankcase and valve cover) are considered part of the PCV system "between the crankcase and the PCV valve" and subject to the malfunction criteria in section (e)(9.2.2) below.

(9.2.2) Except as provided below, the aBO II system shall detect a malfunction of the PCV system when a disconnection of the system occurs between either the crankcase and the PCV valve, or between the PCV valve and the ·intake manifold.

(9.2.3) If the PCV system is designed such that the PCV valve is fastened directly to the crankcase in a manner which makes it significantly more difficult to remove the valve from the crankcase rather than disconnect the line between the valve and the intake manifold (taking aging effects into consideration), the Executive Officer shall exempt the manufacturer from detection of disconnection between the crankcase and the PCV valve.

(9.2.4) Subject to Executive Officer approval, system 'designs that utilize tubing between the valve and the crankcase shall also be exempted from the portion of the monitoring requirement for detection of disconnection between the crankcase and the PCV valve. The manufacturer shall file a request and submit data and/or engineering evaluation in support of the request. The Executive Officer shall approve the request upon determining that the connections between the valve and the crankcase are: (i) resistant to deterioration or accidental disconnection, (ii) significantly more difficult to disconnect than the line between the valve and the intake manifold, and (iii) not subject to disconnection per manufacturer's repair procedures for non-PCV system repair work.

(9.2.5) Manufacturers are not required to detect disconnections between the PCV valve and the intake manifolc! if said disconnection (1)'causes the vehicle to stall immediately during idle operation; or (2) is unlikely to occur due to a PCV system design that is integral to the induction system (e.g., machined passages rather than tubing or hoses).

(9.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section (e)(9.2) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum. ratio requirements).

(9.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2). The stored fault code need not specifically identify the PCV system (e.g., a fault code for idle speed control or fuel system monitoring can be stored) if the manufacturer demonstrates that additional monitoring hardware would be necessary to make this identification, and provided the manufacturer's diagnostic and repair procedures for the detected malfunction include directions to check the integrity of the PCV system.

(10) .ENGINE COOLING SYSTEM MONITORING

(10.1) Requirement:

(10.1.1) The aBO II system shall monitor the thermostat on vehicles so-equipped for proper operation.

(10.1.2) The aBO II system shall monitor the engine coolant temperature (ECT) sensor for circuit continuity, out-of-range values, and rationality faults.

(10.2) Malfunction Criteria:

(l0.2.1) Thermostat

(A) The OBD II system shall detect a thermostat malfunction if, within an Executive Officer approved time interval after starting the engine, either of the following two conditions occur:

(i) The coolant temperature does not reach the highest temperature required by the OBD II system to enable other diagnostics;

(ii) The coolant temperature does not reach a warmed-up temperature within 20 degrees Fahrenheit of the manufacturer's nominal thermostat regulating temperature. Subject to Executive Officer approval, a manufacturer may utilize lower temperatures for this criterion upon the Executive Officer determining that the manufacturer has demonstrated that the fuel, spark timing, and/or other coolant temperature-based modifications to the engine control strategies would not cause an emission increase of 50 or more percent of any of the applicable standards (e.g., 50 degree Fahrenheit emission test, etc.).

(B) Executive Officer approval of the time interval after engine start shall be granted upon determining that the data and/or engineering evaluation submitted by the manufacturer supports the specified times.

(C) With Executive Officer approval, a manufacturer may use alternate malfunction criteria and/or monitoring conditions (see section (e)(10.3)) that are a function of temperature at engine start on vehicles that do not reach the temperatures specified in the malfunction criteria when the thermostat is functioning properly. Executive Officer approval shall be granted upon determining that the manufacturer has submitted data that demonstrate that a properly operating system does not reach the specified temperatures, that the monitor is capable of meeting the specified malfunction criteria at engine start temperatures greater than 50°F, and that the overall 'effectiveness of the monitor is comparable to a monitor meeting these thermostat monitoring requirements at lower temperatures.

(D) With Executive Officer approval, manufacturers may omit this monitor. Executive Officer approval shall be granted upon determining that the manufacturer has demonstrated that a malfunctioning thermostat cannot cause a measurable increase in emissions during any reasonable driving condition nor cause any disablement of other monitors.

(10.2.2) ECT Sensor

(A) Circuit Continuity. The OBD II system shall detect a malfunction when a lack of circuit continuity or out-of-range value occurs.

(B) Time to Reach Closed-Loop Enable Temperature.

(i) The OBD II system shall detect a malfunction if the ECT sensor does not achieve the stabilized minimum temperature which is needed for the fuel control system to begin closed-loop operation (closed-loop enable temperature) within an Executive Officer approved time interval after starting the engine.

(ii) The time interval shall be a function of starting ECT and/or a function of intake air temperature and, except as provided below in section (e)(10.2.2)(B)(iii), may not exceed:

a. two minutes for engine start temperatures at or above 50 degrees Fahrenheit and five minutes for engine start temperatures at or above 20 degrees Fahrenheit and below 50 degrees Fahrenheit for Low Emission Vehicle I applications and 2004 and 2005 model year Low Emission Vehicle II applications;

b. two minutes for engine start temperatures up to 15 degrees Fahrenheit below the closed-loop enable temperature and five minutes for engine start temperatures between 15 and 35 degrees Fahrenheit below the closed-loop enable temperature for all 2006 through 2008 model year Low Emission Vehicle II applications and all 2009 and subsequent model year vehicles.

(iii) Executive Officer approval of the time interval shall be granted upon determining that the data and/or engineering evaluation submitted by the manufacturer supports the specified times. The Executive"Officer shall allow longer time intervals upon determining that the manufacturer has submitted data and/or an engineering evaluation that dempnstrate that the vehicle requires a longer time to warm up under normal conditions.

(iv) The Executive Officer shall exempt manufacturers from the requirement of section (e)(10.2.2)(.B) if the manufacturer does not utilize ECT to enable closed loop fuel control.

(C) Stuck in Range Below the Highest Minimum Enable Temperature. To the extent feasible when using all available information, the aBO II system shall detect a malfunction if the ECTsensor inappropriately indicates a temperature' below the highest minimum enable temperature required by the aBO II system to enable other diagnostics (e.g., an aBO II system that requires ECT to be greater than 140 degrees Fahrenheit to enable a diagnostic must detect malfunctions that cause theECT sensor to inappropriately indicate a temperature below 140 degrees Fahrenheit). Manufacturers are exempted from this requirement for temperature regions in which the monitors required under sections (e)(1 0.2.1) or (e)(10.2.2)(B) will detect ECT sensor malfunctions as defined in section (e)(10.2.2)(C).

(D) Stuck in Range Above the Lowest Maximum Enable Temperature.

(i) To the extent feasible when using all available information, the aBO II system shall detect a malfunction if the ECT sensor inappropriately indicates a temperature above the lowest maximum enable temperature required by the aBO II system to enable other diagnostics (e.g., an OBD II system that requires ECT to be less than 90 degrees Fahrenheit at engine start to enable a diagnostic must detect malfunctions that cause the ECT sensor to inappropriately indicate a temperature above 90 degrees Fahrenheit).

(ii) Manufacturers are exempted from this requirement for temperature regions in which the monitors required under sections (e)(10.2.1), (e)(10.2.2)(B), or (e)(10.2.2)(C) (Le., ECT sensor or thermostat malfunctions) will detect ECT sensor malfunctions as defined in section (e)(10.2.2)(0) or in which the MIL will be illuminated under the requirements of section (d)(2.2.3) for default mode operation (e.g., overtemperature protection strategies).

(iii) For Low Emission Vehicle I applications and 2004 and 2005 model year Low Emission Vehicle II applications only, manufacturers are also exempted from the requirements of section (e)(10.2.2)(0) for vehicles that have a temperature gauge (not a warning light) on the instrument panel "and utilize the same ECT sensor for input to the OBO II system and the temperature gauge.

(iv) For 2006 through 2008 model year Low Emission Vehicle II applications and all 2009 and subsequent model year vehicles, . . manufacturers are also exempted from the requirements of section *(e)(1* 0.2.2)(0) for temperature regions where the temperature gauge indicates a temperature in the red zone (engine overheating zone) for vehicles that have a temperature gauge (not a warning light) on the instrument panel and utilize the same ECT sensor for input to the OBO II system and the temperature gauge.

(10.3) Monitoring Conditions:

(10.3.1) Thermostat

(A) Manufacturers shall define the monitoring conditions for malfunctions identified in section (e)(10.2.1)(A) in accordance with section (d)(3.1) except as provided for in section (e)(10.3.1)(0). Additionally, except as provided for in sections *(e)(1* 0.3.1)(B) and (C), monitoring for malfunctions identified in section (e)(10.2.1)(A) shall be conducted once per driving cycle on every driving cycle in which the ECT sensor indicates, at engine start, a temperature lower than the temperature established as· the malfunction criteria in section' (e)(10.2.1)(A).

(B) Manufacturers may disable thermostat monitoring at ambient temperatures below 20 degrees Fahrenheit.

(C) Manufacturers may request Executive Officer approval to suspend or disable thermostat monitoring if the vehicle is subjected to conditions which could lead to false diagnosis (e.g., vehicle operation at idle for more than 50 percent of the warm-up time, hot restart conditions, etc.). In general, the Executive Officer shall not approve disablement of the monitor on engine starts where the ECT at engine start is more than 35 degrees Fahrenheit lower than the thermostat malfunction threshold temperature determined under section (e)(10.2.1)(A). The Executive Officer shall approve the request upon determining that the manufacturer has provided data and/or engineering analysis that demonstrate the need for the request.

(D) With respect to defining enable conditions that are encountered during the FTP or Unified cycle as required in (d)(3.1.1) for malfunctions identified in section (e)(10.2.1)(A), the FTP cycle or Unified cycle shall refer to on-road driving following the FTP or Unified cycle in lieu of testing on a chassis dynamometer.

. (10.3.2) ECT Sensor

(A) Except as provided below in section (e)(10.3.2)(E), monitoring for malfunctions identified in section (e)(10.2.2)(A) (Le., circuit continuity and out-of-range) shall be conducted continuously.

(B) Manufacturers shall define the monitoring conditions for malfunctions identified in section (e)(10.2.2)(B) in accordance with section (d)(3.1).

Additionally, except as provided for in section (e)(10.3.2)(O), monitoring for malfunctions identified in section (e)(10.2.2)(8) shall be conducted once per driving cycle on every driving cycle in which the ECT sensor· indicates a temperature lower than the closed loop enable temperature at engine start (Le., all engine start temperatures greater than the ECT sensor out of range low temperature and less than the closed loop enable temperature).

(C) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (e)(10.2.2)(C) and (0) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements).

(0) Manufacturers may suspend or delay the time to reach closed loop enable temperature diagnostic if the vehicle is subjected to conditions which could lead to false diagnosis (e.g., vehicle operation at idle for more than 50 to 75 percent of the warm-up time).

(E) A manufacturer may request Executive Officer approval to disable continuous ECT sensor monitoring when an ECT sensor malfunction cannot be distinguished from other effects. The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or engineering evaluation that demonstrate a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(10.4) .MIL Illumination and Fault Code. Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(11) COLD START EMISSiON REDUCTION STRATEGY MONITORING

(11.1) Requirement:

(11.1.1) For all 2006 through 2008 model year Low Emission Vehicle II applications and all 2009 and subsequent model year applications, if a vehicle incorporates a specific engine control strategy to reduce cold start emissions, the 080 II system shall monitor the commanded elements for proper function (e.g., increased engine idle speed, commanded ignition timing retard, etc.), other than secqndary air, while the control strategy is active to ensure proper operation of the control strategy. Secondary air systems shall be monitored under the provisions of section (e)(5).

(11.1.2) In lieu of meeting the requirements of section (e)(11) on all 2006 through 2008 model year Low Emission Vehicle II applications, a manufacturer may phase in the requirements on a portion of its Low Emission Vehicle II applications as long as that portion of Low Emission Vehicle II applications comprises at least 30 percent of all 2006 model year vehicles, 60 percent of all 2007 model year vehicles, and 100 percent of all 2008 and subsequent model year vehicles.

(11.2) Malfunction Criteria: .

(11.2.1) For vehicles not included in the phase-in spe.cified in section (e)(11.2.2):

(A) The OBO II system shall detect a malfunction prior to any failure or deterioration of the' individual components associated with the cold start emission reduction control strategy that would cause a vehicle's emissions to exceed 1.5 times the applicable FTP standards. Manufacturers shall:

(i) Establish the malfunction criteria based on data from one or more representative vehicle(s).

(ii) Provide an engineering evaluation for establishing the 'malfunction criteria for the remainder of the manufacturer's product line. The Executive Officer shall waive the evaluation requirement each year if, in the judgment of the Executive Officer, technological changes do not affect the previously determined malfunction criteria.

(B) For components where no failure or deterioration of the component used for the cold start emission reduction strategy could result in a vehicle's emissions exceeding 1.5 times the applicable standards, the individual component shall be monitored for proper functional response in accordance with the malfunction criteria in section *(e)(15.2)* while the control strategy is active.

(11.2.2) For 25 percent of 2010, 50 percent of 2011, and 100 percent of 2012 and subsequent model year vehicles, the OBO " system shall, to the extent feasible, detect a malfunction if either of the following occurs:

(A) Any single commanded element does not properly respond to the commanded action while the cold start strategy is active. For elements involving spark timing (e.g., retarded spark timing), the monitor may verify final commanded spark timing in lieu of verifying actual delivered spark timing. For purposes of this section, "properly respond" is defined as when the element responds:

(i) by a robustly detectable amount; and

(ii) in the direction of the desired command; and

(iii) above and beyond what the element would achieve on start-up without the cold start strategy active (e.g., if the cold start strategy commands a higher idle engine speed, a fault must be detected if there is no detectable amount of engine speed increase above what the system would achieve without the cold start strategy active);

(B) Any failure or deterioration of the cold start emission reduction control strategy that would cause a vehicle's emissions to be equal to or above 1.5 times the app'licable FTP standards. For this requirement, the OBO " system shall either monitor elements of the system as a whole (e.g., measuring air flow and modeling overall heat into the exhaust) or the individual elements (e.g., increased engine speed, commanded final spark timing) for failures that cause vehicle emissions to exceed 1.5 times the applicable FTP standards.

(11.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section *(e)(11.2)* in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(11.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and faultcode storage are set forth in section (d)(2).

(12) AIR CONDITIONING (AIC) SYSTEM COMPONENT MONITORING

(12.1) Requirement: If a vehicle incorporates an engine control strategy that alters off-idle fuel and/or spark control when the AIC system is on, the OBO " system shall monitor, all electronic air conditioning system components for malfunctions that cause the system to fail to invoke the alternate control while the AIC system is on or cause the system to invoke the alternate control while the AIC system is off. Additionally, the aBO II system shall monitor for malfunction all electronic air conditioning system components that are used as part of the diagnostic strategy for any other mQnitored system or component. The requirements of section.(e}(12} shall be phased in as follows: 30 percent of all 2006 model year vehicles, 60 percent of all 2007 model year vehicles, and 100 percent of all 2008 and subsequent model year vehicles.

(12.2) Malfunction Criteria:

(12.2.1) The aBO II system shall detect a malfunction prior to any failure or .deterioration of an electronic component of the air conditioning system that would cause a vehicle's emissions to exceed 1.5 times any of the appropriate applicable emission standards or would, through software, effectively disable any other monitored system or component covered by this regulation. For malfunctions that result in the alternate control being erroneously invoked while the AIC system is off, the appropriate emission standards shall be the FTP standards. For malfunctions that result in the alternate control failing to be invoked while the AIC system is on, the appropriate emission standards shall be the SC03 emission standards.

(12.2.2) If no single electronic component failure or deterioration causes emissions to exceed 1.5 times any of the appropriate applicable emission standards as defined above in section (e)(12.2.1) nor is used as part of the diagnostic strategy for any other monitored system or component, manufacturers are not required to monitorany air conditioning system component for purposes of section (e}(12).

(12.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section (e)(12.2) in accordance with sections (d}(3.1) and (d}(3.2) (Le., minimum ratio requirements).

(12.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(13) VARIABLE VALVE TIMING AND/OR CONTROL (WT) SYSTEM MONITORING

(13.1) Requirement: On all 2006 through 2008 model year Low Emission Vehicle II applications and all 2009 and subsequent model year vehicles, the aBO II system shall monitor the VVT system on vehicles so-equipped for target error and slow response malfunctions. The individual electronic components (e.g., actuators, valves, sensors, etc.) that are used in the VVT system shall be monitored in accordance with the comprehensive components requirements in section (e)(15). VVT systems on Low Emission Vehicle I applications and 2004 and 2005 model year Low Emission Vehicle II applications shall be monitored in accordance with the comprehensive components requirements in section (e)(15).

(13.2) Malfunction Criteria:

(13.2.1) Target Error. The aBO II system shall detect a malfunction prior to any failure or deterioration in the capability of the VVT system to achieve the commanded valve timing and/or control within a crank angle and/or lift tolerance that would cause a vehicle's emissions to exceed 1.5 times any of the applicable FTP standards.

(13.2.2) Slow Response. The OBD " system shall detect a malfunction prior to any failure or deterioration in the capability of the WT system to achieve the commanded valve timing and/or control within a time that would cause a vehicle's emissions to exceed 1.5 times any of the applicable FTP standards.

(13.2.3) For vehicles in which no failure or deterioration of the WT system could result in a vehicle's emissions exceeding 1.5 times any of the applicable standards, the WT system shall be monitored for proper functional response in accordance with the malfunction criteria in section (e)(15.2).

(13.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions forWT system malfunctions identified in section (e)(13.2) in accordance with sections (d)(3.1) and- (d)(3.2) (Le., minimum ratio requirements), with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2). Additionally, manufacturers shall track-and report WT system monitor performance under section (d)(3.2.2). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in section (e)(13.2) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(13.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(14) DIRECT OZONE REDUCTION (DOR) SYSTEM MONITORING

(14.1) Requirement:

(14.1.1) The OBD II system shall monitor the DOR system on vehicles so-equipped for malfunctions that reduce the ozone reduction performance of the system.

(14.1.2) For 2003,2004, 'and 2005 model year vehicles subject to the malfunction criteria of section (e)(14.2.1) below, manufacturers may request to be exempted from DOR system monitoring. The Executive Officer shall approve the exemption upon the manufacturer:

(A) Agreeing that the DOR system receive only 50 percent of the NMOG credit assigned to the DOR system as calculated under Air Resources Board (ARB) Manufacturers Advisory Correspondence (MAC) No. 99-06, December 20, 1999, which is hereby incorporated by reference herein.

(B) Identifying the DOR system component(s) as an emission control device on both the underhood emission control label and a separate label as specified below. The DOR system shall be included in the list of emission control devices on the underhood emission control label and be identified as a "DOR system" or other equivalent term from SAE J1930 "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms – Equivalent to ISOITR 15031-2:April30, 2002 (SAE 1930)", incorporated by reference. A separate label shall be located on or near the DOR system component(s) in a location that is visible to repair technicians prior to the removal of any parts necessary to replace the DOR system component(s) and shall identify the components as a "DOR system" or other equivalentSAE J1930 term.

(14.2) Malfunction Criteria:

(14.2.1) For vehicles in which the NMOG credit assigned to the OOR system, as calculated in accordance with ARB MAC No. 99-06, is less than or equal to 50 percent of the applicable FTP NMOG standard, the OBO II system shall detect a malfunction when the OOR system has no detectable amount of ozone reduction.

(14.2.2) For vehicles in which the NMOG credit assigned to the OOR system, as calculated in accordance with ARB MAC No. 99-06, is greater than 50 percent of the applicable FTP NMOG standard, the OBO II system shall detect a malfunction when the ozone reduction performance of the OOR system deteriorates to a point where the difference between the NMOG credit assigned to the properly operating OOR system and the NMOG credit calculated for a OOR system performing at the level of the malfunctioning system exceeds 50 percent of the applicable FTP NMOG standard.

(14.2.3) For vehicles equipped with a OOR system, the mamifacturer may modify any of the applicable NMOG malfunction criteria in sections (e)(1)-(3), (e)(5)-(8), (e)(11)-(e)(13), and (e)(16) by adding the NMOG credit received by the OOR system to the required NMOG malfunction criteria (e.g., a malfunction criteria of 1.5 x NMOG standard would be modified to (1.5 x NMOG standard) + OOR system NMOG credit).

(14.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section (e)(14.2) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(14.4) MIL Illumination and Fault Code' Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(15) COMPREHENSIVE COMPONENT MoNITORING

(15.1) Requirement:

(15.1.1) Except as provided in sections (e)(15.1.3), (e)(15.1.4), and (e)(16), the OBO II system shall monitor for malfunction any electronic powertrain component/system not otherwise described in sections (e)(1) through (e)(14) that either provides input to (directly or indirectly) or receives commands from the on-board computer(s), and: (1) can affect emissions during any reasonable in-use driving condition, or (2) is used as part of the diagnostic strategy for any other monitored system or component.

(A) Input Components: Input components required to be monitored may include the vehicle speed sensor,crank angle sensor, knock sensor, throttle position sensor, cam position sensor, fuel composition sensor (e.g. flexible fuel vehicles), and transmission electronic components such as sensors, modules, and solenoids which provide signals to the powertrain control system.

(B) Output Components/Systems: Output components/systems required to be monitored may include the idle speed control system, automatic transmission solenoids or controls, variable length intake manifold runner systems, supercharger or turbocharger electronic components, heated fuel preparation systems, and a warm-up catalyst bypass valve.

(15.1.2) For purposes of criteria (1) in section (e)(15.1.1) above, the manufacturer shall determine whether a powertrain input or output component/system can affect emissions. If the Executive Officer reasonably believes that a manufacturer has incorrectly determined that a component/system cannot affect emissions, the Executive Officer shall require the manufacturer to provide emission data showing that the component/system, when malfunctioning and installed in a suitable test vehicle, does not have an emission effect. The Executive Officer may request emission data for any reasonable driving condition.

(15.1.3) Manufacturers shall monitor for malfunction electronic powertrain input or output components/systems associated with an electronic transfer case, electronic power steering system, or other components that are driven by the engine and not related to the control of fueling, air handling, or emissions only if the component or system is used as part of the diagnostic strategy for any other monitored system or component.

(15.1.4) Except as specified for hybrids in section (e)(15.1.5), manufacturers shall monitorfor malfunction electronic powertrain input or output components/systems associated with components that only affect emissions by causing additional electrical load to the engine and are not related to the control of fueling, air handling, or emissions only if the component or system is used as part of the diagnostic strategy for any other monitored system or component.

(15.1.5) For hybrids, manufacturers shall submit a plan to the Executive Officer for approval of the hybrid components determined by the manufacturer to be subject to monitoring in section (e)(15.1.1). In general, the Executive Officer shall approve the plan if it includes monitoring of all components/systems used as part of the diagnostic strategy for any other monitored system or component, monitoring of all energy input devices to the electrical propulsion system, monitoring of battery and charging system performance, monitoring of electric motor performance, and monitoring of regenerative braking performance.

(15.2) Malfunction Criteria:

(15.2.1) Input Components:

(A) The OBD " system shall detect malfunctions of input components caused by a lack of circuit continuity, out of range values, and, where feasible, rationality faults. To the extent feasible, the rationality fault diagnostics shall verify that a sensor output is neither inappropriately high nor inappropriately low (e.g., "two-sided" diagnostics).

(B) To the extent feasible on all 2005 and subsequent model year vehicles, rationality faults shall be separately detected and store different fault codes than the respective lack of circuit continuity and out of range diagnostics. Additionally, input component lack of circuit continuity and out of range faults shall be separately detected and store different fault codes for each distinct malfunction (e.g., out-of-range low, out-of-range high, open circuit, etc.). Manufacturers are not required to store separate fault codes for lack of circuit continuity faults that cannot be distinguished from other out-of-range circuit faults.

(C) For vehicles that require precise alignment between the camshaft and the crankshaft, the OBD " system shall monitor the crankshaft position sensor(s) and camshaft position sensor(s) to verify proper alignment between the camshaft and crankshaft in addition to monitoring the sensors for circuit continuity and rationality malfunctions. Proper alignment monitoring between a camshaft and a crankshaft shall only be required in cases where both are equipped with position sensors. For 2006 through 2008 model year Low Emission Vehicle II applications and all 2009 and subsequent model year vehicles equipped with VVT systems and a timing belt or chain; the OBO II system shall detect a malfunction if the alignment between the camshaft and crankshaft is off by one or more cam/crank sprocket cogs (e.g., the timing belt/chain has slipped by one or more teeth/cogs). If a manufacturer demonstrates that a single tooth/cog misalignment cannot cause a measurable increase in emissions during any reasonable driving condition, the manufacturer shall detect a malfunction when the minimum number of tee.th/cogs misalignment needed to cause a measurable emission increase has occurred. For the 2006 through 2009 model years only, a manufacturer may also request Executive Officer approval to use a larger threshold than one tooth/cog. The Executive Officer shall approve the request upon determining that the manufacturer has demonstrated that hardware modifications are necessary to meet the one tooth/cog threshold and that further software modifications are not able to reduce the larger threshold.

(15.2.2) Output Components/Systems:

(A) The OBO /I system shall detect a malfunction of an output component/system when proper functional response of the component and system to computer commands does not occur. If a functional check is not feasible, the OBO II system shall detect malfunctions of output components/systems caused by a lack of circuit continuity or circuit fault (e.g., short to ground or high voltage). For output component lack of circuit continuity faults and circuit faults, manufacturers are not required to store different fault codes for each distinct malfunction (e.g., open circuit, shorted low, etc.). Manufacturers are not required to activate an output component/system when it would not normally be active for the purposes of performing functional monitoring of output components/systems as required in section (e)(15).

(B) The idle speed control system shall be monitored for proper functional response to computer commands. For strategies based on deviation from target idle speed, a malfunction shall be detected when either of the following conditions occur:

(i) The idle speed control system cannot achieve the target idle speed within 200 revolutions per minute (rpm) above the target speed or 100 rpm below the target speed. The Executive Officer shall' allow larger engine speed tolerances upon determining that a manufacturer has submitted data and/or an engineering evaluation which demonstrate that the tolerances can be exceeded without a malfunction being present.

(ii) The idle speed control system cannot achieve the target idle speed within the smallest engine speed tolerance range required by the OBO /I system to enable any other monitor.

(15.3) Monitoring Conditions:

(15.3.1) Input Components:

(A) Except as provided in section (e)(15.3.1)(C), input components shall be monitored continuously for proper range of values and circuit continuity.

(8) For rationality monitoring (where applicable):

(i) For 2004 model year vehicles, manufacturers shall define the monitoring conditions for detecting malfunctions in accordance with section (d)(3.1).

(ii) For 2005 and subsequent model year vehicles, manufacturers shall define the monitoring conditions for detecting malfunctions in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that rationality monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2).

(C) A manufacturer may request Executive Officer approval to disable continuous input component proper range of values or circuit continuity monitoring when a malfunction cannot be distinguished from other effects. The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning input component cannot be distinguished from a malfunctioning input component and that the disablement interval is limited only to that necessary for avoiding false detection.

(15.3.2) Output Components/Systems:

(A) Except as provided in section (e)(15.3.2)(0), monitoring for circuit continuity and circuit faults shall be conducted continuously.

(8) Except as provided in section (e)(15.3.2)(C), for functional monitoring, manufacturers shall define the monitoring conditions for detecting malfunctions in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(C) For the idle speed control system on all 2005 and subsequent model year vehicles, manufacturers shall define the monitoring conditions for functional monitoring in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that functional .monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2).

(0) A manufacturer may request Executive Officer approval to disable continuous output component circuit continuity or circuit fault monitoring when a malfunction cannot be distinguished from other effects. The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning output component cannot be distinguished from a malfunctioning output component and that the disablement interval is limited only to that necessary for avoiding false detection.

(15.4) MIL Illumination and Fault Code Storage:

(15.4.1) Except as provided in section (e)(15.4.2) below, general requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(15.4.2) Exceptions to general requirements for MIL il.lumination. MIL illumination is not required in conjunction with storing a confirmed fault code for any comprehensive component if:

(A) the component or system, when malfunctioning, could not cause vehicle emissions to increase by:

(i) 25 percent or more for PC/LOT SULEV II vehicles, or

(ii) 15 percent or more for all other vehicles, and

(B) the component or system is not used as part of the diagnostic strategy'for any other monitored system or component.

(15.4.3) For purposes of determining the emission increase in section (e)(15.4.2)(A), the manufacturer shall request Executive Office(approval of the test cycle/vehicle operating conditions for which the emission increase will be determined. Executive Officer approval shall be granted upon determining that the manufacturer has submitted data and/or engineering evaluation that demonstrate that the testing conditions represent in-use driving conditions where emissions are likely to be most affected by the malfunctioning component. For purposes of determining whether the specified percentages in section (e)(15.4.2)(A) are exceeded, if the approved testing conditions are comprised of an emission test cycle with an emission standard, the measured increase shall be compared to a percentage of the emission standard (e.g., if the increase is equal to or more than 15 percent of the emission standard for that test cycle). If the approved testing conditions are comprised of a test cycle or vehicle operating condition that does not have an emission standard, the measured increase shall be calculated as a percentage of the baseline test (e.g., if the increase from a back-to-back test sequence between normal and malfunctioning condition is equal to or more than 15 percent of the baseline test results from the normal condition).

(16) OTHER EMISSION CONTROL OR SOURCE SYSTEM MONITORING

(16.1) Requirement: For other emission control or source systems that are: (1) not identified or addressed in sections (e)(1) through (e)(15) (e.g., hydrocarbon traps, homogeneous charge compression ignition (HCCI) controls, NOx storage devices, fuel-fired passenger compartment heaters, etc.), or (2) identified or addressed in section (e)(15) but not corrected or compensated for by the adaptive fuel control system (e.g., swirl control valves), manLifacturers shall submit a plan for Executive Officer approval of the monitoring strategy, malfunction criteria, and monitoring conditions prior to introduction on a production vehicle intended for sale in California. Executive Officer approval shall be based on the effectiveness of the monitoring strategy, the malfunction criteria utilized, the monitoring conditions required by the diagnostic, and, if applicable, the determination that the requirements of section (e)(16.3) below are satisfied.

(16.2) For purposes of section (e)(16), emission source systems are components or devices that emit pollutants subject to vehicle evaporative and exhaust emission standards (e.g., NMOG, CO, NOx, PM, etc.) and include non-electronic components and non-powertrain components (e.g., fuel-fired passenger compartment heaters, on-board reformers, etc.).

(16.3) Except as provided below in this paragraph, for 2005 and subsequent model year vehicles that utilize, emission control systems that alter intake air flow or cylinder charge characteristics by actuating valve(s), flap(s), etc. in the intake air delivery system (e.g., swirl control valve systems), the manufacturers, in addition to meeting the requirements of section (e)(16.1) above, may elect to have the OBO II system monitor the shaft to which all valves in one intake bank are physically attached in lieu of monitoring the intake air flow, cylinder charge, or individual valve(s)/flap(s) for proper functional response. For non-metal shafts or segmented shafts, the monitor shall verify all shaft segments for proper functional response (e.g., by verifying the segment or portion of the shaft furthest from the actuator properly functions). For systems that have more than one shaft to operate valves in multiple intake banks, manufacturers are not required to add more than one set of detection hardware (e.g., sensor, switch, etc.) per inta.ke bank to meet this requirement. Vehicles utilizing these emission control systems designed and certified for 2004 or earlier model year vehicles and carried over to the 2005 through 2009 model year shall not be required to meet the provisions of section (e)(16.3) until the engine or intake air delivery system is redesigned.

(17) EXCEPTIONS TO MONITORING REQUIREMENTS

(17.1) Except as provided in sections (e)(17.1.1) through (17.1.3) below, upon request of a manufacturer or upon the best engineering judgment of the ARB, the Executive Officer may revise the emission threshold for a malfunction on any diagnostic required in section (e) if the most reliable monitoring method deYeloped requires a higher threshold to prevent significant errors of commission in detecting a malfunction.

(17.1.1) For PC/LOT SULEV II vehicles, the Executive Officer shall approve a malfunction criteria of 2.5 times the applicable FTP standards in lieu of 1.5 wherever required in section (e).

(17.1.2) For 2004 model year PC/LOT SULEV II vehicles only, the Executive Officer shall approve monitors with thresholds that exceed 2.5 times the applicable FTP.standard if the manufacturer demonstrates that a higher threshold is needed given the state of development of the vehicle and that the malfunction criteria and monitoring approach and technology (e.g., fuel system limits, percent misfire, monitored catalyst volume, etc.) are at least as stringent as comparable ULEV (not ULEV II) vehicles.

(17.1.3) For vehicles certified to Federal Bin 3 or Bin 4 emission standards, manufacturers shall utilize the ULEV II vehicle NMOG and CO malfunction criteria (e.g., 1.5 times the Bin 3 or Bin 4 NMOG and CO standards) and the PC/LOT SULEV II vehicle NOx malfunction criteria (e.g., 2.5 times the Bin 3 or Bin 4 NOx standards).

(17.1.4) For medium-duty vehicles certified to an engine dynamometer tailpipe emission standard, the manufacturer shall request Executive Officer approval of a malfunction criterion that is equivalent to that proposed for each monitor in section (e). The Executive Officer shall approve the request upon finding that the manufacturer has used good engineering judgment in determining the equivalent malfunction criterion and that the criterion will provide for similar timeliness in detection of malfunctioning components.

(17.2) Whenever the requirements in section *(e)* of this regulation require a manufacturer to meet a specific phase-in schedule (e.g., *(e)(11)* cold start emission reduction strategy monitoring requires 30 percent in 2006 model year, 60 percent in 2007 model year, and 100 percent in 2008 model year):

(17.2.1) The phase-in percentages shall be based on the manufacturer's projected sales volume for all vehicles subject to the requirements of.title 13, CCR section 1968.2 unless specifically stated otherwise in section *(e).*

(17.2.2) Manufacturers may use an alternate phase-in schedule in lieu of the required phase-in schedule if the alternate phase-in schedule provides for equivalent compliance volume as defined in section (c) except as specifically noted for the phase in of in-use monitor performance ratio monitoring conditions in section (d)(3.2).

(17.2.3) Small volume manufacturers may use an alternate phase-in schedule in accordance with section *(e)(17.2.2)* in lieu of the required phase-in schedule or may meet the requirement on all vehicles by the final year of the phase-in in lieu of meeting the specific phase-in requirements for each model year (e.g., in the example in section *(e)(17.2),* small volume manufacturers are required to meet 100 percent in the 2008 model year for cold start emission reduction strategy monitoring, but not 30 percent in the 2006 model year or 60 percent in the 2007 model year).

(11.3) Manufacturers may request Executive Officer approval to disable an OBD II system monitor at ambienttemperatures below twenty degrees Fahrenheit (20°F) (low ambient temperature conditions may be determined based on . intake air or engine coolant temperature) or at elevations above 8000 feet above sea level. The Executive Officer shall approve the request upon determining that.the manufacturer has provided data and/or an engineering evaluation that demonstrate that monitoring during the conditions would be unreliable. A manufacturer may further request, and the Executive Officer shall approve, that an OBD II system monitor be disabled at other ambient temperatures upon determining that the manufacturer has demonstrated with data and/or an engineering evaluation that misdiagnosis would occur at the ambient temperatures because of its effect on the component itself (e.g., component freezing).

(17.4) Manufacturers may request Executive Officer approval to disable monitoring systems that can be affected by low fuel level or running out of fuel (e.g., misfire detection) when the fuel level is 15 percent or less of the nominal capacity of the fuel tank. The Executive Officer shall approve the request upon determining that the manufacturerhas submitted data and/or an engineering evaluation -that demonstrate that monitoring at the fuel levels would be unreliable.

(17.5) Manufacturers may disable monitoring systems that can be affected by vehicle battery or system voltage levels.

(17.5.1) For monitoring systems affected by low vehicle battery or system voltages, manufacturers may disable monitoring systems when.the battery or system voltage is below 11.0 Volts. Manufacturers may request

Executive Officer approval to'utilize a voltage threshold higher than 11.0 Volts to disable system monitoring. The Executive Officer shall approve the request upon 'determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that monitoring at the voltages would be unreliable and that either operation of a vehicle below the disablement criteria for extended periods of time is unlikely or the OBO II system monitors the battery or system voltage and will detect a malfunction at the voltage used to disable other monitors.

(17.5.2) For monitoring systems affected by high vehicle battery or system voltages, manufacturers may request Executive Officer approval to disable monitoring systems when the battery or system voltage exceeds a manufacturer-defined voltage. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that monitoring above the manufacturer-defined voltage would be unreliable and that either the electrical charging system/alternator warning light is illuminated (or voltage gauge is in the "red zone") or that the OBO II system monitors the battery or system voltage and will detect a malfunction at the voltage used to disable other monitors.

(17.6) A manufacturer may disable affected monitoring systems in vehicles designed to accommodate the installation of Power Take-Off (PTO) units (as defined in section (c», provided disablement occurs only while the PTa unit is active, and the aBO II readiness status is cleared by the on-board computer (Le., all monitors set to indicate "not complete") while the PTa unit is activated (see section (g)(4.1». If the disablement occurs, the readiness status may be restored to its state prior to PTa activation when the disablement ends.

(17.7) A manufacturer may request Executive Officer approval to disable affected monitoring systems in vehicles equipped with tire pressure monitoring systems that cause a vehicle to enter a default mode of operation (e.g., reduced top speed) when a tire pressure problem is detected. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that the default mode can affect monitoring system performance, that the tire pressure monitoring system will likely result in action by the consumer to correct the problem, and that the disablement will not prevent or hinder effective testing in an Inspection and Maintenance program.

(17.8) Whenever the requirements in section (e) of this regulation require monitoring "to the extent feasible", the manufacturer shall submit its proposed monitor(s) for Executive Officer approval. The Executive Officer shall approve the proposal upon determining that the proposed monitor(s) meets the criteria of "to the extent feasible" by considering the best available monitoring technology to the extent that it is known or should have.been known to the manufacturer and given the limitations of the manufacturer's existing hardware, the extent and degree to which the monitoring requirements are met in full, the limitations of monitoring necessary to prevent significant errors of commission and omission, and the extent to which the manufacturer has considered and pursued alternative monitoring concepts to meet the requirements in full. The manufacturer's consideration and pursuit of alternative monitoring concepts shall include eval.uation of other modifications to the proposed monitor(s), the monitored components themselves, and other monitors that use the monitored components (e.g., altering other monitors to lessen the sensitivity and reliance on the component or characteristic of the component subject to the proposed monitor(s)}.

(17.9) For 2004 model year vehicles certified to run on alternate fuels, manufacturers may request the Executive Officer to waive specific monitoring requirements in section (e) for which monitoring may not be reliable with respect to the use of alternate fuels. The Executive Officer shall grant the request upon determining that the manufacturer has demonstrated that the use of the alternate fuel could cause false illumination of the MIL even when using the best available monitoring technologies.

(17.10) For 2004 model year vehicles only, wherever the requirements of section (e) reflect a substantive change from the requirements of title 13, CCR section 1968.1 (b) for 2003 model year vehicles, the manufacturer may request Executive Officer approval to continue to use the requirements of section 1968.1 'in lieu of the requirements of section (e). The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or engineering evaluation that demonstrate that software or hardware changes would be required to comply with the requirements of section (e) and that the system complies with the requirements of section 1968.1 (b).

(f) *MONITORING REQUIREMENTS FOR DIESEUCOMPRESSION-/GNITION ENGINES.*

(1) *NON-METHANE HYDROCARBON (NMHC) CONVERTING CATALYST MONITORING*

(1.1) Requirement: The OBO II system shall monitor the NMHC converting catalyst(s} for proper NMHC conversion capability. For vehicles equipped with catalyzed PM filters that convert NMHC emissions, the catalyst function of the PM filter shall be monitored in accordance with the PM filter requirements in section (f}(9).

(1.2) Malfunction Criteria:

(1.2.1) For purposes of section (f}(1), each catalyst in a series configuration that converts NMHC shall be monitored either individually or in combination with others.

(1.2.2) Conversion Efficiency:

(A) The OBO " system shall detect an NMHC catalyst malfunction when the catalyst conversion capability decreases to the point that NMHC emissions exceed:

(i) For passenger cars, light-duty trucks, and MOPVscertified to a chassis dynamometer tailpipe emission standard:

a. 5.0 times the applicable FTP NMHC standards for 2004 through 2009 model year vehicles;

b. 3.0 times the applicable FTP NMHC standards for 2010 through 2012 model year vehicles; and

c. 1.75 times the applicable FTP.NMHC standards for 2013 and subsequent model year vehicles.

(ii) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

a. 2.5 times the applicable NMHC standards for 2007 through 2012 model year vehicles; and

b. 2.0 times the applicable NMHC standards or the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) for 2013 and subsequent model year vehicles.

(B) Except as provided below in section (f)(1.2.2)(C), if no failure or deterioration of the catalyst NMHC conversion capability could result in NMHC or NOx emissions exceeding the applicable malfunction criteria of section (f)(1.2.2)(A), the OBO II system shall detect a malfunction when the catalyst has no detectable amount of NMHC or NOx conversion capability.

(C) For 2004 through 2009 model year vehicles, a manufacturer may request to be exempted from the requirements for NMHC catalyst conversion efficiency monitoring. The Executive Officer shall approve the request upon determining that the manufacturer has demonstrated, through data and/or engineering evaluation, that the average FTP test NMHC conversion efficiency of the system is less than 30 percent (Le., the cumulative NMHC emissions measured at the outlet of the catalyst. are more than 70 percent of the cumulative engine-out NMHC emissions measured at the inlet of the catalyst(s)).

(1.2.3) Other Aftertreatment Assistance Functions. Additionally, for 2010 and subsequent model year vehicles, the catalyst(s) shall be monitored for other aftertreatment assistance functions:

(A) For catalysts used to generate an exotherm to assist PM filter regeneration, the'OBO II system shall detect a malfunction when the catalyst is unable to generate a sufficient exotherm to achieve regeneration of the PM filter. '

(B) For 2010 and subsequent model year passen'ger cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard and 2013 and subsequent model year medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, ~~F~~for catalysts used to generate a feedgas constituency to assist SCR systems (e.g., to increase NO_2 concentration upstream of an SCR system), the OBO II system shall detect a malfunction when the catalyst is unable to generate the necessary feedgas constituents for proper SCR system operation.

(C) For catalysts located downstream of a PM filter and used to convert NMHC emissions during PM filter regeneration, the OBO II system shall detect a malfunctton when the catalyst has no detectable amount of NMHC conversion capability.

(D) For catalysts located downstream of an SCR system (e.g., ~~and~~ used to prevent ammonia slip}, the OBO II system shall detect a malfunction when the catalyst has no detectable amount of NMHC, CO, NOx, or PM conversion capability. Monitoring of the catalyst shall not be required if there is no measurable emission impact on the criteria pollutants (Le., NMHC, CO, NOx, and PM) during any reasonable driving condition where the catalyst is most likely to affect criteria pollutants (e.g., during conditions most likely to result in ammonia generation or excessive reductant delivery).

(1.2.4) Catalyst System Aging and Monitoring

(A) For purposes of determining the catalyst malfunction criteria in sections (f)(1.2.2) and (1.2.3) for individually monitored catalysts, the manufacturer s11all use a catalyst(s) deteriorated to the malfunction criteria using methods established by the manufacturer to represent real world catalyst deterioration under normal and malfunctioning engine operating conditions. If the catalyst system contains catalysts in parallel (e.g., a two bank exhaust system where each bank has its own catalyst), the . malfunction criteria shall be determined with the "parallel" catalysts equally deteriorated.

(B) For purposes of determining the catalyst malfunction criteria in sections (f)(1.2.2) and (1.2.3) for catalysts monitored in combination with others, the manufacturer shall submit a catalyst system aging and monitoring plan to the Executive Officer for review and approval. The plan shall include the description, emission control purpose, and location of each component, the monitoring strategy for each component and/or combination of components, and the method for determining the malfunction criteria of sections (f)(1.2.2) and (1.2.3) including the deterioration/aging process. If the catalyst system contains catalysts in parallel (e.g., a two bank exhaust system where each bank has its own catalyst), the malfunction criteria shall be determined with the "parallel" catalysts equally deteriorated. Executive Officer approval of the plan shall be based on the representativeness of the aging to real world catalyst system component deterioration under normal and malfunctioning engine operating conditions, the effectiveness of the method used to determine the malfunction criteria of section (f)(1.2), the ability of the component monitor(s) to pinpoint the likely area of malfunction and ensure the correct components are repairedlreplaced in-use, and the ability of the component monitor(s) to accurately verify that each catalyst component is functioning as designed and as required in sections (f)(1.2.2) and (1.2.3).

(1.3) Monitoring Conditions:

(1.3.1) Manufacturers shall define.the monitoring conditions for malfunctions identified in sections (f)(1.2.2) and (1.2.3) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in sections (f)(1.2.2) and (1.2.3) shall be tracked separately but reported as a single set of values as specified in . section (d)(5.2.2).

(1.4) MIL Illumination and Fault Code Storage:

(1.4.1) General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(1.4.2) The monitoring method for the catalyst(s) shall be capable of detecting all instances, except diagnostic self-clearing, when a catalyst fault code has been cleared but the catalyst has not been replaced (e.g., catalyst overtemperature histogram approaches are not acceptable).

(2) OXIDES OF NITROGREN (NOx) CONVERTING CATALYST MONITORING

(2.1) Requirement: The OBO " system shall monitor the NOx converting catalyst(s) for proper conversion capability. For vehicles equipped with selective catalytic reduction (SCR) systems or other catalyst systems that utilize an active/intrusive reductant injection (e.g., active lean NOx catalysts utilizing diesel fuel injection), the OBO " system shall monitor the SCR or active/intrusive reductant injection system for proper performance. The individual electronic components (e.g., actuators, valves, sensors, heaters, pumps) in the SCR or activelintrusive reductant injection system shall be monitored in accordance with the comprehensive component requirements in section (f)(15).

(2.2) Malfunction Criteria:

(2.2.1) For purposes of section (f)(2), each catalyst in a series configuration that converts NOx shall be monitored either individually or in combination with others.

(2.2.2) Conversion Efficiency:

(A) The OBO II system shall detect a NOxcatalyst malfunction when the catalyst conversion capability decreases to the point that NOx or NMHC emissions exceed:

(i) For passenger cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard:

a. 3.0 times the applicable FTP standards for 2004 through 2009 model year vehicles;

b. 2.5 times the applicable FTP standards for 2010 through 2012 model year vehicles; and

c. 1.75 times the applicable FTP standards for 2013 and subsequent model year vehicles.

(ii) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

a. the applicable NOx standard by more than 0.5 g/bhp-hr (e.g., cause NOx emissions to exceed 0.7 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 3.5 times the applicable NMHC standard for 2007 through 2009 model year vehicles;

b. the applicable NOx standard by more than 0.~~3~~4 g/bhp-hr (e.g., cause NOx emissions to exceed 0.~~5~~6 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 2.5 times the applicable NMHC standard for 2010 through 2012 model year vehicles; and

c. the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 2.0 times the applicable NMHC standard for 2013 and subsequent model year vehicles.

(B) Except as provided below in section (f)(2.2.2)(C), if no failure or deterioration of the catalyst NOx or NMHC conversion capability could result in NOx or NMHC emissions exceeding the applicable malfunction criteria of section (f)(2.2.2), the OBO II system shall detect a malfunction when the catalyst has no detectable amount of NOx or NMHC conversion capability. .

(C) For 2004 through 2009 model year vehicles, a manufacturer may request to be exempted froin the requirements for NOx catalyst conversion efficiency monitoring. The Executive Officer shall approve the request upon determining that the manufacturer has demonstrated, through data andlor engineering evaluation, that the average FTP test NOx conversion efficiency of the system is less than 30 percent (i.e., the cumulative NOx emissions measured at the outlet of the catalyst are more than 70 percent of the cumulative engine-out NOx emissions measured at the inlet of the catalyst(s)).

(2.2.3) Selective Catalytic Reduction (SCR) or Other Activellntrusive Reductant Injection System Performance:

(A) Reductant Delivery Performance:

(i) For 2007 and subsequent model year vehicles, the OBO II system shall detect a system malfunction prior to any failure or deterioration of the system to properly regulate reductant delivery (e.g., urea injection, separate injector fuel injection, post injection of fuel, air assisted injection/mixing) that would cause a vehicle's NOx or NMHC emissions to exceed the applicable emission levels specified in sections (f)(2.2.2)(A). .

(ii) If no failure or deterioration of the reductant delivery system could result in a vehicle's NOx or NMHC emissions exceeding the applicable malfunction criteria specified in section (f)(2.2.3)(A)(i), the OBO II system shall detect a malfunction when the system has reached its control limits such that it is no longer able to deliver the desired quantity of reductant.

(B) If the catalyst system uses a reductant other than the fuel used for the engine or uses a reservoir/tank for the reductant that is separate from the fuel tank used for the engine, the OBO II system shall detect a malfunction when there is no longer sufficient reductant available to properly operate the reductant system (e.g., the reductant tank is empty).

(C) If the catalyst system uses a reservoir/tank for the reductant that is separate from the fuel tank used for the vehicle, the OBO II system shall detect a malfunction when an improper reductant is used in the reductant reservoir/tank (e.g., the reductant tank is filled with something other than the reductant).

(0) Feedback control: Except as provided for in section (f)(2.2.3)(E), if the vehicle is equipped with feedback or feed-forward control of the reductant injection, the OBO II system shall detect a malfunction:

(i) If the system fails to begin feedback control within a manufacturer specified time'interval;

(ii) If a failure or deterioration causes open loop or default operation; or

(iii) If feedback the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the feedback target.

(E) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (f)(2.2.3)(0)(iii) during conditions that a manUfacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on a vehicle with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(F) In lieu of detecting the malfunctions specified in sections (f)(2.2.3)(D)(i) and (ii) with a reductant injection system-specific monitor, the OBO II system may monitor the individual parameters or components that are used as inputs for reductant injection feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (f)(2.2.3)(0)(i) and (ii).

(2.2.4) Catalyst System Aging and Monitoring

(A) For'purposes of determining the catalyst malfunction criteria in section (f)(2.2.2) for individually monitored catalysts, the manufacturer shall use a catalyst deteriorated to the malfunction criteria using methods established by the manufacturer to represent real world catalyst deterioration under normal and malfunctioning engine operating conditions. If the catalyst system contains catalysts in parallel (e.g., a two bank exhaust system where each bank has its own catalyst), the malfunction criteria shall be determined with the "parallel" catalysts equally deteriorated.

(B) For purposes of determining the catalyst malfunction criteria in section (f)(2.2.2) for catalysts monitored in combin'ation with others, the manufacturer shall submit a catalyst system aging and monitoring plan to the Executive Officer for review and approval. The plan shall include the description, emission control purpose, and location of each component, the monitoring strategy for each component and/or combination of components, and the method for determining the malfunction criteria of section (f)(2.2.2) including the deterioration/aging process. If the catalyst system contains catalysts in parallel (e.g., a two bank exhaust system where each bank has its own catalyst), the malfunction criteria shall be determined with the "parallel" catalysts equally deteriorated. Executive Officer approval of the plan shall be based on the representativeness of the aging to real world catalyst system component deterioration under normal and malfunctioning engine operating conditions, the effectiveness of the method used to determine the malfunction criteria of section (f)(2.2.2), the ability of the component monitor(s) to pinpoint the likely area of malfunction and ensure the correct components are repairedlreplaced in-use, and the ability of the component monitor(s) to accurately verify that each catalyst component is functioning as designed and as required in section (f)(2.2.2).

(2.3) Monitoring Conditions:

(2.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (f)(2.2.2) and (f)(2.2.3)(C) (Le., catalyst efficiencyJ. improper reductant) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2:2), all monitors used to detect malfunctions identified in section (f)(2.2.2) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(2.3.2) Except as provided for in section (f)(2.3.3), Tthe OBO II system shall monitor continuously for malfunctions identified in section (f)(2.2.3)(A), (B). and (D) (e.g., SCR performance, insufficient reductant. feedback control).

(2.3.3) Manufacturers may request Executive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating system cannot be 'distinguished from a malfunctioning system and that the disablement interval is limited only to that which is technically necessary.

(2.4) MIL Illumination and Fault Code Storage:

(2.4.1) Except as provided below for reductant faults, general requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(2.4.2) If the OBO II system is capable of discerning that a system fault is being caused by a empty reductant tank:

(A) The manufacturer may request Executive Officer approval to delay illumination of the MIL if the vehicle is equipped with an alternative indicator for notifying the vehicle operator of the malfunction. The Executive Officer shall approve the request upon determining the alternative indicator is of sufficient illumination and location to be readily visible under all lighting conditions and provides equivalent assurance that a vehicle operator will be promptly notified and that corrective action will be undertaken.

(B) If the vehicle is not equipped with an alternative indicator and the MIL illuminates, the MIL may be immediately extinguished and the corresponding fault codes erased once the OBO II system has verified that the reductant tank has been properly refilled and the MIL has not been illuminated for any other type of malfunction.

(C) The Executive Officer may approve other strategies that provide equivalent assurance that a vehicle operator will be promptly notified and that corrective action will be undertaken.

(2.4.3) The monitoring method for the catalyst(s) shall be capable of detecting all instances, except diagnostic self-clearing, when a catalyst fault code has been cleared but the catalyst has not been replaced (e.g., catalyst overtemperature histogram approaches are not acceptable).

(3) MISFIRE MONITORING

(3.1) Requirement:

(3.1.1) The OBO II system shall monitor the engine for misfire causing excess emissions. The OBO II system shall be capable of detecting misfire occurring in one or more cylinders. To the extent possible without adding hardware for this specific purpose, the OBO II system shall also identify the specific misfiring cylinder.

(3.1.2) If more than one cylinder is misfiring, a separate fault code shall be stored indicating that multiple cylinders are misfiring. When identifying multiple cylinder misfire, the OBO II system is not required to also identify each of the misfiring cylinders individually through separate fault codes.

(3.2) Malfunction Criteria:

(3.2.1) The OBO II system shall detect a misfire malfunction when one or more cylinders are continuously misfiring.

(3.2.2) Additionally, for 2010 and subsequent model year vehicles equipped with sensors that can detect combustion or combustion quality (e.g., for use in homogeneous charge compression ignition (HCCI) control systems):

(A) The OBO II system shall detect a misfire malfunction that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed:

(i) For passenger cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard, 1.5 times any of the applicable FTP standards.

(ii) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard, 2.0 times any of the applicable NMHC, CO, and NOx standards or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test.

(B) Manufacturers shall determine the percentage of misfire evaluated in 1000 revolution increments that would cause NMHC, CO, NOx, or PM emissions from an emission durability demonstration vehicle to exceed the levels specified in section (f)(3.2.2)(A) if the percentage of misfire were present from the beginning of the test. To establish this percentage of misfire, the manufacturer shall utilize misfire events occurring at equally spaced, complete engine cycle intervals, across randomly selected cylinders throughout each 1ODD-revolution increment. If this percentage of misfire is determined to be lower than one percent, the manufacturer may set the malfunction criteria at one percent.

(C) Subject to Executive Officer approval, a manufacturer may employ other revolution increments. The Executive Officer shall grant approval upon determining that the manufacturer has demonstrated that the strategy would be equally effective and timely in detecting misfire.

(3.2.3) A malfunction shall be detected if the percentage of misfire established in section (f)(3.2.2)(B) is exceeded regardless of the pattern of misfire events (e.g., random, equally spaced, continuous).

(3.2.4) For multiple cylinder misfire situations that result in a misfire rate greater than or equal to 50 percent, the OBO II system shall only be required to detect a misfire malfunction for situations that are caused by a single component failure.

(3.3) Monitoring Conditions:

(3.3.1) The OBO II system shall monitor for misfire during engine idle conditions at least once per driving cycle in which the monitoring conditions for misfire are met. A manufacturer shall submit monitoring conditions to the Executive Officer for approval. The Executive. Officer shall approve manufacturer-defined monitoring conditions that are determined (based on manufacturer-submitted data and/or other engineering documentation) to: (i) be technically necessary to ensure robust detection of malfunctions (e.g., avoid false passes and false detection of malfunctions), (ii) require no more than 1000 cumulative engine revolutions, and (iii) do not require any single continuous idle operation of more than 15 seconds to make a determination that a malfunction is present (e.g., a decision can be made with data gathered during several idle operations of 15 seconds or less); or satisfy the requirements of (d)(3.1) with alternative engine operating conditions.

(3.3.2) Manufacturers may request Executive Officer approval to use alternate monitoring conditions (e.g., off-idle). The Executive Officer shall approve alternate monitoring conditions that are determined (based on manufacturer-submitted data and/or other engineering documentation) to ensure equivalent robust detection of malfunctions and equivalent timeliness in detection of malfunctions.

(3.3.3) Additionally, for 2010 and subsequent model year vehicles subject to (f)(3.2.2):

(A) The OBO II system shall continuously monitor for misfire under all positive torque engine speeds and load conditions.

(B) If a monitoring system cannot detect all misfire patterns under all required engine speed and load conditions as required in section (f)(3.3.3)(A), the manufacturer may request Executive Officer approval to accept the monitoring system. In evaluating the manufacturer's request, the Executive Officer shall consider the following factors: the magnitude of the region(s) in which misfire detection is limited, the degree to which misfire detection is limited in the region(s) (Le., the probability of detection of misfire events), the frequency with which said region(s) are expected to be encountered in-use, the type of misfire patterns for which misfire detection is troublesome, and demonstration that the monitoring technology employed is not inherently incapable of detecting misfire under required conditions (Le., compliance can be achieved on other engines). The evaluation shall be based on the following misfire patterns: equally spaced misfire occurring on randomly selected cylinders, single cylinder continuous misfire, and paired cylinder (cylinders firing at the same crank angle) continuous misfire.

(3.4) MIL Illumination and Fault Code Storage:

(3.4.1) General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(3.4.2) Additionally, for 2010 and subsequent model year vehicles subject to (f)(3.2.2):

(A) Upon detection of the percentage of misfire specified in section (f)(3.2.2)(B), the following criteria shall apply for MIL illumination and fault code storage:

(i) A pending fault code shall be stored no later than after the fourth exceedance of the percentage of misfire specified in section (f)(3.2.2)(B) during a single driving cycle.

(ii) If a pending fault code is stored, the aBO II system shall illuminate the MIL and store a confirmed fault code within 10 seconds if the percentage of misfire specified in section (f)(3.2.2)(B) is again exceeded four times during: (a) the driving cycle immediately following the storage of the pending fault code, regardless of the conditions encountered during the driving cycle; or (b) on the next driving cycle in which similar conditions (see section (c)) to the engine conditions that occurred when the pending fault code was stored are encountered.

(iii) The pending fault code may be erased at the end of the next driving cycle in which similar conditions to the engine conditions that occurred when the pending fault code was stored have been encountered without an exceedance of the specified percentage of misfire. The pending code may also bè erased if similar conditions are not encountered during the next 80 driving cycles immediately following initial detection of the malfunction.

(B) Storage of freeze frame conditions.

(i) The aBO II system shall store and erase freeze frame conditions either in conjunction with storing and erasing a pending fault code or in conjunction with storing a confirmed fault code and erasing a confirmed fault code.

(ii) If freeze frame conditions are stored for a malfunction other than a misfire malfunction when a fault code is stored as specified in section (f)(3.4.2), the stored freeze frame information shall be replaced with freeze frame information regarding the misfire malfunction.

(C) Storage of misfire conditions for similar conditions determination. Upon detection of misfire under section (f)(3.4.2), the aBO II system shall store the following engine conditions: engine speed, load, and warm-up status of the first misfire event that resulted in the storage of the pending fault code.

(0) Extinguishing the MIL. The MIL may be extinguished after three sequential driving cycles in which similar conditions have been encountered without an exceedance of the specified percentage of misfire.

(4) FUEL SYSTEM MONITORING

(4.1) Requirement:

The OBO II system shall monitor the fuel delivery·system to determine its ability to comply with emission standards. The individual electronic components (e.g., actuators, valves, sensors, pumps) that are used in the fuel system and not specifically addressed in this section shall be monitored in accordance with the comprehensive component requirements in section (f)(15).

(4.2) Malfunction Criteria:

(4.2.1) Fuel system pressure control:

(A) The OBO II system shall detect a malfunction-of the fuel system pressure control system (e.g., fuel, hydraulic fluid) prior to any failure or deterioration that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed:

(i) For passenger cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard:

a. 3.0 times the applicable FTP standards for 2004 through 2009 model year vehicles;

b. 2.0 times the applicable FTP standards for 2010 through 2012 model year vehicles; and

c. 1.5 times the applicable FTP NMHC, CO, or NOx standards or 2.0 times the applicable FTP PM standard for 2013 and subsequent model year vehicles.

(ii) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

a. 1.5 times any of the applicable NMHC, CO, and NOx standards or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2007 and subsequent ,model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of greater than 0.50 g/bhp-hr NOx;

b. 2.5 times any of the applicable NMHC or CO standards, the applicable NOx standard by more than 0.3 g/bhp-hr (e.g., cause NOx emissions to exceed 0.5 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2007 through 2012 model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of less than or equal to 0.50 g/bhp-hr NOx; and

c. 2.0 times any of the applicable NMHC or CO standards, the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from· an applicable cycle emission test for 2013 and subsequent model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of less than or equal to 0.50 g/bhp-hr NOx;

(B) For vehicles in which no failure or deterioration of the fuel system pressure control could result in a vehicle's emissions exceeding the applicable malfunction criteria specified in section (f)(4.2.1)(A), the OBO II system shall detect a malfunction when the system has reached its control limits such that the commanded fuel system pressure cannot be delivered.

(4.2.2) Injection quantity. Additionally, for all 2010 and subsequent model year vehicles, the fuel system shall be monitored for injection quantity:

(A) The aBO II system shall detect a malfunction of the fuel injection system when the system is unable to deliver the commanded quantity of fuel necessary to maintain a vehicle's NMHC, CO, NOx and PM emissions at or below:

(i) For passenger cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard:

a. 3.0 times the applicable FTP standards for 2010 through 2012 model year vehicles; and

b. 1.5 times the applicable FTP NMHC, CO, or NOx standards or 2.0 times the applicable FTP PM standard for 2013 and subsequent model year vehicles.

(ii) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard, the applicable emission levels specified in sections (f)(4.2.1)(A)(ii).

(B) For vehicles in which no failure or deterioration of the fuel injection quantity could result in a vehicle's emissions exceeding the applicable malfunction criteria specified in section (f)(4.2.2)(A), the aBO II system shall detect a malfunction when the system has reached its control limits such that the commanded fuel quantity cannot be delivered.

(4.2.3) Injection Timing. Additionally, for all 2010 and subsequent model year vehicles, the fuel system shall be monitored for injection timing:

(A) The aBO II system' 'shall detect a malfunction of the fuel injection system when the system is unable to deliver fuel at the proper crank angle/timing (e.g., injection timing too advanced or too retarded) necessary to maintain a vehicle's NMHC, CO, NOx, and PM emissions at or below the applicable emission levels specified in sections (f)(4.2.2)(A).

(B) For vehicles in which no failure or deterioration of the fuel injection timing could result in a vehicle's emissions exceeding the applicable malfunction criteria specified in section (f)(4.2.3)(A), the aBO II system shall detect a malfunction when the system has reached its control limits such that the commanded fuel injection timing cannot be achieved.

(4.2.4) Feedback control:

(A) Except as provided for in section (f)(4.2.4)(B), if the vehicle is equipped with feedback or feed-forward control of the fuel system (e.g., feedback control of pressure or pilot injection quantity), the aBO II system shall detect a malfunction:

(i) If the system fails to begin feedback control within a manufacturer specified time interval;

(ii) If a failure or deterioration causes open loop or default operation; or

(iii) If feedback control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the feedback target.

(B) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (f)(4.2.4)(A)(iii) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on a vehicle with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(C) In lieu of detecting the malfunctions specified in sections (f)(4.2.4)(A)(i) and (ii) with a fuel system-specific monitor, the OBO II system may monitor the individual parameters or components that are used as inputs for fuel system feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (f)(4.2.4)(A)(i) and (ii).

(4.2.5) For purposes of determining the fuel system malfunction criteria in sections (e)(4.2.1) through (4.2.3) for medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard, the manufacturer shall do the following:

(A) For 2004 through 2012 model year vehicle.s, the malfunction criteria shall be established by using a fault that affects either a single injector or all injectors equally.

(B) For 2013 and subsequent model year vehicles, for section (e)(4.2.1), the malfunction criteria shall be established by using a fault that affects all injectors equally. Additionally, for systems that have single component failures which could affect a single injector (e.g., systems that build injection pressure within the injector that could have a single component pressure fault caused by the injector itself), the malfunction criteria shall also be established by using a fault that affects a single injector.

(C) For 2013 and subsequent model year vehicles, for sections (e)(4.2.2) through (4.2.3), the malfunction criteria shall be established by both (1) a fault that affects all the injectors equally and (2) a fault that affects only one injector.

(4.3) Monitoring Conditions:

(4.3.1) Except as provided in sections (e)(4.3.2) and (e)(4.3.4), ~~T~~the OBO II system shall monitor continuously for malfunctions identified in sections (f)(4.2.1) and (f)(4.2.4) (Le., fu"el pressure control and feedback operation).

(4.3.2) For fuel systems that achieve injection fuel pressure within the injector or increase pressure within the injector (e.g. in the injector of an amplified common rail system), manufacturers may request Executive Officer approval to define the monitoring conditions for malfunctions identified in sections (e)(4.2.1) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). The Executive Officer shall approve the monitoring conditions upon the manufacturer submitting data and/or analysis identifying all possible failure modes and the effect each has (e.g., failure modes and effects analysis) on fuel pressure across the entire range of engine operating conditions, and upon the Executive Officer determining based on the data and/or analysis that the monitoring conditions allow for robust detection of all causes of fuel pressure malfunctions.

(4.3.2)(4.3.3) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (f)(4.2.2) and (f)(4.2.3) (i.e., injection quantity and timing) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements). For all 2013 and subsequent model year vehicles, for purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in sections (f)(4.2.2) and (f)(4.2.3) shall be tracked separately but reported as a single set of values as specified in section Cd)(5.2.2).

(4.3.4) Manufacturers may request Executive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating system cannot be distinguished from a malfunctioning system and that the disablement interval is limited only to that which is technically necessary.

(4.4) MIL Illumination and Fault Code Storage:

(4.4.1) General requirem"ents for MIL illumination and fault code storage are set forth in section (d)(2).

(4.4.2) Additionally, for malfunctions identified in section (f)(4.2.1) (i.e., fuel pressure control) on all 2010 and subsequent model year vehicles:

(A) A pending fault code shall be stored immediately upon the fuel system exceeding the malfunction criteria established pursuant to section (f)(4.2.1).

(B) Except as provided below, if a pending fault code is stored, the OBD II system shall immediately illuminate the MIL and store a confirmed fault code if a malfunction is again detected during either of the following two events: (a) the driving cycle immediately following the storage of the pending fault code, regardless of the conditions encountered during the driving cycle; or (b) on the next driving cycle in which similar conditions (see section (c» to those that occurred when the pending fault code was stored are encountered.

(C) The pending fault code may be erased at the end of the next driving cycle in which similar conditions have been encountered without an exceedance of the specified fuel system malfunction criteria. The pending code may also be erased if similar conditions are not encountered during the 80 driving cycles immediately after the initial detection of a malfunction for which the pending code was set.

(D) Storage of freeze frame conditions. ."

(i) A manufacturer shall store and erase freeze frame conditions either in conjunction with storing and erasing a pending fault code or in conjunction with storing and erasing a confirmed fault code.

(ii) If freeze frame conditions are stored for a malfunction other than misfire (see section (f)(3» or fuel system malfunction when a fault code is stored as specified in section (f)(4.4.2) above, the stored freeze frame information shall be replaced with freeze frame information regarding the fuel system malfunction.

(E) Storage of fuel system conditions for determining similar conditions of operation.

(i) Upon detection of a fuel system malfunction under section (f)(4.4.2), the OBO II system shall store the engine speed, load, and warm-up status of the first fuel system malfunction that resulted in the storage of the pending fault code.

(ii) The manufacturer may request Executive Officer approval to use an alternate definition of similar conditions in lieu of the definition specified in section (c). The Executive Officer shall approve the alternate definition upon the manufacturer.providing data or analysis demonstrating that the alternate definition provides for equivalent robustness in detection of fuel system faults that vary in severity depending on engine speed, load, and/or warm-up status.

(F) Extinguishing the MIL. The MIL may be extinguished after three sequential driving cycles in which similar conditions have been encountered without a malfunction of the fuel system.

(5) EXHAUST GAS SENSOR MONITORING

(5.1) Requirement:

'(5.1.1) The OBO II system shall monitor all exhaust gas sensors (e.g., oxygen, air-fuel ratio, NOx) used for emission control system feedback (e.g., EGR control/feedback, SCR control/feedback, NOx adsorber control/feedback) or as a monitoring device for proper output signal, activity, response rate, and any other parameter that can affect emissions.

(5.1.2) For vehicles equipped with heated exhaust gas sensors, the OBO II system shall monitor the heater for proper performance.

(5.2) Malfunction Criteria:

(5.2.1) Air-Fuel Ratio Sensors:

(A) For sensors located upstream of the exhaust aftertreatment:

(i) Sensor performance faults: The OBO II system shall detect a malfunction prior to any failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed:

a. For passenger cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard:

1. 2.5 times the applicable FTP standards for 2004 through 2009 model year vehicles;
2. 2.0 times the applicable FTP standards for 2010 through 2012 model year vehicles; and
3. 1.5 times the applicable FTP NMHC, CO, or NOx standards or 2.0 times the applicable FTP PM standard for 2013 and subsequent model year vehicles.

b. For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

1. 1.5 times the applicable NMHC, CO, and NOx standards or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2007 and subsequent model year vehicles certified to an

engine dynamometer tailpipe NOx emission standard of greater than 0.50 g/bhp-hr NOx;

2. 2.5 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.3 g/bhp-hr (e.g., cause NOx emissions to exceed 0.5 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2007 through 2012 model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of less than or equal to 0.50 g/bhp-hr NOx; and
3. 2.0 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2013 and subsequent model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of less than or equal to 0.50 g/bhp-hr NOx.

(ii) Circuit faults: The OBO II system shall detect malfunctions of the sensor caused by either a lack of circu'it continuity or out-of-range values.

(iii) Feedback faults: The OBO II system shall detect a malfunction of the sensor when a sensor failure or deterioration causes an emission control system (e.g., EGR, SCR, or NOx adsorber) to stop using that sensor as a feedback or feed-forward input (e.g., causes default or open-loop operation).

(iv) Monitoring capability: To the extent feasible, the OBO II system shall detect a malfunction of the sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OBO II system monitoring device (e.g., for catalyst, EGR, SCR, or NOx adsorber monitoring).

(B) For sensors located downstream of the exhaust aftertreatment:

(i) Sensor performance faults: The OBO II system shall detect a malfunction prior to any failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed:

a. For passenger cars, light-duty. trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard:

1. 3.5 times the applicable FTP NMHC, CO, or NOx standards or 5.0 times the applicable FTP PM standard for 2004 through 2009 model year vehicles;
2. 2.5 times the applicable FTP NMHC, CO, or NOx standards or 4.0 times the applicable FTP PM standard for 2010 through 2012 model year vehicles;
3. 1.5 times the applicable FTP NMHC or CO standards, 1.75 times the applicable FTP NOx standard, or 2.0 times the applicable

FTP PM standard for 2013 and subsequent model year vehicles.

b. For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

1. 2.5 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.5 g/bhp-hr (e.g., cause NOx emissions to exceed 0.7 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.05 g/bhp-hr PM as measured from an applicable cycle emission test for 2007 through 2009 model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of greater than 0.50 g/bhp-hr NOx;
2. 2.5 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.3 g/bhp-ht (e.g., cause NOx emissions to exceed 0.5 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.05 g/bhp-hr PM as measured from an applicable cycle emission test for 2007 through 2012 model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of less than or equal to 0.50 g/bhp-hr NOx; and
3. 2.0 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2013 and subsequent model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of less than or equal to 0.50 g/bhp-hr NOx.

(ii) Circuit faults: The OBO II system shall detect malfunctions of the sensor caused by either a lack of circuit continuity or out-of-range values.

(iii) Feedback faults: The OBO II system shall detect a malfunction of the sensor when a sensor failure or deterioration causes an emission control system (e.g., EGR, SCR, or NOx adsorber) to stop using that sensor as a feedback or feed-forward input (e.g., causes default or open-loop operation).

(iv) Monitoring capability: To the extent feasible, the OBO II system shall detect a malfunction of the sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OBO II system monitoring device (e.g., for catalyst, EGR, SCR, or NOx adsorber monitoring).

(5.2.2) NOx and PM sensors:

(A) Sensor performance faults: The bBD II system shall detect a malfunction prior to any failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude; offset, or other characteristic(s) that would cause a vehicle's emissions to exceed:

(i) For passenger. cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard:

1. 3.5 times the applicable FTP NMHC, CO, or NOx standards or 5.0 times the applicable FTP PM standard for 2004 through 2009 model year vehicles;
2. 2.5 times the applicable FTP NMHC, CO, or NOx standards, or 4.0 times the applicable FTP PM standard for 2010 through 2012 model year vehicles;
3. 1.5 times the applicable FTP NMHC or CO standards, 1.75 times the applicable FTP NOx standard, or 2.0 times the applicable FTP PM standard for 2013 and subsequent model year vehicles.

(ii) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

a. 2.5 times the applicable NMHC standards, the applicable NOx standard by more than 0.5 g/bhp-hr (e.g., cause NOx emissions to exceed 0.7 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 0.05 g/bhp-hr PM as measured from an applicable cycle emission test for 2007 through 2009 model year vehicles;

b. 2.5 times the applicable NMHC standards, the applicable NOx standard by more than 0.~~3~~4 g/bhp-hr (e.g., cause NOx emissions to exceed 0.~~5~~6 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 0.05 g/bhp-hr PM as measured from an applicable cycle emission test for 2010 through 2012 model year vehicles; and

c. 2.0 times the applicable NMHC standards, the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2013 and subsequent model year vehicles.

(B) Circuit faults: The OBO " system shall detect malfunctions of the sensor caused by either a lack of circuit continuity or out-of-range values.

(C) Feedback faults: The OBO " system shall detect a malfunction of the sensor when a sensor failure or deterioration causes an emission control system (e.g., EGR, SCR, or NOx adsorber) to stop using that sensor as a feedback or feed-forward input (e.g., causes default or open-loop operation).

(D) Monitoring capability: To the extent feasible, the.OBO " system shall detect a malfunction of the sensor when the sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OBO " system monitoring device (e.g., for catalyst, EGR, PM filter, SCR, or NOx adsorber monitoring).

(5.2.3) Other exhaust gas sensors:

(A) For other exhaust gas sensors, the manufacturer shall submit a monitoring plan to the Executive Officer for approval. The Executive

Officer shall approve the request upon determining that the manufacturer 'has submitted data and an engineering evaluation that demonstrate that the monitoring plan is as reliable and effective as the monitoring plan required for air-fuel ratio sensors, ~~and~~ NOx sensors, and PM sensors under sections (f)(5.2.1) and (f)(5.2.2).

(5.2.4) Sensor Heaters:

(A) The OBO II system shall detect a malfunction of the heater performance when the current or voltage drop in the heater circuit is no longer within the manufacturer's specified limits for normal operation (Le., within the criteria required to be met by the component vendor for heater circuit performance at high mileage). Subject to Executive Officer approval, other malfunction criteria for heater performance malfunctions may be used upon the Executive Officer determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate the monitoring reliability and timeliness to be equivalent to -the stated criteria in section (f)(5.2.4)(A).

(B) The OBO II system shall detect malfunctions of the heater circuit including open or short circuits that conflict with the commanded state of the heater (e.g., shorted to 12 Volts when commanded to 0 Volts (ground».

(5.3) Monitoring Conditions:

(5.3.1) Exhaust Gas Sensors

(A) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (f)(5.2.1)(A)(i), (5.2.1)(B)(i), and (5.2.2)(A) (e.g., sensor performance faults) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For all 2010 and subsequent model year vehicles, for purposes of tracking and·reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in sections (f)(5.2.1)(A)(i), (5.2.1)(B)(i), and (5.2.2)(A) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(B) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (f)(5.2.1)(A)(iv), (5.2.1)(B)(iv), and (5.2.2)(0) (e.g., monitoring capability) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements) with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2).

(C) Except as provided in section (f)(5.3.1)(0), monitoring for malfunctions identified in sections (f)(5.2.1)(A)(ii), (5.2.1)(A)(iii), (5.2.1)(B)(ii), (5.2.1)(B)(iii), (5.2.2)(B), and (5.2.2)(C) (Le., circuit continuity, out-of-range, and open-loop malfunctions) shall be conducted continuously.

(D) A manufacturer may request Executive Officer approval to disable continuous exhaust gas sensor monitoring when an exhaust gas sensor malfunction cannot be distinguished from other effects (e.g., disable out-of-range low monitoring during fuel cut conditions). The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(5.3.2) Sensor Heaters

(A) Manufacturers shall define monitoring conditions for malfunctions identified in section (f)(5.2.4)(A) (Le., sensor heater performance) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(B) Monitoring for malfunctions identified in section (f)(5.2.4)(B) (Le., circuit malfunctions) shall be conducted continuously.

(5.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault coc;le storage are set forth in section (d)(2).

(6) EXHAUST GAS RECIRCULATION (EGR) SYSTEM MONITORING

(6.1) Requirement:

(6.1.1) The aBO II system shall monitor the EGR system on vehicles so-equipped for low flow rate, high flow rate, and slow response malfunctions. For vehicles equipped with EGR coolers (e.g., heat exchangers), the aBO II system shall monitor the cooler system for insufficient cooling malfunctions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the EGR system shall be monitored in accordance with the comprehensive component requirements in section (f)(15).

(6.1.2) For vehicles with other charge control strategies that affect EGR flow (e.g., systems that modify EGR flow to achieve a desired fresh air flow rate instead of a desired EGRfiow rate), the manufacturer shall submit a monitoring plan to the Executive Officer for approval. The Executive Officer shall approve the request upon determining that .the manufacturer has submitted data and an engineering evaluation that demonstrate that the monitoring plan is as reliable and effective as the monitoring plan required for EGR systems under section (f)(6).

(6.2) Malfunction Criteria:

(6.2.1) Low Flow:

(A) The aBO II system shall detect a malfunction of the EGR system at or prior to a decrease from the manufacturer's specified EGR flow rate that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed:

(i) For passenger. cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard:

a. 3.0 times the applicable FTP standards for 2004 through 2009 model year vehicles;

b. 2.5 times the applicable FTP standards for 2010 through 2012 model year vehicles; and

c. 1.5 times the applicable FTP NMHC, CO, or NOx standards or 2.0 times the applicable FTP PM standard for 2013 and subsequent model year vehicles.

(ii) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

a. 1.5 times the applicable FTP standards for 2004 through 2006 model year vehicles; .
b. 1.5 times the applicable NMHC, CO, and NOx standards or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2007 and subsequent model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of greater than 0.50 g/bhp-hr NOx;
c. 2.5 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.3 g/bhp-hr (e.g., cause NOx emissions to exceed 0.5 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2007 through 2012 model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of less than or equal to 0.50 g/bhp-hr NOx; and
d. 2.0 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2013 and subsequent model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of less than or equal to 0.50 g/bhp-hr NOx.

(B) For vehicles in which no failure or deterioratio'n of the EGR system that causes a decrease in flow could result in a vehicle's emissions exceeding the malfunction criteria specified in section (f)(6.2.1)(A), the OBO II system shall detect a malfunction when either the EGR system has reached its control limits such that it cannot increase EGR flow to achieve the commanded flow rate or, for non-feedback controlled EGR systems, the EGR system has no detectable amount of EGR flow when EGR flow is expected.

(6.2.2) High Flow:

(A) The OBO II system shall detect a malfunction of the EGR system, including a leaking EGR valve (Le., exhaust gas flowing through the valve when the valve is commanded closed), at or prior to an increase from the manufacturer's specified EGR flow rate that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed the applicable emission levels specified in sections (f)(6.2.1)(A):

(B) For vehicles in which no failure or deterioration of the EGR system that causes an increase in flow could result in a vehicle's emissions exceeding the malfunction criteria specified in section (f)(6.2.2)(A), the OBO II system shall detect a malfunction when either the EGR system has reached its control limits such that it cannot reduce EGR flow to achieve the commanded flow rate or,. for non-feedback controlled EGR systems, the EGR system has maximum detectable EGR flow when little or no EGR flow is expected.

(6.2.3) Slow Response. Additionally, for 2010 and subsequent model year vehicles, the EGR system shall be monitored for slow response:

(A) The OBO II system shall detect a malfunction of the EGR system at or prior to any failure or deterioration in the capability of the EGR system response (e.g.! capability to achieve the commanded specified flow rate within a manufacturer-specified time) that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed the applicable emission levels specified in sections (f)(6.2.1)(A).

(B) The OBO II system shall monitor ~~the~~ capability of the EGR system response under both increasing and decreasing EGR flow ratesto respond to both a commanded increase in flow and a commanded decrease in ~~flow~~. For vehicles in which no failure or deterioration of the EGR system response could result in an engine's emissions exceeding the levels specified in section (f)(6.2.1)(A), the OBD II system shall detect a malfunction of the EGR system when no detectable response to a change in commanded or expected flow rate occurs

(6.2.4) Feedback control:

(A) Except as provided for in section (f)(6.2.4)(B), if the vehicle is equipped with feedback or feed-forward control of the EGR system (e.g., feedback control of flow, valve position, pressure differential across the valve via intake throttleor exhaust backpressure), the OBO II system shall detect a malfunction:

(i) If the system fails to begin feedbacl(control within a manufacturer specified time interval;

(ii) If a failure or deterioration causes open loop or default operation; or

(iii) If feedback the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the feedback target

(B) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (f)(6.2.4)(A)(iii) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement Lipon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on a vehicle with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(C) In lieu of detecting the malfunctions specified in sections (f)(6.2.4)(A)(i) and (ii) with an EGR system-specific monitor, the OBD II system may monitor the individual parameters or components that are used as inputs for EGR system feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (f)(6.2.4)(A)(i) and (ii).

(6.2.5) EGR Cooler Performance:

(A) The OBD II system shall detect a malfunction of the EGR cooler system cooler at or prior to a reduction from the manufacturer's specified cooling performance that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed the applicable emission levels specified in sections (f)(6.2.1)(A):

(B) For vehicles in which no failure or deterioration of the EGR cooler system cooler could result in a vehicle's emissions exceeding the malfunction criteria specified in section (f)(6.2.5)(A), the OBD II system shall detect a malfunction when the system has no detectable amount of EGR cooling.

(C) For purposes of determining the EGR cooler performance malfunction criteria in section (f)(6.2.5)(A) for EGR cooler systems that consist of *mote* than one cooler (e.g., a pre-cooler and a main' cooler, two or more coolers in series), the manufacturer shall submit an EGR cooler system aging and monitoring plan to the Executive Officer for review and approval. The plan shall include the description and location of each component, the monitoring strategy for each component and combination of components, and the method for determining the malfunction criteria of section (e)(3.2.5)(A) including the deterioration/agingprocess. Executive Officer approval of the plan shall be based on the representativeness of the 'aging to real world EGR cooler system component deterioration under normal and malfunctioning engine operating conditions and the effectiveness of the method used to determine the malfunction criteria 'of section (e)(3.2.5)(A).

(6.2.6) EGR Catalyst Performance: For catalysts located in the EGR system on 2013 and subsequent model year vehicles and used to convert constituents to reduce emissions or protect or extend the durability of other emission-related components (e.g., to reduce fouling of an EGR cooler or valve), the OBD II system shall detect a malfunction when the catalyst has no detectable amount of constituent (e.g., hydrocarbons,' soluble organic fractions) oxidation. For 2004 through 2012 model year vehicles, the catalyst shall be' monitored in accordance with the other emission control or source system monitoring requirements under section (f)(16).

(6.3) Monitoring Conditions:

(6.3.1) For malfunctions identified in sections (f)(6.2.1) and (f)(6.2.2) (Le., EGR low and high flow) manufacturers shall, manufacturers shall ~~define~~ monitoring conditions: '

(A) For 2004 through 2009 model year vehicles, Define monitoring conditions in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements) for 2004 through 2009 model year vehicles. For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in sections (f)(6.2.1) and (f)(6.2.2) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2);

(B) Except as provided in section (e)(6.3.5), ensure that monitoring is ~~C~~conducted continuously for all 2010 and subsequent model year vehicles.

(6.3.2) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(6.2.3) (Le., slow response) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in section (f)(6.2.3) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(6.3.3) The OBO II system shall monitor continuously for malfunctions identified in section (f)(6.2.4) (Le., EGR feedback control). '

(6.3.4) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(6.2.5) and (f)(6.2.6) (Le., cooler performance and EGR catalyst performance) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in section (f)(6.2.5) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(6.3.5) Manufacturers may request Executive Officer approval to temporarily disable the EGR system checl<continuous monitoring under specific conditions teghnically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions (e.g., disable EGR low flow monitoring when no or very little flow is commanded, disable EGR high and low flow monitoring when freezing may affe,ct performance of the system). The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating EGR system cannot be distinguished from a malfunctioning EGR system and that the disablementinterval is limited onlv to that which is technically necessaryreliabJe check cannot be made when these conditions exist.

(6.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(7) BOOST PRESSURE CONTROL SYSTEM MONITORING

(7.1) Requirement:

(7.1.1) For 2010 and subsequent model year vehicles, the OBO 1\ system shall monitor the boost pressure control system (e.g., turbocharger) on vehicles so-equipped for under and over boost malfunctions and'slow response malfunctions. For vehicles equipped with variable geometry turbochargers (VGT), the aBO 1\ system shall monitor the VGT system for slow response malfunctions. For vehicles equipped with charge air cooler systems, the OBO 1\ system shall monitor the charge air cooler system for cooling system performance malfunctions. For 2004 and subsequent model year vehicles, the individual electronic components (e.g., actuators, valves, sensors) that are used in the boost pressure control system shall be monitored in accordance with the comprehensive component requirements in section (f)(15).

(7.1.2) For vehicles with other charge control strategies that affect boost pressure (e.g., systems that modify boost pressure to achieve a desired air-fuel ratio instead of a desired boost pressure), the manufacturer shall submit a monitoring plan to the Executive Officer for approval. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and an engineering evaluation that demonstrate that the monitoring plan is as reliable and effective as the monitoring plan required for boost pressure control systems under section (f)(7).

(7.2) Malfunction Criteria:

(7.2.1) Underboost:

(A) The OBD II system shall detect a malfunction of the boost pressure control system at or prior to a decrease from the manufacturer's commanded or expected boost pressure that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed:

(i) For passenger cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard:'

a. 2.0 times the applicable FTP standards for 2010 through 2012 model year vehicles; and

b. 1.5 times the applicable FTP NMHC, CO, or NOx standards or 2.0 times the applicable FTP PM standard for 2013 and subsequent model year vehicles.

(ii) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

a. 2.5 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.3 g/bhp-hr (e.g., cause NOx emissions to exceed 0.5 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from 'an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2010 through 2012 model year vehicles; and

b. 2.0 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the' emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2013 and subsequent model year vehicles.

(B) For vehicles in which no failure or.deterioration of the boost pressure control system that causes a decrease in boost could result in a vehicle's emissions exceeding the malfunction criteria specified in section (f)(7.2.1)(A), the OBO II system shall detect a .malfunction when either the boost system has reached its control limits such that it cannot increase boost to achieve the commanded boost pressure or, for non-feedback controlled boost systems, the boost system has no detectable amount of boost when boost is expected.

(7.2.2) Overboost:

(A) The OBO II system shall detect a malfunction of the boost pressure control system at or prior to an increase from the manufacturer's commanded or expected boost press.ure that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed the applicable emission levels specified in sections (f)(7.2.1)(A).

(B) For vehicles inwhich no failure or deterioration of the boost pressure control system that causes an increase in boost could result in a vehicle's emissions exceeding the malfunction criteria specified. in section (f)(7.2.2)(A), the OBO II system shall detect a malfunction when either the boost system has reached its control limits such that it cannot decrease boost to achieve the commanded boost pressure or, for non-feedback controlled boost systems, the boost system has maximum detectable boost when little or no boost is expected.

(7.2.3) VGT sSlow response:

(A) For 2010 through 2012 model year vehicles equipped with variable geometry turbochargers (VGT), Tthe OBO II system shall detect a malfunction at *or* prior to any failure or deterioration in the capability of the VGT system to achieve the commanded turbocharger geometry within a manufacturer-specified time that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed the **applicable** emission levels specified in **sections** (f)(7.2.1)(A). For vehicles in which no failure or deterioration of the VGT system response could result in a vehicle's emissions exceeding these levels, the OBO II system shall detect a malfunction of the VGT system when proper functional response of the system to computer commands does not occur.

(B) For 2013 and subsequent model year vehicles, the OBO II system shall detect a malfunction prior to any failure or deterioration in the boost pressure control system response (e.g., capability to achieve the commanded or expected boost pressure within a manufacturer-specified time) that would cause vehicle's NMHC, CO, NOx, or PM emissions to exceed the applicable emission levels specified in section (f)(7.2.1)(A). For vehicles in which no failure or deterioration of the boost system response could result in an engine's emissions exceeding these levels, the OBO II system shall detect a malfunction of the boost system when no detectable response to a commanded or expected change in boost pressure occurs. For vehicles in 'Nhich no failure or deterioration of the VGT system response could result in a vehicle'S emissions exceeding the malfunction criteria specified in section (f)(7.2.3)(A), the aBO II system shall detect a malfunction of the VGT system when proper functional response of the system to computer commands does not occur.

(7.2.4) Charge Air Undercooling:

(A) The OBO II system shall detect a malfunction of the charge air cooling system at or prior to a decrease from the manufacturer's specified cooling rate that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed the applicable emission levels specified in sections (f)(7.2.1)(A).

(B) For vehicles in which no failure or deterioration of the charge air cooling system that causes a decrease in cooling performance could result in a vehicle's emissions exceeding the malfunction criteria specified in section (f)(7.2.4)(A), the OBO II system shall detect a malfunction when the system has no detectable amount of charge air cooling.

(C) For purposes of determining the charge air cooling performance malfunction criteria in section (f)(7.2.4)(A) for charge air cooling systems that consist of more than one cooler (e.g., a pre-cooler and a main cooler, two or more coolers in series), the manufacturer shall submit a charge air cooling system aging and monitoring plan to the Executive Officer for review and approval. The plan shall include the description and location of each component, the monitoring strategy for each component and combination of components, and the method for determining the malfunction criteria of section (f)(7.2.4)(A) including the deterioration/aging process. Executive Officer approval of the plan shall be based on the representativeness of the aging to real world charge air cooling system component deterioration under normal and malfunctioning engine operating conditions and the effectiveness of the method used to determine the malfunction criteria of section (f)(7.2.4)(A).

(7.2.5) Feedback control:

(A) Except as provided for in section (f)(7.2.5)(B), if the vehicle is equipped with feedback or feed-forward control of the boost pressure system (e.g., control of VGT position, turbine speed, manifold pressure) the aBO II system shall detect a malfunction:

(i) If the system fails to begin feedback control within a manufacturer specified time interval;

(ii) If a failure or deterioration causes open loop or default operation; or

(iii) If feedback the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the ·feedbacl< target.

(B) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (f)(7.2.5)(A)(iii) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on a vehicle with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(C) In lieu of detecting the malfunctions specified in sections (f)(7.2.5)(A)(i) and (ii) with a boost pressure system-specific monitor, the aBO II system may monitor the individual parameters or components that are used as inputs for boost pressure system feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (f)(7.2.5)(A)(i) and (ii).

(7.3) Monitoring Conditions:

(7.3.1) Except as provided in section (e)(7.3.4), ~~T~~the aBO II system shall monitor continuously for malfunctions identified in sections (f)(7.2.1), (7.2.2), and (7.2.5) (Le., *over* and under boost, feedback control).

(7.3.2) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(7.2.3) (Le., ~~VGT~~ slow response) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2). For all 2010 and subsequent model year v.ehicles, for purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in section (f)(7.2.3) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(7.3.3) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(7.2.4) (Le., charge air cooler performance) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in section (f)(7.2,4) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(7.3.4) Manufacturers may request Executive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions (e.g., disable monitoring of underboost when commanded or expected boost pressure is very low). The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating system cannot be distinguished from a malfunctioning system and that the disablement interval is limited only to that technically necessary.

(7.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(8) NOx ADSORBER MONITORING

(8.1) Requirement: The OBO II system.shall monitor the NOx adsorber(s) on vehicles so-equipped for proper performance. For vehicles equipped with active/intrusive injection (e.g., in-exhaust fuel and/or air injection) to achieve desorption of the NOx adsorber(s), the OBO II system shall monitor the active/intrusive injection system for proper performance. The individual electronic components (e.g., injectors, valves, sensors) that are used in the active/intrusive injection system shall be monitored in accordance with the comprehensive component requirements in section (f)(15).

(8.2) Malfunction Criteria:

(8.2.1) NOx adsorber capability:

(A) The OBO II system shall detect a NOx adsorber system malfunction when the NOx adsorber system capability decreases to the point that would cause a vehicle's NOx or NMHC emissions to exceed:

(i) For passenger cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard:

a. 3.0 times the applicable FTP standards for 2004 through 2009 model year vehicles;

b. 2.5 times the applicable FTP standards for 2010 through 2012 model year vehicles; and

c. 1.75 times the applicable FTP standards for 2013 and subsequent model year vehicles.

(ii) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

a. the applicable NOx standard by more than 0.5 g/bhp-hr (e.g., cause NOx emissions to exceed 0.7 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 3.5 times the applicable NMHC standard for 2007 through 2009 model year vehicles;

b. the applicable NOx standard by more than 0.3 g/bhp-hr (e.g., cause NOx emissions to exceed 0.5 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 2.5 times the applicable NMHC standard for 2010 through 2012 model year vehicles; and

c. the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test or 2.0 times the applicable NMHC standard for 2013 and subsequent model year vehicles.

(B) If no failure or deterioration of the NOx adsorber system capability could result in a vehicle's NOx or NMHC emissions exceeding the applicable malfunction criteria specified in section (f)(8.2.1)(A), the OBO II system shall detect a malfunction When the system has no detectable amount of NOx adsorber capability.

(8.2.2) For systems that utilize active/intrusive injection (e.g., in-cylinder post fuel injection,in-exhaust air-assisted fuel injection) to achieve desorption of the NOx adsorber, the OBO II system shall detect a malfunction if any failure or deterioration of the injection system's ability to properly regulate injection causes the system to be unable to achieve desorption of the NOx adsorber.

(8.2.3) Feedback control:

(A) Except as provided for in section (f)(8.2.3)(B), if the vehicle is equipped with feedback or feed-forward control of the NOx adsorber or active/intrusive injection system (e.g., feedback control of injection quantity, time), the OBO II system shall detect a malfunction:

(i) If the system fails to begin feedback contro! within a manufacturer specified time interval;

(ii) If a failure or deterioration causes open loop or default operation; or

(iii) If feedback the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the feedback targ,et.

(B) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (f)(8.2.3)(A)(iii) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data *and/or* analysis demonstrating that the control system, when operating as designed on a vehicle with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(C) In lieu of detecting the malfunctions specified in sections (f)(8.2.3)(A)(i) and (ii) with a NOx adsorber-specific monitor, the OBO II system may monitor the individual parameters or components that are used as inputs for NOx adsorber or active/intrusive injection system feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (f)(8.2.3)(A)(i) and (ii).

(8.2.4) For purposes of determining the NOx adsorbersystem malfunction criteria in section (f)(8.2.1) for NOx adsorber systems that consist of more than one NOx adsorber (e.g., two or more adsorbers in series), the manufacturer shall submit a system aging and monitoring plan to the Executive Officer for review and approval. The plan shall include the description and location of each component, the monitoring strategy for each component and/or combination of components, and the method for determining the malfunction criteria of section (f)(8.2.1) including the deterioration/aging process. Executive Officer approval of the plan shall be based on the representativeness of the aging to real world NOx adsorber system component deterioration under normal and malfunctioning engine operating conditions, the effectiveness of the method used to determine the malfunction criteria of section (f)(8.2.1), the ability of the component monitor(s) to pinpoint the likely area of malfunction and ensure the correct components are re.paired/replaced in-use, and the ability of the component monitor(s) to accuratelyverify that each NOx adsorber system component is functioning as designed and as required in section (f)(8.2.1).

(8.3) Monitoring Conditions:

(8.3.1) Manufacturers sh.all define the monitoring conditions for malfunctions identified in section (f)(8.2.1) (Le., adsorber capability) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in sections (f)(8.2.1) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(8.3.2) Except as provided in section (e)(8.3.3), ~~T~~the OBO II system shall monitor continuously for malfunctions identified in sections (f)(8.2.2) and (8.2.3) (e.g., injection function, feedback control).

(8.3.3) Manufacturers may request Executive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indicatiohs of malfunctions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating system-cannot be distinguished from a malfunctioning system and that the disablement interval is limited only to that which is te.Chnically necessary.

(8.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(9) PARTICULATE MAITER (PM) FILTER MONITORING

(9.1) Requirement: The OBO II system shall monitor the PM filter on vehicles so-equipped for proper performance. For vehicles equipped with active regeneration systems that utilize an active/intrusive injection (e.g., in-exhaust fuel injection, in-exhaust fuel/air burner), the OBO II system shall monitor the active/intrusive injection system for proper performance. The individual electronic components (e.g., injectors, valves, sensors) that are used in the active/intrusive injection system shall be monitored in accordance with the comprehensive component requirements in section (f)(15).

(9.2) Malfunction Criteria:

(9.2.1) Filtering Performance:

(A) The OBD II system shall detect a malfunction prior to a decrease in the filtering capability of the PM filter that would cause a vehicle's PM emissions to exceed:

(i) For passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard:

a. 5.0 times the applicable FTP standard for 2004 through 2009 model year vehicles;

b. 4.0 times the applicable FTP standard for 2010 through 2012 model year vehicles; and

c. 1.75 times the applicable FTP standard for 2013 and subsequent model year vehicles.

(ii) For medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard:

a. 0.09 g/bhp-hr PM as measured from an applicable cycle emission test for 2004 through 2009 model year vehicles;

b. 0.0~~5~~7 g/bhp-hr PM as measured from an applicable cycle emission test for 2010 through 2012 model year vehicles; and

c. 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2013 and subsequent model year vehicles.

(B) If no failure or deterioration of the PM filtering performance could result in a vehicle's PM emissions exceeding the applicable malfunction criteria specified in section (f)(9.2.1)(A), the OBD II system shall detect a malfunction when no detectable amount of PM filtering occurs.

(9.2.2) Frequent Regeneration:

(A) For 2010 and subsequent model year vehicles, the OBD II system shall detect a malfunction when PM filter regeneration occurs more frequently than (i.e., occurs more often than) the manufacturer's specified regeneration frequency such that it would cause a vehicle's emissions to exceed:

(i) For passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard:

a. 3.0 times the applicable FTP NMHC, CO, or NOx standards for 2010 through 2012 model year vehicles; and

b. 1.5 times the applicable FTP NMHC, CO, or NOx standards for 2013 and subsequent model year vehicles.

(ii) For medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard:

a. 2.5 times the applicable NMHC standards or the applicable NOx standard by more than 0.3 g/bhp-hr (e.g., cause NOx emissions to exceed 0.5 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test for 2010 through 2012 model year vehicles; and

b. 2.0 times the applicable NMHC standards or the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured ,from an applicable cycle emission test for 2013 and subsequent model year vehicles.

(B) If no failure or deterioration causes an increase in the PM filter regeneration frequency that could result in a vehicle's NMHC, CO, or NOx emissions exceeding the applicable malfunction criteria specified in section (f)(9.2.2)(A), the OBO II system shall detect a malfunction when the PM filter regeneration frequency exceeds the manufacturer's specified design limits for allowable regeneration frequency.

(9.2.3) Incomplete regen.eration: For 2010 and subsequent model year vehicles, the aBO II system shall detect a regeneration malfunction when the PM filter does not properly regenerate under manufacturer-defined conditions where regeneration is designed to occur.

(9.2.4) NMHC conversion: For 2010 and subsequent model year vehicles passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard and 2013 and subsequent model year medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard with catalyzed PM filters that convert NMHC emissions, the OBO II system shall monitor the catalyst function of the PM filter and detect a malfunction when the NMHC conversion capability decreases to the point that NMHC emissions exceed the applicable emission levels specified in section (f)(9.2.2)(A). If no failure or deterioration of the NMHC conversion capability could result in a vehicle's NMHC emissions exceeding these emission levels, the OBO II system shall detect a malfunction when the system has no detectable amount of NMHC conversion capability.

(9.2.5) Missing substrate: The OBO II system shall detect a malfunction if either the PM filter substrate is completely destroyed" removed, or missing, or if the PM filter assembly is replaced with a muffler or straight pipe.

(9.2.6) Active/lntrusive Injection: For systems that utilize active/intrusive injection (e.g., in-cylinder post fuel injection, in-exhaust air-assisted fuel injection) to achieve regeneration of the PM filter, the OBO II system shall detect a malfunction if any failure or deterioration of the injection system's ability to properly regulate .injection causes the system to be unable to achieve regeneration of the PM filter.

(9.2.7) Feedback Control:

(A) Except as provided for in section (f)(9.2.7)(B), if the vehicle is equipped with feedback or feed-forward control of the PM filter regeneration (e.g., feedback control of oxidation catalyst inlet temperature, PM filter inlet or outlet temperature, in-cylinder or in-exhaust fuel injection), the OBO II system shall detect a malfunction:

(i) If the system fails to begin feedback control within a manufacturer specified time interval;

(ii) If a failure or deterioration causes open loop or default operation; or

(iii) If feedback the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the feedback target.

(B) A manufacturer may request Executive Officer approval to temporarily disable monitoring for the malfunction criteria specified in section (f)(9.2.7)(A)(iii) during conditions that a manufacturer cannot robustly distinguish between a malfunctioning system and a properly operating system. The Executive Officer shall approve the disablement upon the manufacturer submitting data and/or analysis demonstrating that the control system, when operating as designed on a vehicle with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

(C) In lieu of detecting the malfunctions specified in sections (f)(9.2.7)(A)(i) and (ii) with a PM filter-specific monitor, the OBD II system may monitor the individual parameters or components that are used as inputs for PM filter regeneration feedback control provided that the monitors detect all malfunctions that meet the criteria in sections (f)(9.2.7)(A)(i) and (ii).

(9.3) Monitoring Conditions:

(9.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (f)(9.2.1) through (9.2.~~7~~6) in accordance with sections (d)(3.1) and (d)(3.2) (Le', minimum ratio requirements), with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2). For all 2010 and subsequent model year vehicles, for purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in section (f)(9.2.1) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

(9.3.2) Except as provided in section (f)(9.3.3), the OBD II system shall monitor. continuously for malfunctions identified in section (f)(9.2.7) (Le., PM filter feedback control).

(9.3.3) Manufacturers may request Executive Officer approval to temporarily disable continuous monitoring under conditions technically necessary to ensure robust detection of malfunctions and to avoid false passes and false indications of malfunctions. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation which demonstrate that a properly operating system cannot be distinguished from a malfunctioning system and that the disablement interval is limited only to that which is technically necessary..

(9.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(10) CRANKCASE VENTILATION (CV) SYSTEM MONITORING

(10.1) Requirement: Manufacturers shall monitor the CV system on vehicles so-equipped for system integrity. Vehicles not subject to crankcase emission control requirements shall be exempt from monitoring of the CV system.

(10.2) Malfunction Criteria:

(10.2.1) For the purposes of section (f)(10), "CV system" is defined as any form of crankcase ventilation system, regardless of whether it utilizes positive pressure or whether it vents to the atmosphere, the intake, or the exhaust.

"CV valve" is defined as any form of valve, orifice, or filter/separator used to restrict, control, or alter the composition (e.g., remove oil vapor or particulate matter) of the crankcase vapor flow. Further, any additional external CV system tubing or hoses used to equalize crankcase pressure or to provide a ventilation path between various areas of the engine (e.g., crankcase and valve cover) are considered part of the CV system "between the crankcase and the CV valve" and subject to the malfunction criteria in section (f)(10.2.2) below.

(10.2.2) Except as provided below, the OBO II system shall detect a malfunction of the CV system when a disconnection of the system occurs between either the crankcase and the CV valve, or between the CV valve and the intake ducting.

(10.2.3) If disconnection in the system results in a rapid loss of oil or other overt indication of a CV system malfunction such that the vehicle operator is certain to respond and have the vehicle repaired, the Executive Officer shall exempt the manufacturer from detection of that disconnection.

(10.2.4) Detection of a disconnection is not required if the disconnection cannot be made without first disconnecting a monitored portion of the system (e.g., the CV system is designed such that the CV valve is fastened directly to the crankcase in a manner which makes it significantly more difficult to remove the valve from the crankcase before disconnecting the line between the valve and the intake ducting (taking aging effects into consideration) and the line between the valve and the intake ducting is monitored for disconnection).

(10.2.5) Subject to Executive Officer approval, system designs that utilize tubing between the valve and the crankcase shall also be exempted from the monitoring requirement for detection of disconnection between the crankcase and the CV valve. The manufacturer shall file a request and submit data and/or engineering evaluation in support of the request. The Executive Officer shall approve the request upon determining that the connections between the valve and the crankcase are: (i) resistant to deterioration or accidental disconnection, (ii) significantly more difficult to disconnect than the line between the valve and the intake ducting, and (iii) not subject to disconnection per manufacturer's maintenance, service, and/or repair procedures for non-CV system repair work.

(10.2.6) Manufacturers are not required to detect disconnections that are unlikely to occur due to a CV system design that is integral to the induction system (e.g., internal machined passages rather than tubing or hoses).

(10.2.7) For medium-duty vehicles with engines certified on an engine dynamometer having an open CV system (Le., a system that releases crankcase emissions to the atmosphere without routing them to the intake ducting or to the exhaust upstream of the aftertreatment), the manufacturer shall submit a plan for Executive Officer approval of the monitoring strategy, malfunction criteria, and monitoring conditions prior to OBO certification. Executive Officer approval shall be based on the effectiveness of the monitoring strategy to (i) monitor the performance of the CV system to the extent feasible with respect to the malfunction criteria in section (f)(10.2.1) through (f)(10.2.4) and the monitoring conditions required by the diagnostic, and (ii) monitor the ability of the CV system to control crankcase vapor emitted to the atmosphere relative to the manufacturer's design and performance specifications for a properly functioning system (e.g., if the system is equipped with a filter and/or separator to reduce crankcase emissions to the atmosphere, the OBO II system shall monitor the i"ntegrity of the filter and/or function of the separator).

(10.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(10.2) in accordance with sections· (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(10.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2). The stored fault code need not specifically-identify the CV system (e.g., a fault code for EGR or intake air mass flow rationality monitoring can be stored) if the manufacturer demonstrates that additional monitoring hardware would be necessary to make this identification and provided that the manufacturer's diagnostic and repair procedures for the detected malfunction include directions to check the integrity of the CV system.

(11) *ENGINE COOLING SYSTEM MONITORING*

(11.1) Requirement:

(11.1.1) The OBO II system shall monitor the thermostat on vehicles so-equipped for proper operation., "

(11.1.2) The OBO II system shall monitor the engine coolant temperature (ECT) sensor for circuit continuity, out-of-range values, and rationality faults.

(11.2) Malfunction Criteria:

(11.2.1) Thermostat

(A) The OBO II system shall detect a thermostat malfunction (e.g., leaking or early-to-open thermostat) if, within an Executive Officer approved time interval after starting the engine, either of the fOllowing two conditions occur:

(i) The coolant temperature does not reach the highest temperature required by the OBO II system to enable other diagnostics;

(ii) The coolant temperature does not reach a warmed-up temperature within 20 degrees Fahrenheit of the manufacturer's nominal thermostat regulating temperature. Subject to Executive Officer approval, a manufacturer may utilize lower temperatures for this criterion upon the Executive Officer determining that the manufacturer has demonstrated that the fuel, injection timing, and/or other coolant temperature-based modifications"to the engine control strategies would not cause an emission increase of 50 or more percent of any of the applicable standards.

.(B) For 2013 and subsequent model year vehicles, the aBO II system shall detect a thermostat fault if, after the coolant temperature has reached the temperatures indicated in sections (f)(11.2.1)(A)(i) and (ji), the coolant temperature drops below the" temperature indicated in section (f)(11.2.1)(A)(i).

~~(B)~~(C) Executive Officer approval of the time interval after engine start under section (f)(11.2.1)(A) above shall be granted upon determining that the data and/or engineering evaluation submitted by the manufacturer supports the specified times.

~~(C)~~(D) For monitoring of malfunctions under section (f)(11.2.1)(A), Wwith Executive Officer approval, a manufacturer may use alternate malfunction criteria and/or monitoring conditions (see section (f)(11.3» that are a function of temperature at engine start on vehicles that do not reach the temperatures specified in the malfunction criteria when the thermostat is functioning properly. Executive Officer approval shall be granted upon determining that the manufacturer has submitted data that demonstrate that a properly operating system does not reach the specified temperatures, that the monitor is capable of meeting the specified malfunction criteria at engine start temperatures greater than 50 degrees Fahrenheit, and that the overall effectiveness of the monitor is comparable to a monitor meeting these thermostat monitoring requirements at lower temperatures.

~~(D)~~(E) With Executive Officer approval, manufacturers may omit this monitor. Executive Officer approval shall be granted upon determining that the manufacturer has demonstrated that a malfunctioning thermostat cannot cause a measurable increase in emissions during any reasonable driving condition nor cause any disablement of other monitors.

(11.2.2) ECT Sensor .

(A) Circuit Continuity.. The OBO II system shall detect a malfunction when a lack of circuit continuity or out-of-range value occurs.

(B) Time to Reach Closed-Loop Enable Temperature.

(i) The OBO II system shall detect a malfunction if the ECT sensor does not achieve the stabilized minimum temperature which is needed to begin closed-loop or feedback operation of emission-related engine controls (e.g., feedback control of fuel pressure, EGR flow, boost pressure) within an Executive Officer approved time interval after starting the engine. The time interval shall be a function of starting ECT and/or a functiqn of intake or ambient temperature.

(ii) Executive Officer approval of the time interval shall be granted upon determining that the data and/or engineering evaluation submitted by the manufacturer supports the specified times.

(iii) The Executive Officer shall exempt manufacturers from the requirement of section (f)(11.2.2)(B) if the manufacturer does not utilize ECT to enable closed loop or feedback operation of emission-related engine controls.

(C) Stuck in Range Below the Highest Minimum Enable Temperature. To the extent feasible when using all available information, the OBO II system shall detect a malfunction if the ECT sensor inappropriately indicates a temperature below the highest minimum enable temperature required by the OBD II system to enable other diagnostics (e.g., an OBO II system that requires ECT to be greater than 140 degrees Fahrenheit to enable a diagnostic must detect malfunctions that cause the ECT sensor to inappropriately indicate a temperature below 140 degrees Fahrenheit).

Manufacturers are exempted from this requirement for temperature regions in which the monitors required under sections (f)(11.2.1) or (f)(11.2.2)(B) will detect ECT sensor malfunctions as defined in section (f)(11.2.2)(C).

(0) Stuck in Range Above the Lowest Maximum Enable Temperature.

(i) To the extent feasible when using all available information, the OBO II system shall detect a malfunction if the ECT sensor inappropriately indicates a temperature above the lowest maximum enable temperature required by the OBO II system to enable other diagnostics (e.g., an OBO II system that requires ECT to be less than 90 degrees Fahrenheit at engine start to enable a diagnostic must detect malfunctions that cause the ECT sensor to inappropriately indicate a temperature above 90 degrees Fahrenheit).

(ii) Manufacturers are exempted from this requirement for temperature regions in which the monitors required under sections (f)(11.2.1), (f)(11.2.2)(B), or (f)(11.2.2)(C) (Le., ECT sensor or thermostat malfunctions) will detect ECT sensor malfunctions as defined in section (f)(11.2.2)(0) or in which the MIL will be illuminated under the requirements of section (d)(2.2.3) for default mode operation (e.g.; overtemperature protection strategies).

(iii) For 2006 and subsequent model year applications, manufacturers are also exempted from the requirements of section (f)(11.2.2)(0) for temperature regions where the temperature gauge indicates a temperature in the red 'zone (engine overheating zone) or an overtemperature warning light is illuminated for vehicles that have a temperature gauge or warning light on the instrument panel and utilize the same ECT sensor for input to the OBO II system and the temperature gauge/warning light.

(11.3) Monitoring Conditions:

(11.3.1) Thermostat

(A) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(11.2.1)(A) in accordance with section (d)(3.1) except as provided for in section (f)(11.3.1)(.Q.E). Additionally, except as provided for in sections (f)(11.3.1)(B) and (C), monitoring for malfunctions identified in section (f)(11.2.1)(A) shall be conducted once per driving cycle on every driving cycle in which the ECT sensor indicates, at engine start, a temperature lower than the temperature established as the malfunction criteria in section (f)(11.2.1)(A).

(B) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(11.2.1)(8) in accordance with section (d)(3.1) with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle.

~~(B)~~(C) Manufacturers may disable thermostat monitoring at ambient temperatures below 20 degrees Fahrenheit.

~~(C)~~(D) Manufacturers may request Executive Officer approval to suspend or disable thermostat monitoring if the vehicle is subjected to conditions which could lead to false diagnosis (e.g., vehicle operation at idle for more than 50 percent of the warm-up time, hot restart conditions, etc.). In general, the Executive Officer shall not approve disablement of the monitor on engine starts where the ECT at engine start is 'more than 35 degrees Fahrenheit lower than the thermostat malfunction threshold temperature determined under section (f)(11.2.1)(A). The Executive Officer shall approve the request upon determining that the manufacturer has provided data and/or engineering analysis that demonstrate the need for the request. '

~~(D)~~(E) With respect to defining enable conditions that are encountered during the FTP or Unified cycle as required in (d)(3.1.1) for malfunctions identified in section (f)(11.2.1)(A), the FTP cycle shall refer to on-road driving following the FTP cycle in lieu of testing on a chassis or engine dynamometer.

(11.3.2) ECT Sensor

(A) Except as provided below in section (f)(11.3.2)(E), monitoring for malfunctions identified in section (f)(11.2.2)(A) (i.e., circuit continuity and out-of-range) shall be conducted continuously.

(B) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(11.2.2)(B) in accordance with section (d)(3.1). Additionally, except as provided for in section (f)(11.3.2)(0), monitoring for malfunctions identified in section (f)(11.2.2)(B) shall be conducted once per driving cycle on every driving cycle in which the ECT sensor indicates a temperature lower than the closed-loop enable temperature at engine start (i.e., all engine start temperatures greater than the ECT sensor out-of-range low temperature and less than the closed-loop enable temperature).

(C) Manufacturers shall define'the monitoring conditions for malfunctions identified in sections (f)(11.2.2)(C) and (0) in accordance with sections (d)(3.1) and (d)(3:2) (i.e., minimum ratio requirements).

(0) Manufacturers may suspend or delay the time to reach closed-loop enable temperature diagnostic if the vehicle is subjected to conditions which could lead to false diagnosis (e.g., vehicle operation at idle for more than 50 to 75 percent of the warm-up time).

(E) A manufacturer may request Executive Officer approval to disable continuous ECT sensor monitoring when an ECT sensor malfunction ' cannot be distinguished from other effects. The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or engineering evaluation that demonstrate a properly functioning sensor cannot be distinguished from a malfunctioning sensor and that the disablement interval is limited only to that necessary for avoiding false detection.

(11.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(12) COLD START EMISSION REDUCTION STRATEGY MONITORING

(12.1) Requirement:

(12.1.1) For all 2010 and subsequent model year vehicles, if a vehicle incorporates a specific engine control strategy to reduce cold start emissions, the OBO II system shall monitor the system to verify the strategy achieves the desired effect (e.g., to a'chieve accelerated catalyst light-off temperature) and monitor the commanded elements/components for proper function (e.g., injection timing, increased engine idle speed, increased engine load via intake or exhaust throttle activation) while the control strategy is active to ensure proper operation of the control strategy. .

(12.2) Malfunction Criteria: The OBO II system shall, to the extent feasible, detect a malfunction if either of the following occurs:

(12.2.1) Any single commanded element/component does not properly respond to the commanded action while the cold start strategy is active. For . purposes of this section, "properly respond" is defined as when the element responds:

(A) by a robustly detectable amount by the monitor; and

(B) in the direction of the desired command; and

(C) above and beyond what the element/component *wou'/d* achieve on start-up without the cold start strategy active (e.g., if the cold start strategy commands a higher idle engine speed, a fault must be detected if there is no detectable amount of engine speed increase above what the system would achieve without the cold start strategy active);

(12.2.2) Any failure or deterioration of the cold start emission reduction control strategy that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed:

(A) For passenger cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard: .

(i) 2.5 times the applicable FTP standards for 2010 through 2012 model year vehicles; and

(ii) 1.5 times the. applicable FTP NMHC, CO, or NOx standards or 2.0 times the applicable FTPPM standard for 2013 and subsequent model year vehicles.

(B) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

(i) 2.0 times the applicable NMHC or CO standards, the applicable NOx standard by niore than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2013 and subsequent model year vehicles.

(12.2.3) For section **(f)(12.2.2)**~~,~~:

(A) For 2010 through 2012 model year vehicles, the OBO " system shall either monitor the combined effect of the elements of the system as a whole or the individual elements (e.g., increased engine speed, increased engine load from restricting an **exhaust** throttle) for failures that cause emissions to exceed the applicable emission levels specified in section (f)(12.2.2).

(B) For 2013 and subsequent model year vehicles, to the extent feasible (without adding hardware for this purpose), the OBO II system shall monitor the ability of the system to achieve the desired effect (e.g., strategies used to accelerate catalyst light-off by increasing catalyst inlet temperature shall verify the catalyst inlet temperature actually achieves tne desired temperatures within an Executive Officer approved time interval after starting the engine) for failures that cause emissions to exceed the applicable emission levels specified in section (f)(12.2.2). For strategies where it is notfeasible to be monitored as a system, the aBD II system shall monitor the individual elements/components (e.g., increased engine speed, increased engine load from restricting an exhaust throttle) for failures that cause emissions to exceed the applicable emission levels specified in section (f)(12.2.2).

(12.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(12.2) in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(12.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(13) VARIABLE VALVE TIMING AND/OR CONTROL (WT) SYSTEM MONITORING

(13.1) Requirement: On all 2006 and subsequent model year applications, the aBO 1/ system shall monitor the VVT system on vehicles so-equipped for target error and slow response malfunctions. The individual electronic components (e.g., actuators, valves, sensors, etc.) that are used in the VVT system shall be monitored in accordance with the comprehensive components requirements in section (f)(15).

(13.2) Malfunction Criteria:

(13.2.1) Target Error: The aBO 1/ system shall detect a malfunction prior to any failure or deterioration in the capability of the VVT system to achieve the commanded valve timing and/or control within a crank angle or lift tolerance that would cause a vehicle's NMHC, CO, NOx, or PM emissions. to exceed:

(A) For passenger cars, light-duty trucks, and MOPVs certified to a chassis dynamometer tailpipe emission standard:

(i) 3.0 times the applicable FTP standards for 2006 through 2009 model year vehicles;'

(ii) 2.5 times the applicable FTP standards for 2010 through 2012 model year vehicles; and

(iii) 1.5 times the applicable FTP NMHC, CO, or NOx standards or 2.0 times the applicable FTP PM standard for 2013 and subsequent model year vehicles.

(B) For medium-duty vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard:

(i) 1.5 times the applicable NMHC, CO, and NOx standards or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2006 and subsequent model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of greater than 0.50 g/bhp-hr NOx;

(ii) 2.5 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.3 g/bhp-hr (e.g., cause NOx emissions to exceed 0.5 g/bhp-hr if the e'mission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2006 through 2012 model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of less than or equal to 0.50 g/bhp-hr NOx; and

(iii) 2.0 times the applicable NMHC or CO standards, the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., cause NOx emissions to exceed 0.4 g/bhp-hr if the emission standard is 0.2 g/bhp-hr) as measured from an applicable cycle emission test, or 0.03 g/bhp-hr PM as measured from an applicable cycle emission test for 2013 and subsequent model year vehicles certified to an engine dynamometer tailpipe NOx emission standard of less than or equal to 0.50 g/bhp-hr NOx.

(13.2.2) Slow Response: The OBO /I system shall detect a malfunction prior to any failure or deterioration in the capability of the WT system to achieve the commanded valve timing and/or control within a time that would cause a vehicle's emissions to exceed the applicable emission levels specified in sections (f)(13.2.1).

(13.2.3) For vehicles in which no failure or deterioration of the WT system could result in a vehicle's emissions exceeding the levels specified in sections (f)(13.2.1), the WT system shall be monitored for proper functional response in accordance with the malfunction criteria in section (f)(15.2).

(13.3) Monitoring Conditions: Manufacturers shall define the monitoring conditions for WT system malfunctions identified in section (f)(13.2) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements), with the exception that monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2). Additionally, manufacturers shall track and report WT system monitor performance under section (d)(3.2.2). For purposes of tracking and reporting as required in section (d)(3.2.2), all monitors used to detect malfunctions identified in section (f)(13.2) shall be tracked separately but reported as a single set of values as specified in section (d){5.2.2).

(13.4) MIL Illumination and Fault Code Storage: General requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(14) [RESERVED]

(15) COMPREHENSIVE COMPONENT MONITORING

(15.1) Requirement:

(15.1.1) Except as provided in sections (f)(15.1.3), (f)(15.1.4), and (f)(16), the OBD /I system shall monitor for malfunction any electronic powertrain component/system not otherwise described in sections (f)(1) through (f)(14) that either provides input to (directly or indirectly) or receives commands from the on-board computer(s), and: (1) can affect emissions during any reasonable in-use driving condition, or (2) is used as part of the diagnostic strategy for any other monitored system or component.

(A) Input Components: Input components required to be monitored may include the vehicle. speed sensor, crank angle' sensor, pedal position sensor, mass air flow sensor, cam position sensor, fuel pressure sensor, intake air temperature sensor, exhaust temperature sensor, and transmission electronic components such as sensors, modules, and solenoids which provide signals to the powertrain control system.

(B) Output Components/Systems: Output components/systems required to be monitored may include the idle governor, fuel injectors, automatic transmission solenoids or controls, turbocharger electronic components, the wait-to-start lamp, and cold start aids (e.g., glow plugs, intake air heaters).

(15.1.2) For purposes of criteria (1) in section (f)(15.1.1) above, the manufacturer shall determine whether a powertrain input or output component/system can affect emissions. If the Executive Officer reasonably believes that a manufacturer has incorrectly determined that a component/system cannot affect emissions, the Executive Officer shall require the manufacturer to provide emission data showing that the component/system, when malfunctioning and installed in a suitable test vehicle, -does not have an emission effect. The Executive Officer may request emission data for any reasonable driving condition.

(15.1.3) Manufacturers shall monitor for malfunction electronic powertrain input or output components/systems associated with an electronic transfer case, electronic power steering system, two speed axle, or other components that are driven by the engine and not related to the control of fueling, air handling, or emissions only if the component or system is used as part of the diagnostic strategy for any other monitored system or component.

(15.1.4) Except as specified for hybrids in section (f)(15.1.5), manufacturers shall monitor for malfunction electronic powertrain input or output components/systems associated with components that only affect emissions by causing additional electrical load to the engine and are not related to the control of fueling, air handling, or emissions only if the component or system is used as part of the diagnostic strategy for any other monitored system or component.

(15.1.5) For hybrids, manufacturers shall submit a plan to the Executive Officer for approval of the hybrid components determined by the manufacturer to be subject to monitoring in section (f)(15.1.1). In general, the Executive Officer shall approve the plan if it includes monitoring of all components/systems used as part of the diagnostic strategy for any other monitored system or component, monitoring of all energy input devices to the electrical propulsion system, monitoring of battery and charging system performance, monitoring of electric motor performance, and monitoring of regenerative braking performance.

(15.2) Malfunction Criteria:

(15.2.1) Input Components:

(A) The 080 /I system shall detect malfunctions of input components caused by a lack of circuit continuity, out-of-range values, and, where feasible, rationality faults. To the extent feasible, the rationality fault diagnostics shall verify that a sensor output is neither inappropriately high nor inappropriately low (e.g., "two-sided" diagnostics).

(B) To the extent feasible, rationality faults shall be separately detected and store different fault codes than the respective lack of circuit continuity and out of range diagnostics. Additionally, input component lack of circuit continuity and out of range faults shall be separately detected and store different fault codes for each distinct malfunction (e.g., out-of-range low, out-of-range high, open circuit, etc.). Manufacturers are not required to store separate fault codes for lack of circuit continuity faults that cannot be distinguished from other out-of-range circuit faults.

(C) For input components that are directly or indirectly used for any emission control strategies that are not covered under sections (f)(1) through (f)(13) (e.g., exhaust temperature sensors used for a control strategy that regulates SCR catalyst inlet temperature within a target window), the OBD II system shall detect rationality malfunctions that prevent the component from correctly sensing any condition necessary for the strategy to operate in its intended manner. These malfunctions include faults that inappropriately prevent or delay the activation of the emission control strategy, cause the system to erroneously exifthe emission control strategy, or where the control strategy has used up all of the adjustments or authority allowed by the manufacturer and is still unable to achieve the desired condition. The Executive Officer may waive 'detection of specific malfunctions upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that reliable detection of the malfunctiOn is technically infeasible or would require additional hardware.

(15.2.2) Output Components/Systems:

(A) The OBO \I system shall detect a malfunction of an output component/system when proper functional response of the component and system to computer commands does not occur. If a functional check is not feasible, the OBO \I system shall detect malfunctions of-output components/systems caused by a lack of circuit continuity or circuit fault (e.g., short to ground or high voltage). For output component lack of circuit continuity faults and circuit faults, manufacturers are not required to store different fault codes for each distinct malfunction (e.g., open circuit, shorted low, etc.). Manufacturers are not required to activate an output component/system when it would not normally be active for the purposes of performing functional monitoring, of output components/systems as required in section (f)(15).

(B) The idle fuel control system shall be monitored for proper functional response to computer commands. A malfunction shall be detected when either any of the following conditions occur:

(i) The idle ~~fuel~~ control system cannot achieve or maintain the target idle speed or fuel injection quantity within +/- 30 percent of the manufacturer-specified fuel quantity and target or desired engine speed tolerances.

(ii) The idle ~~fuel~~ control system cannot achieve the target idle speed ~~or~~ fuel injection quantity within the smallest engine speed or fueling quantity tolerance range required by the OBO \I system to enable any other monitor.

(iii) For 2013 and subsequent model year vehicles, the idle control system cannot achieve the fuel injection quantity within the smallest fueling quantity tolerance range required by the OBO II system to enable any other monitor.

(iv) For 2013 and subsequent model year vehicles, the idle control system cannot achieve the target idle speed with a fuel injection quantity within +/-50 percent of the fuel quantity necessary to achieve the target idle speed for a properly functioning vehicle and the *given* operating conditions.

(C) Glow plugs/intake air heaters shall be monitored for proper functional response to computer commands. The glow plug/intake air heater circuit(s) shall be monitored for proper current and voltage drop. The Executive Officer shall approve other monitoring strategies based on manufacturer's data and/or engineering analysis demonstrating equally reliable and timely detection of malfunctions. If a manufacturer demonstrates that a single glow plug failure cannot cause a measurable increase in emissions during any reasonable driving condition, the manufacturer shall detect a malfunction for the minimum number of glow plugs needed to cause an emission increase.. Further, to the extent feasible on existing engine designs (without adding additional hardware for this purpose) and on all new design engines, the stored fault code shall identify the specific malfunctioning glow plug(s). For 2010 and subsequent model year vehicles, manufacturers shall detect a malfunction . when a single glow pluglintake air heater no longer operates within the manufacturer's specified limits for normal operation (e.g., within specifications established by the manufacturer with the part supplier for acceptable part performance at high mileage).

(0) The wait-to-start lamp circuit shall be monitored for malfunctions that cause the lampto fail to illuminate when commanded on (e.g., burned out bulb).

(E) For output components/systems that are directly or indirectly used for any emission control strategies that are not *covered* under sections (f)(1) through (f)(13) (e.g., an intake throttle used for a control strategy that adjusts intake throttle position to regulate SCR catalyst inlet temperature within a target window), the OBO II system shall detect functional malfunctions that *prevent* the component/system from achieving the desired functional response necessary for the strategy to operate in its intended manner. These malfunctions include faults that inappropriately *prevent* or delay the activation of the emission control strategy, cause the system to erroneously exit the emission control strategy, or where the control strategy has used up all of the adjustments or authority allowed by the manufacturer' and is still unable to achieve the desired condition. The Executive Officer may waive detection of specific malfunctions upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that reliable detection of the malfunction is technically infeasible or would require additional hardware.

~~(E)~~(F) For 2013 and subsequent model year vehicles that utilize fuel control system components (e.g., injectors, fuel pump) that have tolerance compensation features implemented in hardware or software during production or repair procedures (e.g., individually coded injectors for flow characteristics that are programmed into an electronic control unit to compensate for injector to injector tolerances, fuel pumps that use in-line resistors to correct for differences in fuel pump volume output), the components shall be monitored to ensure the proper compensation is being used. The system shall detect a fault if the compensation being used by the control system does not match the compensation designated for the installed component (e.g., the flow characteristic coding designated on a specific injector does not match the compensation being used by the fuel control system for that injector). If a manufacturer demonstrates that a single component (e.g., injector) using the wrong compensation cannot cause a measurable increase in emissions during any reasonable driving condition, the manufacturer shall detect a malfunction for the minimum number of components using the wrong compensation needed to cause an emission increase. Further, the stored fault code shall identify the specific component that does not match the compensation. .

(15.3) Monitoring Conditions:

(15.3.1) Input Components:

(A) Except as provided in section (f)(15.3.1)(C), input components shall be monitored continuously for proper range of values and circuit continuity.

(8) For rationality monitoring (where applicable), manufacturers shall define the monitoring conditions for detecting malfunctions in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that rationality monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2).:

(C) A manufacturer may request Executive Officer approval to disable continuous input component proper range of values or circuit continuity monitoring when a malfunction cannot be distinguished from other effects. The Executive Officer shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning input component cannot be distinguished from a malfunctioning input component and that the disablement interval is limited only to that necessary for avoiding false detection.

(15.3.2) Output Components/Systems:

(A) Except as provided in section (f)(15.3.2)(D), monitoring for circuit contir.lUity and circuit faults shall be conducted continuously.

(8) Except as provided in section (f)(15.3.2)(C), for functional monitoring, manufacturers shall define the monitoring conditions for detecting malfunctions in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements).

(C) For the idle fuel control system, manufacturers shall define the monitoring conditions for functional monitoring in accordance with sections (d)(3.1) and (d)(3.2) (Le., minimum ratio requirements), with the exception that functional monitoring shall occur every time the monitoring conditions are met during the driving cycle in lieu of once per driving cycle as required in section (d)(3.1.2).

(D) A manufacturer may request Executive Officer approval to disable continuous output component circuit continuity or circuit fault monitoring when a malfunction cannot be distinguished from other effects. The Executive Officer'shall approve the disablement upon determining that the manufacturer has submitted test data and/or documentation that demonstrate a properly functioning output component cannot be distinguished from a malfunctioning output component and that the disablement interval is limited only to that necessary for avoiding false detection.

(15.4) MIL Illumination and Fault Code Storage:

(15.4.1) Except as provided in sections (f)(15.4.2) and (f)(15.4.4) below, general requirements for MIL illumination and fault code storage are set forth in section (d)(2).

(15.4.2) Exceptions to general requirements for MIL illumination. MIL illumination is not required in conjunction with storing a confirmed-fault code for any comprehensive component if:

(A) the component or system, when malfunctioning, could not cause vehicle emissions to increase by: .

(i) 25 percent or more for PC/LDT SULEV II vehicles, or

(ii) 15 percent or more for all other vehicles, and

(B) the component or system is not used as part of the diagnostic strategy for any other monitored system or component.

(15.4.3) For purposes of determining the emission increase in section (f)(15.4.2)(A), the manufacturer shall request Executive Officer approval of the test cycle/vehicle operating conditions for which the emission increase will be determined. Executive Officer approval shall be granted upon determining that the manufacturer has submitted data and/or engineering evaluation that demonstrate that the testing conditions represent in-use driving conditions where emissions are likely to be most affected by the malfunctioning component. For purposes of determining whether the specified percentages in section (f)(15.4.2)(A) are exceeded, if the approved testing conditions are comprised of an emission test cycle with an emission standard, the measured increase shall be compared to a . percentage of the emission standard (e.g., if the increase is equal to or more than 15 percent of the emission standard for that test cycle). If the approved testing conditions are comprised of a test cycle or vehicle operating condition that does not have an emission standard, the measured increase shall be calculated as a percentage of the baseline test (e.g., if the increase from a back-to-back test sequence between normal and malfunctioning condition is equal to or more than 15 percent of the baseline test results from the normal condition). .

(15.4.4) For malfunctions required to be detected by section (f)(15.2.2)(B)(iii) (idle control fuel injection quantity faults), the stored fault code is not required to specifically identify the idle control system (e.g., a fault code for cylinder fuel injection quantity imbalance or combustion quality monitoring'can be stored).

(16) *OTHER EMISSION CONTROL OR SOURCE SYSTEM MONITORING*

(16.1) Requirement: For other emission control or source systems that are not identified or addressed in sections (f)(1) through (f)(15) (e.g., homogeneous charge compression ignition (HCCI) controls, hydrocarbon traps, fuel-fired passenger compartment heaters), manufacturers shall submit a plan for Executive Officer approval of the monitoring strategy, malfunction criteria, and monitoring conditions prior to introduction on a production vehicle intended for sale in California. Executive Officer approval shall be based on the effectiveness of the monitoring strategy, the malfunction criteria utilized, and the monitoring conditions required by the diagnostic and, if applicable, the determination that the requirements of section (f)(16.3) and (f)(16.4) below are satisfied.

(16.2) For purposes of section (f)(16), emission source systems are components or devices that emit pollutants subject to vehicle evaporative and exhaust emission standards (e.g., NMOG, CO, NOx, PM) and include non-electronic components and non-powertrain components (e.g., fuel-fired passenger compartment heaters, on-board reformers).

(16.3) Except as provided below in this paragraph, for 2005 and subsequent model year vehicles that utilize emission control systems that alter intake air flow or cylinder charge characteristics by actuating valve(s), flap(s), etc. in the intake air delivery system (e.g., swirl control valve systems), the manufacturers, in addition to meeting the requirements of section (f)(16.1) above, may elect to have the OBD II system monitor the shaft to which all valves in one intake bank are physically attached in lieu of monitoring the intake air flow, cylinder charge, or individual valve(s)/flap(s) for proper functional response. For non-metal shafts or segmented shafts, the monitor shall verify all shaft segments for proper functional response (e.g., by verifying the segment or portion of the shaft furthest from the actuator properly functions). For systems that have more than one shaft to operate valves in multiple intake banks, manufacturers are not required to add more than one set of detection hardware (e.g., sensor, switch, etc.) per intake bank to meet this requirement. Vehicles utilizing these emission control systems designed and certified for 2004 or earlier model year vehicles and carried over to the 2005 through 2009 model year shall not be required to meet the provisions of section (f)(16.3) until the engine or intake air delivery system is redesigned.

(16.4) For emission control strategies that are not covered under sections (f)(1) through (f)(13) (e.g.. a control strategy that regulates SCR catalyst inlet temperatures within a target Window), Executive Officer approval shall be. based on the effectiveness of the plan in detecting malfunctions that prevent the strategy from operating in its intended manner. These malfunctions include faults that inappropriately prevent or delay the activation of the emission control strategy, faults that cause the system to erroneously exit the emission control strategy, and faults where the control strategy has used up all of the adjustments or authority allowed by the manufacturer and is still unable to achieve the desired condition. The Executive Officer may waive detection of specific malfunctions upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that reliable detection of the malfunction is technically infeasible or would require. additional hardware.

(17) EXCEPTIONS TO MONITORING REQUIREMENTS

(17.1) Except as provided in sections (f)(17.1.1) through (17.1.4) below, upon request of a manufacturer or upon the best engineering judgment of the ARB, the Executive Officer may revise the emission threshold for a malfunction on any diagnostic required in section (f) for medium-duty vehicles if the most reliable monitoring method developed requires a higher threshold to prevent significant errors of commission in detecting a malfunction. Additionally, for 2007 through 2009 model year light-duty vehicles and 2007 through 2012 model year medium-duty vehicles, the Executive Officer may revise the PM filter malfunction criteria of section (f)(9.2.1) to exclude detection of specific failure modes (e.g., combined failure of partially melted and partially cracked substrates) if the most reliable monitoring method developed. requires the exclusion of specific failure modes to prevent significant errors of commission in detecting a malfunction.

(17.1.1) For PC/LOT SULEV II vehicles, the Executive Officer shall approve a malfunction criterion of 2.5 times the applicable FTP standards in lieu of 1.5 or 1.75 wherever required in section (f).

(17.1.2) For vehicles certified to Federal Bin 3 or Bin 4 emission standards, manufacturers shall utilize the ULEV II vehicle NMOG and CO malfunction criteria (e.g., 1.5 times the Bin 3 or Bin 4 NMOG and CO standards) and the PC/LOT SULEV II vehicle NOx malfunction criteria (e.g., 2.5 times the Bin 3 or Bin 4 NOx standards).

(17.1.3) For medium-duty diesel vehicles (including MOPVs) certified to an engine dynamometer tailpipe emission standard, the Executive Officer shall approve a malfunction criteria of "the applicable PM standard plus-0.02 g/bhp-hrPM (e.g., unable to maintain PM emissions at or below 0.03 g/bhp-hr if the emission standard is 0.01 g/bhp-hr) as measured from an applicable cycle emission test" in lieu of "0.03 g/bhp-hr PM as measured from an applicable cycle emission test" wherever required in section (f). The Executive Officer shall also approve a malfunction criteria of "the applicable PM standard plus 0.04 g/bhp-hr PM (e.g., unable to maintain PM emissions at or below 0.05 g/bhp-hr if the emission standard is 0.01 g/bhp-hr) as measured from an applicable cycle emission test" in lieu of "0.05 g/bhp-hr PM as measured from an applicable cycle emission test" wherever required in section (f).

(17.1.4) For 2007 through 2009 medium-duty diesel vehicles (inclUding MOPVs) certified to an engine dynamometer FTP tailpipe PM emission standard of greater than or equal 0.08 g/bhp-hr, the Executive Officer shall approve a malfunction of criteria of 1.5 times the applicable PM standard in lieu of the applicable PM malfunction criteria required for any monitor in section (f).

(17.1.5) For medium-duty diesel vehicles (except MOPVs) certified to a chassis dynamometer tailpipe emission standard, the monitoring requirements and malfunction criteria in section (f) applicable to medium-duty diesel vehicles certified to an engine dynamometer tailpipe emission standard shall apply. However, the manufacturer shall request Executive Officer approval of manufacturer-proposed medium-duty chassis dynamometer-based malfunction criteria in lieu of the engine dynamometer-based malfunction criteria required for each monitor in section (f). The Executive Officer shall approve the request upon finding that:

(A) the manufacturer has used good engineering judgment in determining the malfunction criteria,

(B) the malfunction criteria will provide for similar 'timeliness in detection of malfunctioning components with respect to detection of malfunctions on medium-duty diesel vehicles certified to an engine dynamometer tailpipe emission standard,

(C) the malfunction criteria are set as stringently as technologically feasible with respect to indicating a malfunction at the lowest possible tailpipe emission levels (but not lower than 1.5 times the chassis dynamometer tailpipe emission standard the vehicle is certifi.ed to), considering the best available monitoring technology to the extent that it is known or should *have* been known to the manufacturer,

(0) the malfunction criteria will *prevent* detection of a malfunction when the monitored component is within the performance specifications for. components aged to the end of the full useful life, and

(E) the manufacturer has provided emission data showing the emission levels at which the malfunctions are detected.

(17.2) *Whenever* the requirements in section (f) of this regulation require a manufacturer to meet a specific phase-in schedule:

(17.2.1) The phase-in percentages shall be based on the manufacturer's projected sales *volume* for ail vehicles subject to the requirements of title 13, CCR section 1968.2 unless specifically stated otherwise in section (f).

(17.2.2) Manufacturers may use an alternate phase-in schedule in lieu of the required phase-in schedule if the alternate phase-in schedule provides for equivalent compliance *volume* as defined in section (c) except as specifically noted for the phase in of in-use monitor performance ratio monitoring conditions in section (d)(3.2).

(17.2.3) Small *volume* manufacturers may use an alternate phase-in schedule in accordance with section (f)(17.2.2) in lieu of the required phase-in schedule or may meet the requirement on all vehicles by the final year of the phase-in in lieu of meeting the specific phase-in requirements for each model year.

(17.3) Manufacturers may request Executive Officer approval to disable an OBOII system monitor at ambient temperatures below twenty degrees Fahrenheit (20°F) (low ambient temperature conditions may be determined based on intake air or engine coolant temperature) or at elevations *above* 8000 feet *above* sea *level.* The Executive Officer shall approve the request upon determining that the manufacturer has provided data and/or an engineering evaluation that demonstrate that monitoring during the conditions would be unreliable. A manufacturer may further request, and the Executive Officer shall approve, that an OBO II system monit()r be disabled at other ambient temperatures upon determining that the manufacturer has demonstrated with data and/or an engineering evaluation that misdiagnosis would occur at the ambient temperatures because of its effect on the component itself (e.g., component freezing).

(17.4) Manufacturers may request Executive Officer approval to disable monitoring systems that can be affected by low fuel level or running out of fuel (e.g., misfire detection) when the fuel level is 15 percent or less of the nominal capacity of the fuel tank. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that monitoring at the fuel levels would be unreliable.

(17.5) Manufacturers may disable monitoring systems that can be affected by vehicle battery or system voltage levels.

(17.5.1) For monitoring systems affected by low vehicle battery or system voltages, manufacturers may disable monitoring systems when the battery or system voltage is below 11.0 Volts. Manufacturers may request Executive Officer approval to utilize a voltage threshold higher than 11.0 Volts to disable system monitoring. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that monitoring at the voltages would be unreliable and that either operation of a vehicle below the disablement criteria for extended periods of time is unlikely or the OBO 1/ system monitors the battery or system voltage and will detect a malfunction at the voltage used to disable other monitors.

(17.5.2) For monitoring systems affected by high vehicle battery or system voltages, manufacturers may request Executive Officer approval to disable monitoring systems when the battery or system voltage exceeds a manufacturer-defined voltage. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or an engineering evaluation that demonstrate that monitoring above the manufacturer-defined voltage would be unreliable and that either the electrical charging system/alternator warning light is illuminated (or voltage gauge is in the "red zone") or that the OBO 1/ system monitors the battery or system voltage and will detect a malfunction at the voltage used to disable other monitors.

(17.6) A manufacturer may disable affected monitoring systems in vehicles designed to accommodate the installation of Power Take-Off (PTO) units (as defined in section (c», provided disablement occurs only while the PTO unit is active, and the OBO 1/ readiness status is cleared by the on-board computer (Le., all monitors set to indicate "not complete") while the PTO unit is activated (see section (g)(4.1) below). If the disablement occurs, the readiness status may be restored to its state prior to PTO activation when the disablement ends.

(17.7) Whenever the requirements in section (f) of this regulation require monitoring "to the extent feasible", the manufacturer shall submit its proposed monitor(s) for Executive Officer approval. The Executive Officer shall approve the proposal upon determining that the proposed monitor(s) meets the criteria of "to the extent feasible" by considering the best available monitoring technology to the extent that it is known or should have been known to the manufacturer and given the limitations of the manufacturer's existing hardware, the extent and degree to which the monitoring requirements are met in full, the limitations of the monitoring necessary to prevent significant errors of commission and omission, and the extent to which the manufacturer has considered and pursued alternative monitoring concepts to meet the requirements in full. The manufacturer's consideration and pursuit of alternative monitoring concepts shall include evaluation of other modifications to the proposed monitor(s), the monitored components themselves, and other monitors that use the monitored components (e.g., altering other monitors to lessen the sensitivity and reliance on the component or characteristic of the component subject to the proposed monitor(s)).

(g) *STANDARDIZATION REQUIREMENTS.*

(1) Reference Documents:

The following Society of Automotive Engineers (SAE) and International Organization for Standardization (ISO) documents are incorporated by reference into this regulation:

(1.1). SAE J1930 "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms - Equivalent to ISOITR 15031-2:April 30, ~~2002~~", April 2002October 2008 (SAE J1930).

(1.2) SAE J1962 "Diagnostic Connector - Equivalent to ISO/DIS 15031-3:December 14, 2001", April 2002 (SAE J1962).

(1.3) SAE J1978 "OBD II Scan Tool- Equivalent to ISO/DIS 15031-4:December 14,2001", April 2002 (SAE J1978).

(1.4) SAE J1979 "E/E Diagnostic Test Modes", May 2007 (SAE J1979).

(1.5) SAE J1850 "Class B Data Communications Network Interface", May 2001 (SAE 1850).

(1.6) SAE J2012 "Diagnostic Trouble Code Definitions - Equivalent to ISO/DIS 15031-6:April 30, 2002", April 2002December 2007 (SAE J2012).

(1.7) ISO 9141-2:1994 "Road Vehicles-Diagnostic Systems-CARB Requirements for Interchange of Digital Information", February 1994 (ISO 9141-2).

(1.8) ISO 14230-4:2000 "Road Vehicles-Diagnostic Systems-KWP 2000 Requirements for Emission-related Systems", June 2000 (ISO 14230-4).

(1.9) ISO 15765.-4:2005 "Road vehicles-Diagnostics on Controller Area Network (CAN) - Part 4: Requirements for emissions-related systems", January 2005 (ISO 15765-4).

(1.10) SAE J1939 consisting of:

(l.10.1) January 2005 J1939 "Recommended Practice for a Serial Control and Communications Vehicle Network" and the associated subparts included in SI\E ~~HS~~ 1939, "Truck and ~~Bus~~ Control and Communications ~~Network~~ Standards Manual", 2005 Edition ~~(SAE~~ J1939)March 2009~~.~~;

(l.10.2) J1939/1 "Recommended Practice for Control and Communications Network for On-Highway Equipment", September 01,2000;

(1.10.3) J1939/11 "Physical Layer, 250K bits/s, Twisted Shielded Pair", September 18, 2006;

(l.10A) J1939/13 "Off-Board Diagnostic Connector", March 11,2004;

(1.10.5) J1939/15 "Reduced Physical Layer, 250K bits/sec, UN-Shielded Twisted Pair (UTP)", August 21,2008;

(1.10.6) J1939/21 "Data Link Layer", December 22,2006;
(1.10.7) J1939/31 "Network Layer", April 02, 2004;
(1.10.8) J1939/71 "Vehicle Application Layer (Through February 2008)", January 20,2009;
(1.10.1)(1.10.9) ~~SAE~~ J1939-/73 "Application Layer- Diagnostics", September 08, 2006.;
(1.10.10) J1939/81 "Network Management", May 08, 2003; and
(1.10.11) J1939/84 "OBD Communications Compliance Test Cases For Heavy Duty Components and Vehicles", December 2008.
(1.11) SAE J1699-3 - "OBD II Compliance Test Cases", May 2006 (SAE J1699-3).
(1.12) SAE J2534-1 - "Recommended Practice for Pass-Thru Vehicle Programming", December 2004 (SAE J2534-1).

(2) Diagnostic Connector.
A standard data link connector conforming to SAE J1962 specifications (except as specified in section (g)(2.3» shall be incorporated in each vehicle.
(2.1) The connector shall be located in the driver's side foot-well region of the vehicle interior in the area bound by the driver's side of the vehicle and the driver's side edge of the center console (or the vehicle centerline if the vehicle does not have a center console) and at a location no higher than the bottom of the steering wheel. when in the lowest adjustable position. The connector may not be located on or in the center console (Le., neither on the horizontal faces near the floor-mounted gear selector, parking brake lever, or cup-holders nor on the vertical faces near the car stereo, climate system, or navigation system controls). The location of the connector shall be capable of being easily identified by a "crouched" technician entering the vehicle from the driver's side.
(2.2) If the connector is covered, the cover must be removable by hand without the use of any tools and be labeled to aid technicians in identifying the location of the connector. Access to the diagnostic connector may not require opening or the removal of any storage accessory (e.g., ashtray, coinbox, etc.). The label shall be submitted to the Executive Officer for review and approval, at or before the time the manufacturer submits its certification application. The Executive Officer shall approve the label upon determining that it clearly identifies that the connector is located behind the cover and is consistent with language and/or symbols commonly used in the automotive industry.
(2.3) Any pins in the connector that provide electrical power shall be properly fused to protect the integrity and usefulness of the connector for diagnostic purposes and may not exceed 20.0 Volts DC regardless of the nominal vehicle system or battery voltage (e.g., 12V, 24V, 42V, etc.).

(3) Communications to a *Scan Tool:*
Manufacturers shall use one of the following standardized protocols for communication of all required emission related messages from on-board to off-board network communications to a scan tool meeting SAE J1978 specifications:
(3.1) SAE J1850. All required emission related messages using this protocol shall use the Cyclic Redundancy Check and the three byte header, may not use

inter-byte separation or checksums, and may not require a minimum delay of 100 ms between SAE J1978 scan tool requests. This protocol may not be used on any 2008 or subsequent model year vehicle.

(3.2) ISO 9141-2. This protocol may not be used on any 2008 or subsequent model year vehicle.

(3.3) ISO 14230-4. This protocol may not be used on any 2008 or subsequent model year vehicle.

(3.4) ISO 15765-4. This protocol shall be allowed on any 2003 and subsequent model year vehicle and required on all 2008 and subsequent model year vehicles. All required emission-related messages using this protocol shall use a 500 kbps baud rate.

(4) Required Emission Related Functions:

The following standardized functions shall be implemented in accordance with the specifications in SAE J1979 to allow for access to the required information by a scan tool meeting SAE J1978 specifications:

(4.1) Readiness Status: In accordance with SAE J1979 specifications, the OBO II. system shall indicate "complete" or "not complete" since the fault memory was last cleared for each of the installed monitored components and systems identified in sections (e)(1) through (e)(8), (e)(15), (f)(1) through (f)(4), (f)(6), (f)(8), and (f)(15). All 2010 and subsequent model year diesel vehicles shall additionally indicate the appropriate readiness status for monitors identified in sections (f)(5), (f)(7); and (f)(9). All 2010 subsequent model year vehicles equipped with VVT system mon'itoring and subject to the test results requirements specified in section (g)(4.5.4)(C) shall additionally indicate the appropriate readiness status for VVT system monitors identified in sections (e)(13) and (f)(13). All components or systems that are monitored continuously shall always indicate "complete". Those components or systems that are not subject to continuous monitoring shall immediately indicate "complete" upon the respective diagnosti.c(s) being fully executed and determining that the component or system is not malfunctioning. A component or system shall also indicate "complete" if after the requisite number of decisions necessary for determining MIL status have been fUlly executed, the monitor indicates a malfunction for the component or system. The status for each of the monitored components or systems shall indicate "not complete" whenever fault memory has been cleared or erased by a means other than that allowed in section (d)(2). Normal vehicle shut down (Le., key off, engine off) may not cause the status. to indicate "not complete".

(4.1.1) Subject to Executive Officer approval, if monitoring is disabled for a multiple number of driving cycles due to the continued presence of extreme operating conditions (e.g., cold ambient temperatures, high altitudes, etc), readiness status for the subject monitoring system may be set to indicate "complete" without monitoring having been completed. Executive Officer approval shall be based on the conditions for monitoring system disablement and the number of driving cycles specified without completion of monitoring before readiness is indicated as "complete".

(4.1.2) For the evaporative system monitor:

(A) Except as provided below in section (g)(4.1.2)(B), the readiness status shall be set in accordance with section (g)(4.1) when both the functional check of the purge valve and the leak detection monitor of the orifice size specified in either section (e)(4.2.2)(B) or (C) (e.g., 0.040 inch or 0.020 inch) indicate that they are complete.

(B) For vehicles that utilize a 0.090 inch (in lieu of 0.040 inch) leak detection monitor in accordance with section (e)(4.2.5), the readiness status shall be set in accordance with section (g)(4.1) when both the functional check of the purge valve and the leak detection monitor of the orifice size specified in section (e)(4.2.2)(C) (e.g., 0.020 inch) indicate that they are complete.

(4.1.3) If the manufacturer elects to additionally indicate readiness status through the MIL in the key on, engine off position as provided for in section (d)(2.1.3), the readiness status shall be indicated in the following manner: If the readiness status for all monitored components or systems is "complete", the MIL shall remain continuously illuminated in the key on, engine off position for at least 15-20 seconds. If the readiness status for one or more of the monitored components or systems is "not complete", after 15-20 seconds of operation in the key on, engine off position with the MIL illuminated continuously, the MIL shall blink once per second for 5-10 seconds. The data stream value for MIL status (section (g)(4.2» shall indicate "commanded off' during this sequence unless the MIL has also been "commanded on" for a detected fault.

(4.2) Data Stream: The following signals shall be made available on demand through the standardized data link connector in accordance with SAE J1979 specifications. The actual signal value shall always be used instead of a default or limp home value.

(4.2.1) For all vehicles: calculated load value, number of stored confirmed fault codes, engine coolant temperature, engine speed, absolute throttle position (if equipped with a throttle), vehicle speed, aBO requirements to which the engine is certified (e.g., California aBO II, EPA aBO, European aBO, non-aBO) and MIL status (Le., commanded-on or commanded-off).

(4.2.2) For all vehicles so equipped: fuel control system status (e.g., open loop, closed loop, etc.), fuel trim, fuel pressure, ignition timing advance, intake air temperature, manifold absolute pressure, air flow rate from mass air flow sensor, secondary air status (upstream, downstream, or atmosphere), oxygen sensor output, air/fuel ratio sensor output.

(4.2.3) For all 2005 and subsequent modelyear vehicles using the ISO 15765-4 protocol for the standardized functions required in section (g), the following signals shall also be made available: absolute load, fuel level (if used to enable or disable any other diagnostics), relative throttle position (if equipped with a throttle), barometric pressure (directly measured or estimated), engine control module system voltage, commanded equivalence ratio, catalyst temperature (if directly measured or estimated for purposes of enabling the catalyst monitor(s», monitor status (Le., disabled for the rest of this driving cycle, complete this driving cycle, or not complete this driving cycle) since last engine shut-off for each monitor used for readiness status, time elapsed since engine start, distance traveled while MIL activated, distance traveled since fault memory last cleared, and number of warm-up cycles since fault memory last cleared.

(4.2.4) For all 2005 and subsequent model year vehicles so equipped and using the ISO 15765-4 protocol for the standardized functions required in section (g): ambient air te'mperature, evaporative system vapor pressure, commanded purge valve duty cycle/position, commanded EGR valve duty cycle/position, EGR error between actual and commanded, PTO status (active or not active), redundant absolute throttle position (for electronic throttle or other systems that utilize two or more sensors), absolute pedal position, redundant absolute pedal position, and commanded throttle motor position.

(4.2.5) Additionally, for all 2010 and subsequent model year vehicles with a diesel engine:

(A) Calculated load (engine torque as a percentage of maximum torque available at the current engine speed), driver's demand engine torque (as a percentage of maximum engine torque), actual engine torque (as a percentage of maximum engine torque), engine oil temperature, (if used for emission control or any OBO diagnostics), time elapsed since engine start; and ,

(B) Fuel level (if used to enable or disable any other diagnostics), barometric , pressure (directly measured or estimated), engine control module system voltage; and

(C) Monitor status (Le., disabled for the rest of this driving cycle, complete this driving cycle, or not complete this driving cycle) since last engine shut-off for each monitor used for readiness status, distance traveled (or engine run time for engines not utilizing vehicle speedinformatioh) while MIL activated, distance traveled (or engine run time for engines not utilizing vehicle speed information) since fault memory last cleared, and number of warm-up cycles since fault memory last cleared; and

(0) For all engines so equipped: absolute throttle position, relative throttle position, fuel injection timing, intake manifold temperature, intercooler temperature, ambient air temperature, commanded EGR valve duty cycle/position, actual EGR valve duty cycle/position, EGR error between actual and commanded" PTO status (active or not active), absolute pedal position, redundant absolute pedal position, commanded throttle motor position, fuel rate, boost pressure, commanded/target boost pressure, turbo inlet air temperature, fuel rail pressure, commanded fuel rail pressure, PM filter inlet pressure, PM filter inlet temperature, PM filter outlet pressure, PM filter outlet temperature, PM filter delta pressure, exhaust pressure sensor output, exhaust gas temperature sensor output, injection control pressure, commanded injection control pressure', turbocharger/turbine speed, variable geometry turbo position, commanded variable geometry turbo position, turbocharger ,compressor inlet temperature, turbocharger compressor inlet pressure, turbocharger turbine inlet temperature, turbocharger turbine outlet temperature, wastegate valve position, glow plug lamp status, PM sensor output, and NOx sensor output;

(E) Additionally, for all 2010 and subsequent model year medium-duty vehicles with a diesel engine certified on an engine dynamometer: NOx NTE control area status (Le., inside control area, outside control area, inside manufacturer-specific NOx NTE carve-out area, or NTE deficiency for NOx active area) and PM NTE control area status (Le., inside control area, outside control area, inside manufacturer-specific PM NTE carve-out area, or NTE deficiency for PM active areah

(F) For all 2013 and subsequent model year vehicles, normalized trigger for PM filter regeneration, PM filter regeneration status; and

(G) For all 2013 and subsequent model year vehicles, average distance (or engine run time for engines not utilizing vehicle speed information) between PM filter regenerations.

(4.2.6) Additionally, for all 2013 and subsequent model year vehicles so equipped:

(A) EGR temperature, variable geometry turbo control status (e.g., open loop, closed loop), reductant level (e.g.. urea tank fillleve!), alcohol fuel percentage, type of fuel currently being used, NOx adsorber regeneration status, NOx adsorber deSOx status, hybrid battery pack remaining charge; and

(B) PM sensor output and distance traveled while low/empty SCR reductant driver warning/inducement active.

(4.3) Freeze Frame.

(4.3.1) "Freeze frame" information required to be stored pursuant to sections (d)(2.2.7), (e)(3.4.3), (e)(6.4.4), (f)(3.4.2)(B), and (f)(4.4.2)(O) shall be made available on demand through the standardized data link connector in accordance with SAE J.1979 specifications.

(4.3.2) "Freeze frame" conditions must include the fault code which caused the data to be stored .and all of the signals required in section (g)(4.2.1) except number of stored confirmed fault codes, ·OBO requirements to which the engine is certified, MIL status, and absolute throttle position in accordance with (g)(4.3.3). Freeze frame conditions shall also inClude all of the signals required on the vehicle in sections (g)(4.2.2) through (g)(4.2.5)(O), (g)(4.2.5)(F), and (g)(4.2.6)(A) that are used for diagnostic or control purposes in the specific diagnostic or emission-critical powertrain control unit that stored the fault code except: oxygen sensor output, air/fuel ratio sensor output, catalyst temperature, evaporative system vapor pressure, glow plug lamp status, PM sensor output, NOx sensor output, monitor status since last engine shut off, distance traveled while MIL activated, distance traveled since fault memory last cleared, and number of warm-up cycles since fault memory last cleared.

(4.3.3) In lieu of including the absolute throttle position data specified in (g)(4.2.1) in the freeze frame data, diagnostic or emission-critical powertrain control units that do not use the absolute throttle position data may include the relative throttle position data specified in (g)(4.2.3) or pedal position data specified in (g)(4.2.4).

(4.3.4) Only one frame of data is required to be recorded. Manufacturers may choose to store additiona·1 frames provided that at least the required frame can be read by a scan·tool meeting SAE J1978 specifications.

(4.4) Fault Codes

(4.4.1) For all monitored components and systems, stored pending, confirmed, and permanent fault codes shall be made available through the diagnostic connector in accordance with SAE J1979 specifications. Standardized fault codes conforming to SAE J2012 shall be employed.

(4.4.2) The stored fault code shall, to the fullest extent possible, pinpoint the likely cause of the malfunction. To the extent feasible on all 2005 and subsequent model year vehicles, manufacturers shall use separate fault codes for every diagnostic where the diagnostic and repair procedure or 'likely cause of the failure is different. In general, rationality and functional diagnostics shall use different fault codes than the respective circuit continuity diagnostics. Additionally, input component circuit continuity diagnostics shall use different fault codes for distinct malfunctions (e.g., out-of-rangelow, out-of-range high, open circuit, etc.).

(4.4.3) Manufacturers shall use appropriate SAE-defined fault codes of SAE J2012 (e.g., POxxx, P2xxx) whenever possible. With Executive Officer approval, manufacturers may use manufacturer-defined faul.t codes in accordance with SAE J2012 specifications (e.g., P1xxx). Factors to be considered by the Executive Officer for approval shall include the lack of available SAE-definedfault codes, uniqueness of the diagnostic or monitored component, expected future usage of the diagnostic or component, and estimated usefulness in providing additional diagnostic and repair information to service technicians. Manufacturer-defined fault codes shall be used consistently (Le., the same fault code may not be used to represent two different failure modes) across a manufacturer's entire product line.

(4.4.4) A fault code (pending and/or confirmed, as required in sections (d) (e), and (f)) shall be stored and available to an SAE J1978 scan tool within 10 seconds after a diagnostic has determined that a malfunction has occurred. A permanent fault code shall be stored and available to an SAE J1978 scan tool no later than the end of an ignition cycle (including electronic control unit shutdown) in which the corresponding confirmed fault code causing the MIL to be illuminated has been stored.

(4.4.5) Pending fault codes:

(A) On all 2005 and subsequent model year vehicles, pending fault codes for all components and systems (including continuously and non-continuously monitored components) shall be made available through the diagnostic connector in accordance with SAE J1979 specifications (e.g., Mode/Service $07).

(8) On 13112005 and subsequent model year vehicles, a pending fault code(s) shall be stored and available through the diagnostic connector for all currently malfunctioning monitored component(s) or system(s), regardless of the MIL illumination status or confirmed fault code status (e.g., even after a pending fault has matured to a confirmed fault code and the MIL is illuminated, a pending fault code shall be stored and avaiJable if the most recent monitoring event indicates the component is malfunctioning).

(C) Manufacturers using alternate statistical protocols for MIL illumination as allowed in section (d)(2.2.6) shall submit to the Executive Officer a protocol for setting pending fault codes. The Executive Officer shall approve the proposed protocol upon determining that, overall, it is equivalent to the requirements in sections (g)(4.4.5)(A) and (B) and that it effectively provides service technicians with a quick and accurate indication of a pending failure.

(4.4.6) Permanent fault codes:

(A) Permanent fault codes for all components and systems shall be made available through, the diagnostic connector in a standardized format that distinguishes permanent fault codes from both pending fault codes and confirmed fault codes.

(B) A confirmed fault code shall be stored as a permanent fault code no later than the end of the ignition cycle and subsequently at all times that the confirmed fault code is commanding the MIL on (e.g., for currently failing systems but not during the 40 warm-up cycle self-healing process described in section (d)(2.4». -

(C) Permanent fault codes shall be stored in NVRAM and may not be erasable by any scan tool command (generic or enhanced) or by disconnecting power to the on-board computer.

(0) Permanent fault codes may not be erased when the control module containing the permanent fault codes is reprogrammed unless the readiness status (refer to section (g)(4.1» for all monitored components and systems is set to "not complete" in conjunction with the reprogramming event.

(E) The OBD sy.stem shall have the ability to store a minimum of four current confirmed fault codes as permanent fault codes in NVRAM. If the number of confirmed fault codes currently commanding the MIL on exceeds the maximum number of permanent fault codes that can be stored, the OBO system shall store the earliest detected confirmed fault codes as permanent fault codes. If additional confirmed fault codes are stored when the maximum number of permanent fault codes is already stored in NVRAM, the OBO system may not replace any' existing permanent fault code with the additional confirmed fault codes.

(4.5) Test Results

(4.5.1) For all monitored components and systems for gasoline engine vehicles identified in sections (e)(1) through (e)(8) except misfire detection, fuel system monitoring, and oxygen sensor circuit and out-of-range monitoring, and for all monitored components and systems for diesel engine vehicles identified in sections (f)(1) through (f)(9) except those required to be monitored continuously, results of the most recent monitoring of the components and systems and the test limits established for monitoring the respective components and systems shall be stored and available through the data link in accordance with SAE J1979 specifications.

(4.5.2) The test results shall be reported such that properly functioning components and systems (e.g., "passing" systems) do not store test values outside of the established test limits.

(4.5.3) The test results shall be stored until updated by a more recent valid test result or the fault memory of the OBO II system computer is cleared. Upon fault memory being cleared, test results reported for monitors that have not yet completed since the last time the fault memory was cleared shall report values that do not indicate a failure (Le., a test value which is outside of the test limits).

(4.5.4) Additionally, for vehicles using ISO 15765-4 (see section (g)(3.4» as the communication protocol:

(A) The test results and limits shall be made available in the standardized format specified in SAE J1979 for the ISO 15765-4 protocoL Test results using vehicle manufacturer-defined monitor identifications (Le., SAE J1979 OBOMIOs in the range of $E1-$FF) may not be used.

(B) Test limits shall include both minimum and maximum acceptable values and shall be reported for all test results required in section (g)(4.5.1). The test limits shall be defined so that a test result. equal to either test limit is a "passing" value, not a "failing" value.

(C) For 2005 and subsequent model year vehicles, misfire monitoring test results shall be calculated and reported in the standarClized format specified in SAE J1979. For 25 percent of 2009,50 percent of 2010, and 100 percent of 2011 and subsequent model year vehicles equipped with WT systems, WT monitoring test results and limits shall be stored and available in the standardized format specified in SAE J1979.

(0) Monitors that have not yet completed since the last time the fault memory was cleared shall report values of zero for the test result and test limits.

(E) All test results and test limits shall always be reported and the test results shall be stored until updated by a more recent valid test result or the fault memory of the aBO II system computer is cleared. For monitors with multiple pass/fail criteria (e.g., a purge flow diagnosticthat can pass upon seeing a rich shift, lean shift, or engine speed change), on 25 percent of 2009, 50 percent of 2010, and 100 percent of 2011 and subsequent model year vehicJes.,=only the test results used in the most recent decision shall be reported with valid results and limits while test results not used in the most recent decision shall report values of zero for the test results and limits (e.g., a purge flow monitoring event that passed based on seeing a rich shift shall report the results and the limits of the rich shift test and shall report values of zero for the results and limits of the lean shift and engine speed change tests).

(F) The aBO II system shall store and report unique test results for each separate diagnostic (e.g., an aBO II system with individual evaporative system diagnostics for 0.040 inch and 0.020 inch leaks shall separately report 0.040 inch and 0.020 inch test results).

(4.6) Software Calibration Identification

(4.6.1) On all vehicles, a software calibration identification number (CAL 10) for the diagnostic or emission critical powertrain control unit(s) shall be made available through the standardized data link connector in accordance with the SAE J1979 specifications. Except as provided for in section (g)(4.6.3), for 2009 and subsequent model year vehicles, the aBO II system shall use a single software calibration identification number (CAL 10) for each diagnostic or emission critical powertrain control unit(s) that replies to a generic scan tool with a unique module address.

(4.6.2) A unique CAL 10 shall be used for every emission-related calibration and/or software set having at least one bit of different data from any other emission-related calibration and/or software set. Control units coded with multiple emission or diagnostic calibrations and/or software sets shall indicate a unique CAL 10 for each variant in a manner that enables an off-board device to determine which variant is being used by the vehicle. Control units that utilize a strategy that will result in MIL illumination if the incorrect variant is used (e.g., control units that contain variants for manual and automatic transmissions but will illuminate the MIL if the variant selected does not match the type of transmission on the vehicle) are not required to use unique CAL IDs.

(4.6.3) For 2009 and subsequent model year vehicles, manufacturers may request Executive Officer approval to respond with more than one CAL 10 per diagnostic or emission critical powertrain control unit. Executive Officer approval of the request shall be based on the method used by the manufacturer to ensure each control unit will respond to a SAE J1978 scan tool with the CAL IDs in order of highest to lowest priority with regards to areas of the software most critical to emission and OBO II system performance.

(4.7) Software Calibration Verification Number

(4.7.1) All 2005[2] and subsequent model year vehicles shall use an algorithm to calculate a calibration verification number (CVN) that verifies the on-board computer software integrity in diagnostic or emission critical electronically reprogrammable powertrain control units. The CVN shall be made available through the standardized data link connector in accordance with the SAE J1979 specifications. The CVN shall be capable of being used to determine if the emission-related software and/or calibration data are valid and applicable for that vehicle and CAL 10. For 50 percent of 2010 and 100 percent of 2011 and subsequent model year vehicles, one CVN shall be made available for each CAL 10 made available and each CVN shall be output to a generic scan tool in the same order as the CAL IDs are output to the scan tool to allow the scan tool to match each CVN to the corresponding CAL 10.

(4.7.2) Manufacturers shall request Executive Officer approval of the algorithm used to calculate the CVN. Executive Officer approval of the algorithm shall be based on the complexity of the algorithm and the difficulty in achieving the same CVN with modified calibration values.

(4.7.3) The CVN shall be calculated at least once per driving cycle and stored until the CVN is subsequently updated. Except for immediately after a reprogramming. event or a non-volatile memory clear or for the first 30 seconds of engine operation after a volatile memory clear or battery disconnect, the stored value shall be made available through the data link connector to a ge.neric scan tool in accordance with SAE J1979 specifications. The stored CVN value may not be erased when fault

2 The requirements of section (g)(4.7) shall supercede the requirements set forth in title 13, CCR section 1968.1 (1)(4.0).

memory is erased by a generic scan tool in accordance with SAE J1979 specifications or during normal vehicle shut down (Le., key off, engine off).

(4.7.4) For purposes of Inspection and Maintenance (11M) testing, manufacturers shall make the CVN and CAL 10 combination information available for all 2008 and subsequent model year vehicles in a standardized electronic format that allows for off-board verification that the CVN is valid and appropriate for a specific vehicle and CAL 10. The standardized electronic format is detailed in Attachment E: CAL 10 and CVN Data of ARB Mail-Out #MSC 06-23, December 21, 2006, incorporated by reference. Manufacturers shall submit the CVN and CAL 10 information to the Executive Officer not more than 25 days after the close of a calendar quarter.

(4.8) Vehicle Identification Number:

(4.8.1) All 2005 and subsequent model year vehicles shall have the vehicle identification number (VIN) available in a standardized format through the standardized data link connector in accordance with SAE J1979 specifications. Only one electronic control unit per vehicle shall report the VIN to an SAE J1978 scan tool.

(4.8.2) For 2012 and subsequent model year vehicles, if the VIN is reprogrammable, all emission-related diagnostic information (Le., all information required to be erased in accordance with SAE J1979 specifications when a Mode/Service $04 clearlreset emission-related diagnostic information command is received) shall be erased in conjunction with the reprogramming of the VIN.

(4.9) ECU Name: The name of each electronic control unit that responds to an SAE J1978 scan tool with a unique address or identifier shall be communicated in a standardized format in accordance with SAE J1979 (Le., ECUNAME in Service/Mode $09, InfoType $OA). Except as specified for vehicles with more than one engine control unit, communication of the ECU name in a standardized format is required on 50 percent of 2010,75 percent of 2011, and 100 percent of 2012 and subsequent model year vehicles. For vehicles with more than one engine control unit (e.g., a 12 cylinder engine with two engine control units, each of which controls six cylinders), communication of the ECU name is required on all 2010 and subsequent model year vehicles.

(5) In-use Performance Ratio Tracking Requirements:

(5.1) For each monitor required in section (e) to separately report an in-use performance ratio, manufaCturers shall implement software algorithms to report a numerator and denominator in the standardized format specified below and in accordance with the SAE J1979 specifications.

(5.2) Numerical Value Specifications:

(5.2.1) For the numerator, denominator, general denominator, and ignition cycle counter:

(A) Each number shall have a minimum value of zero and a maximum value of 65,535 with a resolution of one.

(B) Each number shall be reset to zero only when a non-volatile memory reset occurs (e.g., reprogramming event, etc.) or, if the numbers are stored in keep-alive memory (KAM), when KAM is lost due to an interruption in electrical power to the control module (e.g., battery disconnect, etc.). Numbers may not be reset to zero under any other circumstances including when a scan tool command to clear fault codes or reset KAM is received.

(C) If either the numerator or denominator for a specific component reaches the maximum value of 65,535 ±2, both numbers shall be divided by two before either is in"cremented again to avoid overflow problems.

(D) If the ignition cycle counter reaches the maximum value of 65,535 ±2, the ignition cycle counter shall rollover and increment to zero on the next ignition cycle to avoid overflow problems.

(E) If the general denominator reaches the maximum value of 65,535 ±2, the general denominator shall rollover and increment to zero on the next driving cycle that meets the general denominator definition to avoid overflow problems.

(F) If a vehicle is not equipped with a component (e.g., oxygen sensor bank 2, secondary air system), the corresponding numerator and denominator for that specific component shall always be reported as zero.

(5.2.2) For the ratio:

(A) The ratio shall have a minimum value of zero and a maximum value of 7.99527 with a resolution of 0.0"00122.

(8) A ratio for a specific component shall be considered to be zero whenever the corresponding numerator is equal to zero and the corresponding denominator is not zero.

(C) A ratio for a specific component shall be considered to be the maximum value of 7.99527 if the corresponding denominator is zero or if the actual value of the numerator divided by the denominator exceeds the maximum value of 7.99527.

(6) Engine Run Time Tracking" Requirements:

(6.1) For all 2010 and subsequent model year medium-duty vehicles equipped with diesel engines, manufacturers shall implement software algorithms to individually track and report in a standardized format the engine run time while being operated in the following conditions:

(6.1.1) Total engine run time;

(6.1.2) Total idle run time (with "idle" defined as accelerator pedal released by driver, vehicle speed less than or equal to one mile per hour, engine speed greater than or equal to 50 to 150 rpm below the normal warmed-up idle speed (as- determined in the drive position for vehicles equipped with an automatic transmission), and PTO not active), and either vehicle speed less than or equal to one mile per hour or engine speed less than or equal to 200 rpm above normal warmed-up idle;

(6.1.3) Total run time with PTO active.

(6.1.4) Total run time with EI-AECD #1 active;

(6.1.5) Total run time with EI-AECD #2 active; and so on up to

(6.1.6) Total run time withEI-AECD #n active.

(6.2) For all 2010 and subsequent model year light-duty vehicles equipped with diesel engines, manufacturers shall implement software algorithms to individually track and report in a standardized format the engine run time while being operated in the following conditions:

(6.2.1) T0tal engine run time;

(6.2.2) Total run time with EI-AECD #1 active;

(6.2.3) Total run time with EI-AECD #2 active; and so on up to

(6.2.4) Total run time with EI-AECD #n active.

(6.3) Numerical Value Specifications:

(6.3.1) For each counter specified in section (g)(6):

(A) Each number shall conform to the standardized format specified in SAE J1979.

(8) Each number shall be reset to zero only when a non-volatile memory reset occurs (e.g., reprogramming event). Numbers may not be reset to zero under any other circumstances including when a scan tool (generic or enhanced) command to clear fault codes or reset KAM is received.

(C) If any of the individual counters reach the maximum value, all Gounters shall be divided by two before any are incremented again to avoid overflow problems.

(6.4) Separation Specifications of EI-AECDs

(6.4.1) For purposes of section (g)(6.4). the following terms shall be defined as follows:

(A) "Purpose" is defined as the objective of the Et-AECD when it is activated (e.g.. EGR valve protection);

(8) "Action" is defined as a specific component/element act that is commanded when the EI-AE"CD is activated (e.g., EGR system is derated);

(C) "Parameter" is defined as acomponent/element(e.g.! ECT, oil temperature) used to determine when to activate the EI-AECD; and

(D) "Condition" is defined as the specific characteristic/state exhibited by the parameter (e.g., ECT above 100 degrees Celsius) that triggers activation of the EI-AECD.

(6.4.1)Each EI AECD shall be tracked individually and increment the counters at all times the conditions necessary to activate the EI AECD are present.

(6.4.2) Each unique combination of action, parameter. and condition within a purpose shall be tracked as a separate EI-AECD and increment the timer(s) at all times the condition necessary to activate the EI-AECD is present.

(6.4.2)(A) For EI-AECDs that implement an action of variable degree based on the varying characteristics of a parameter (e.g., derate EGR more aggressively as engine oil temperature continues to increase), the EI-AECD shall be tracked by incrementing two separate timers within a single EI-AECD (e.g., EI-AECD #1 timer 1 and EI-AECD #1 timer 2) as . followshave variable actions or degrees of action (e.g., derate EGR more aggressively ~~as~~ engine oil temperature continues to increase), the EI AECD shall be tracked as ~~two~~ separate EI AECDs and increment ~~two counters.~~:

~~(A)~~(i) The first of the two counters timers shall be incremented whenever the EI-AECD is commanding some amount of reduced emission control effectiveness up to but not including 75 percent of the maximum reduced emission control effectiveness that the EI-AECD is capable of commanding during in-use vehicle or engine operation. For example, an Qverheat protection strategy that progressively derates EGR and eventually shuts off EGR as oil temperature increases would accumulate time for the first counter timer from the time derating of EGR begins up to the time that EGR is derated 75 percent. As a second example, an overheat protection strategy that advances fuel injection timing progressively up to a maximum advance of 15 degrees crank angle as the engine coolant temperature increases would accumulate time for the first counter timer from the time advance is applied up to the time that advance reaches 11.25 degrees (75 percent of the maximum 15 degrees).

(B)(ii) The second of the two counters timers shall be incremented whenever the EI-AECD is commanding 75 pe"rcent or more of the maximum reduced emission control effectiveness that the EI-AECD is capable of commanding during in-use vehicle or engine operation. For example, the second counter timer for the first example EI-AECD identified in section (g)(6.4.2.)(A)(i) would accumulate time from the time that EGR is derated 75 percent up to and including when EGR is completely shut off. For the second example EI-AECD identified in section (g)(6.4.2)(A)ill, the second counter timer would accumulate " time from the time fuel injection timing advance is at 11.25 degrees up to and including the maximum advance of 15 degrees.

(6.4.3) A manufacturer may request Executive Officer approval to combine multiple unique actions, parameters, and/or conditions to be tracked within a single EI-AECD. The manufacturer shall submit a plan for combining, tracking, and incrementing the EI-AECD to the Executive Officer for approval. Executive Officer approval of the plan shall be based on the effectiveness and the equivalence of the incrementing plan to determine the amount of EI-AECD activity per condition relative to the measure of EI-AECD activity under section (g)(6.4.2).

(6.4.4) For EI-AECDs that are activated solely due to elevation, the timer shall be incremented only for the portion of EI-AECD activation when the elevation is below 8000 feet (e.g., the timer for an EI-AECD that is activated when the elevation is above 5000 feet shall be incremented only when the EI-AECD is active and the elevation is below 8000 feet).

(6.4.5) For EI-AECDs that are initially activated due to engine warm-up and are SUbsequently reactivated after the engine has warmed up, the timer shall be incremented only when the EI-AECD is active after the initial engine warm-up (e.g., an EI-AECD that turns off an emission control at low engine coolant temperature would not increment the timer during initial warm-up but would increment the timer if coolant temperature subsequently dropped below the low temperature and reactivated the EI-AECD later in the drive cycle).

(6.4.3)(6.4.6) If more than one EI-AECD is currently active, the counters timers for both EI-AECDs shall accumulate time, regardless if there is overlap or redundancy in the commanded action (e.g., two different EI-AECDs independently but simUltaneously commanding EGR off shall both accumulate time in their respective Gounterstimers).

(7) Exceptions to Standardization Requirements.

(7.1) For medium-duty vehicles equipped with a diesel engine certified on an engine dynamometer, a manufacturer may request Executive Officer approval to use both: (1) an alternate diagnostic connector, and emission-related message structure and format in lieu of the standardization requirements in sections (g)(2) and (4) that refer to SAE J1962, SAE J1978, and SAEJ1979, and (2) an alternate communication protocol in lieu of the identified protocols in section (g)(3). The Executive Officer shall approve the request if the alternate d'iagnostic connector, communication protocol, and emission-related message format and structure requested by the manufacturer meet the standardization requirements in title 13, CCR section 1971.1 applicable for 2013 and subsequent model year heavy-duty diesel engines and the information required to be made available in section (g)(4.1) through (g)(6) (e.g., readiness status, data stream parameters, permanent fault codes, engine run time tracking data) is avai,lable in a standardized format through the alternate emission-related message format.

(7.2) For 2004 model year vehicles only, wherever the.requirements of sections (g)(2) and (g)(4) reflect a substantive change from the requirements of title 13, CCR sections 1968.1 (e), (f), (k), or (l) for the 2003 model year vehicles, the manufacturer may request Executive Officer approval to continue to use the requirements of section 1968.1 in lieu of the requirements of sections (g)(2) and (g)(4). The Executive Officer shall approve the request upon determining that the manufacturer has submitted ,data and/or engineering evaluation that demonstrate that software or hardware changes would be required to comply with the requirements of sections (g)(2) and (g)(4) and that the system complies with the requirements of sections 1968.1 (e), (f), (k), and (l).

(h) *MONITORING SYSTEM DEMONSTRATIONREQUIREMENTS FOR CERTIFICATION.*

(1) *General.'*

(1.1) Certification requires that manufacturers submit emission test data from one or 'more durability demonstration test vehicles (test vehicles). For , applications certified on engine dynamometers, engines may be used instead of vehicles.

(1.2) The Executive Officer may approve other demonstration protocols if the manufacturer can provide comparable assurance that the malfunction criteria are chosen based on meeting emission requirements and that the timeliness, of malfunction detection is within the constraints of the applicable monitoring requirements.

(1.3) For flexible fuel vehicles capabie of operating on more than one fuel or fuel combinations, the manufacturer shall submit a plan for providing emission . test data to the Executive Officer for approval. The Executive Officer shall approve the plan if it is determined to be representative of expected in-use fuel or fuel combinations and provides accurate and timely evaluation of the monitored systems. .

(2) Selection of Test Vehicles:

(2.1) Prior to submitting any applications for certification for a model year, a manufacturer shall notify the Executive Officer of the test groups planned for that model year. The Executive Officer will then select the test group(s) that the manufacturer shall use as demonstration test vehicles to provide emission test data. The selection of test vehicles for production vehicle evaluation, as specif!ed in section (j), may take place during this selection process.

(2.2) A manufacturer certifying one to five test groups in a model year shall provide emission test data from a test vehicle from one test group. A manufacturer certifying six to fifteen test groups in a model year shall provide emission test data from test vehicles from two test groups. A manufacturer certifying sixteen or more test groups in a model year shall provide emission test data from test vehicles from three test groups. The Executive Officer may waive the requirement for submittal of data from one or more of the test groups if data have been previously submitted for all of the test groups.

(2.3) For the test vehicle(s), a manufacturer shall use a certification emission durability test vehicle(s), a representative high mileage vehicle(s), or a vehicle(s) aged to the end of the full useful life using an ARB-approved alternative durability procedure (ADP).

(3) Required Testing for Gasoline/Spark-ignited vehicles:

Except as provided below, the manufacturer shall perform single-fault testing based on the applicable. **FTP** test with the following components/systems set at their malfunction criteria limits as delermined by the manufacturer for meeting the requirements of section *(e):*

(3.1) Exhaust Gas Sensors:

(3.1.1) The manufacturer shall perform a test with all primary oxygen sensors (conventional switching sensors and wide range or universal sensors) used for fuel control simultaneously possessing a response rate deteriorated to the malfunction criteria limit. Manufacturers shall also perform a test for any other oxygen sensor parameter that can cause vehicle emissions to exceed the malfunction threshold (e.g., 1.5 times the applicable standards due to a shift in air/fuel ratio at which oxygen sensor switches, decreased amplitude, etc.). When performing additional test(s), all primary and secondary (if applicable) oxygen sensors used for fuel control shall be operating at the malfunction criteria limit for the applicable parameter only. All other primary and secondary oxygen sensor parameters shall be with normal characteristics.

(3.1.2) For vehicles utilizing sensors other than oxygen sensors for primary fuel control (e.g., hydrocarbon sensors, etc.), the manufacturer shall submit, for Executive Officer approval, a demonstration test plan for performing testing of all of the sensor parameters that can cause vehicle emissions to exceed the malfunction threshold (e.g., 1.5 times the applicable standards). The Executive Officer shall approve the plan if it is determined that it will provide data that will assure proper performance of the diagnostics of the sensors, consistent with the intent of section (h).

(3.2) EGR System: The manufacturer shall perform a test at the low flow limit.

(3.3) VVT System: For 2006 through 2008 model year Low Emission II applications and all 2009 and subsequent model year vehicles, the manufacturer shall perform a test at each target error limit and slow response limit calibrated to the malfunction criteria (e.g., 1.5 times the FTP standard) in sections (e)(13.2.1) and (13.2.2). In conducting the VVT system demonstration tests, the manufacturer may use computer modifications to cause the VVT system to operate at the malfunction limit if the manufacturer can demonstrate that the computer modifications produce test results equivalent to an induced hardware malfunction.

(3.4) Fuel System:

(3.4;1) For vehicles with adaptive feedback based on the primary fuel control sensor(s), the manufacturer shall perform a test with the adaptive feedback based on the primary fuel control sensor(s) at the rich limit(s) 'and a test at the lean limit(s) established by ttie manufacturer in section (e)(6.2.1) to detect a malfunction before emissions exceed the malfunctiOn threshold (e.g., 1.5 times the applicable standards).

(3.4.2) For vehicles with feedback based on a secondary fuel control sensor(s) and subject to the malfunction criteria in section (e)(6.2.1), the manufacturer shall perform a test with the feedback based on the secondary fuel control sensor(s) at the rich limit(s) and a test at the lean limit(s) established by the manufacturer in section (e)(6.2.1) to detect a malfunction before emissions exceed the malfunction threshold (e.g., 1.5 times the applicable standards).

(3.4.3) For other fuel metering or control systems,the manufacturer shall perform a test at the criteria limit(s).

(3.4.4) For purposes of fuel system testing, the fault(s) induced may result in a uniform distribution offuel and air among the cylinders. Non-uniform distribution of fuel and air used to induce a fault may not cause misfire. In conducting the fuel system demonstration tests, the manufacturer may use computer modifications to cause the fuel system to operate at the malfunction limit if the manufacturer can demonstrate that the computer modifications produce test results equivalent to an induced hardware malfunction.

(3.5) Misfire: The manufacturer'shall perform a test at the malfunction criteria limit specified in section (e)(3.2.2). The testing is not required for diesel applications.

.(3.6) Secondary Air System: The manufacturer shall perform a test at the low flow limit. Manufacturers performing only a functional check in accordance with the provisions of section (e)(5.2.2)(8) or (e)(5.2.4) shall perform a test at the functional check flow malfunction criteria.

(3.7) Catalyst System: The manufacturer shall perform a test using a catalyst system deteriorated to the malfunction criteria using methods established by the manufacturer in accordance with sections (e)(1.2.6) and (1.2.7).

(3.8) Heated Catalyst Systems: The manufacturer shall perform a test at the malfunction criteria limit established by the manufacturer in section (e)(2.2).

(3.9) Other systems: The manufacturer shall conduct demonstration tests for all other emission control components designed and calibrated to an emission threshold malfunction criteria (e.g., 1.5 times any of the applicable emission standards) (e.g., hydrocarbon traps, adsorbers, etc.) under the provisions of section (e)(16).

(3.10) The manufacturer may electronically simulate deteriorated components if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction but may not make any vehicle control unit modifications (unless otherwise excepted above or exempted pursuant to this section) when' performing demonstration tests. All equipment necessary to duplicate the demonstration test must be made available to the ARB upon request. A manufacturer may request Executive Officer approval to electronically simulate a deteriorated component with engine control unit modifications. The Executive Officer shall approve the request upon determining the manufacturer has submitted data and/or engineering analysis demonstrating that is technically infeasible, very difficult, and/or resource intensive to implant the fault with modifications external to the engine control unit.

(4) Required Testing for DiesellCompression-ignifion vehicles:

Except as provided below, the manufacturer shall perform single-fault testing based on the applicable test with the following components/systems' set at their malfunction criteria limits as determined by the manufacturer for meeting the requirements of section (f).

(4.1) NMHC Catalyst: The manufacturer shall perform a separate test for each monitored NMHC catalyst(s) that is used for a different purpose (e.g., oxidation catalyst upstream of a PM filter, NMHC catalyst used downstream of an SCR catalyst). The catalyst(s) being evaluated shall be deteriorated to the applicable malfunction criteria established by the manufacturer in section (f)(1.2.2) using methods established by the manufacturer in accordance with section (f)(1.2.4). For each monitored NMHC catalyst(s), the manufacturer shall, also demonstrate that the OBD II system will detect a catalyst malfunction with the catalyst at its maximum level of deterioration (Le., the substrate(s) completely removed from the catalyst container or "empty" can). Emission data are not required for the empty can demonstration.

(4.2) NOx Catalyst: The manufacturer shall perform a separate test for each monitored NOx catalyst(s) that is used for a different purpose (e.g., passive lean NOx catalyst, SCR catalyst). The catalyst(s) being evaluated shall be deteriorated to the applicable malfunction criteria established by the manufacturer in sections (f)(2.2.2)(A) and (f)(2.2.3)(A) using methods established by the manufacturer in accordance with section (f)(2.2.4). For each monitored NOx catalyst(s), the manufacturer shall also demonstrate that the OBD II system will detect a catalyst malfunction with the catalyst at its maximum level of deterioration (Le., the substrate(s) completely removed from the catalyst container or "empty" can). Emission data are not required" for the empty can demonstration.

(4.3) Misfire Monitoring: For 2010 and subsequent model year vehicles subject to section (f)(3.2.2), the manufacturer shall perform a test at the malfunction criteria limit specified in section (f)(3.2.2). A misfire' monitor demonstration test is not required for vehicles not subject to section (f)(3.2.2).

(4.4) 'Fuel System: The manufacturer shall perform a separate test for each applicable malfunction limit established by the manufacturer for the fuel system parameters (e.g., fuel pressure, injection timing, injection quantity) specified in sections (f)(4.2.1) through (f)(4.2.3). When performing a test for a specific parameter, the fuel system shall be operating'at the malfunction criteria limit for the applicable parameter only. All other parameters shall be with normal characteristics. In conducting the fuel system demonstration tests, the manufacturer may use computer modifications to cause the fuel system to operate at the malfunction limit if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction.

(4.5), Exhaust Gas Sensor: The manufacturer shall perform a test for each exhaust gas sensor parameter calibrated to the malfunction criteria in sections (f)(5.2.1)(A)(i), (f)(5.2.1)(B)(i), and (f)(5.2.2)(A). When performing a test, all exhaust gas sensors used for the same purpose (e.g., for the same feedback control loop, for the same control feature on parallel exhaust banks) shall be operating at the malfunction criteria limit for the applicable parameter only. All other exhaust gas sensor parameters shall be with normal characteristics.

(4.6) EGR System: The manufacturer shall perform a test at each flow, slow' response, ,and cooling limit calibrated to the malfunction criteria in sections (f)(6.2.1) through (f)(6.2.3) and (f)(6.2.5). In conducting the EGR cooler performance demonstration test, the EGR cooler(s) being evaluated shall be deteriorated to the applicable malfunction criteria using methods established by the manufacturer in accordance with section (f)(6.2.5)(C). In conducting the EGR system slow response demonstration tests, the manufacturerniay use computer modifications to cause the EGR system to operate at the malfunction limit if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction or that there is no reasonably feasible method to induce a hardware malfunction.

(4.7) Boost Pressure Control System: The manufacturer shall perform a test at each boost, response, and cooling'limit calibrated to the malfunction criteria in sections (f)(7.2.1) through (f)(7.2.4). In conducting the charge air undercooling demonstration'test, the charge air cooler(s) being evaluated shall be deteriorated to the applicable malfunction criteria established by the manufacturer in section (f)(7.2.4)(A) using methods established by the manufacturer in accordance with section (f)(7.2.4)(C).

(4.8) NOx Adsorber: The manufacturer shall perform a test using a NOx adsorber(s) deteriorated to the malfunction criteria in section (f)(8.2.1). The manufacturer shall also demonstrate that the OBO II system will detect a NOx adsorber malfunction with the NOx adsorber at its maximum level of deterioration (i.e., the substrate(s) completely removed from the container or "empty" can). Emission data are not required for .the empty can . demonstration.

(4.9) PM Filter: The manufacturer shall perform a test using a PM filter(s) deteriorated to each applicable malfunction criteria in sections (f)(9.2.1), (f)(9.2.2), and (f)(9.2.4). The manufacturer shall also demonstrate that the OBD II system will detect a PM filter malfunction with the filter at its maximum level of deterioration (i.e., the filter(s) completely removed from the filter container or "empty" can). Emission data are not required for the empty can demonstration.

(4.10) Cold Start Emission Reduction Strategy: The manufacturer shall perform a test at the malfunction criteria for the system or for each component monitored according to section (f)(12.2.2).

~~(4.10)~~(4.11) VVT System: The manufacturer shall perform a test at each target error limit and slow response limit calibrated to the malfunction criteria in sections (f)(13.2.1). aOnd (f)(13.2.2). In conducting the WT system demonstration tests, the manufacturer may use computer modifications to cause the VVT system to operate at the malfunction limit if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction.

~~(4.11)~~(4.12) For each of thelesting requirements of section (h)(4), if the manufacturer has established that only a functional check is required because no failure or deterioration of the specific tested system could result in an engine's emissions exceeding the emission malfunction criteria, the manufacturer is not required to perform a demonstration test; however the manufacturer is required to provide the data and/or engineering an.alysis used to determine that only a functional test of the system(s) is required.

(4.13) For each of the testing requirements of (h)(4), when performing a test, all components or systems used in parallel for the same purpose (e.g., separate WT actuators on the intake valves for Bank 1 and Bank 2, separate NOx converting catalysts on parallel exhaust banks) shall be simultaneously deteriorated to the malfunction criteria limit. Components or systems in series or used for different purposes (e.g., upstream and downstream exhaust gas sensors in a single exhaust bank, separate high pressure and low pressure EGR systems) may not be simultaneously deteriorated to the malfunction criteria limit.

(4.14) The manufacturer may electronically simulate deteriorated components if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction but may not make any engine control unit modifications (unless otherwise provided above or exempted pursuant to this section) when performing demonstration tests. All equipment necessary to duplicate the demonstration test must be made available to ARB upon request. A manufacturer may request Executive Officer approval to electronically simulate a deteriorated component with engine control unit modifications. The Executive Officer shall approve the request upon determining the manufacturer has submitted data and/or engineering analysis demonstrating that it is technically infeasible, <u>very</u> difficult, and/or resource intensive to implant the fault with modifications external to the engine control unit.

(5) Testing Protocol:

(5.1) Preconditioning: The manufacturer shall use an applicable cycle (FTP, SET, or Unified Cycle) for preconditioning test vehicles prior to conducting each of the above emission tests. Upon determining that a manufacturer has provided data and/or an engineering evaluation that demonstrate that additional preconditioning is necessary to stabilize the emission control system, the Executive Officer shall allow the manufacturer to perform a single additional preconditioning cycle, identical to the initial preconditioning cycle, or a Federal Highway Fuel Economy Driving Cycle, following a ten minute (20 minutes for medium duty engines certified on an engine dynamometer) hot soak after the initial preconditioning cycle. The manufacturer may not require the test vehicle to be 'cold soaked prior to conducting preconditioning cycles in order for the monitoring system testing to be successful.

(5.2) Test Sequence:

(5.2.1) The manufacturer shall set the system or com'ponent on the test vehicle for which detection is to be tested at the criteria limit(s) prior to conducting the applicable preconditioning cycle(s). If a second preconditioning cycle is permitted in accordance with section (h)(5.1) above, the manufacturer may adjust the system or component to be tested before conducting the second preconditioning cycle. The manufacturer may not replace, modify, or adjust the system or component after the last preconditioning cycle has taken place.

(5.2.2) After preconditioning, the test vehicle shall be 'operated over the applicable cycle to allow for the initial detection of the tested system or component malfunction. This test cycle may be omitted from the testing protocol if it is unnecessary. If required by the designated monitoring strategy, a cold soak may be performed prior to conducting this driving cycle.

(5.2.3) The test vehicle shall then be operated over the applicable exhaust emission test. If monitoring is designed to run during the Unified Cycle, a second Unified Cycle may be conducted prior to the exhaust emission test.

(5.3) .A manufacturer required to test more than one test vehicle (section (h)(2.2)) may utilize internal calibration sign-off test procedures (e.g., forced cool downs, less frequently calibrated emission analyzers, etc.) instead of official exhaust emission test procedures to obtain the emission test data required in section (h) for all but one of the required test vehicles. The manufacturer may elect this option if the data from the alternative test procedure are representative of official exhaust emission test results. Manufacturers using this option are still responsible for meeting the malfunction criteria specified in sections (e) and (f) when emission tests are performed in accordance with official exhaust emission test procedures.

(5.4) For medium-duty vehicles certified to an engine dynamometer exhaust emission standard, a manufacturer may request Executive Officer approval to utilize an alternate testing protocol for demonstration of MIL illumination if the engine dynamometer emission test cycle does not allow all of a monitor's enable conditions to be satisfied. A manufacturer may request the use of an alternate engine dynamometer test cycle or the use of chassis testing to demonstrate proper MIL illumination. In evaluating the manufacturer's request, the Executive Officer shall consider the technical necessity for using an alternate test cycle and the degree to which the alternate test cycle demonstrates that in-use operation with the malfunctioning component will properly result in MIL illumination.

(6) Evaluation Protocol:

(6.1) For all tests conducted under section (h), the MIL shall be illuminated upon detection of the tested system or component malfunction before the end of the first engine start portion of the exhaust emission test (or before the hot start portion of the last Unified Cycle, if applicable) in accordance with requirements of sections (e) and (f).

(6.2) For all tests conducted 'under section (h), manufacturers may use Non-Methane Hydrocarbon (NMHC) emission results in lieu of Non-Methane Organic Gas (NMOG) emission results for comparison to the applicable standards or malfunction criteria (e.g., 1.5 times the FTP standards). If NMHC emission results are used in lieu of NMOG, the emission result shall be multiplied by 1.04 to generate an equivalent NMOG result before comparison to the applicable standards.

(6.3) If the MIL illuminates prior to emissions exceeding the applicable malfunction criteria specified in sections (e) and (f), no further demonstration is required. With respect to the misfire monitor demonstration test, if a manufacturer has elected to use the minimum misfire malfunction criteria of one percent as allowed in sections (e)(3.2.2)(A) and (f)(3.2.2)(B), no further demonstration is required if the MIL illuminates with misfire implanted at the malfunction criteria limit.

(6.4) If the MIL does not illuminate when the systems or components are set at their limit(s), the criteria limit or the OBD II system is not acceptable.

(6.4.1) Exceptfor testing of the catalyst (Le., components monitored under (e)(1), (f)(2) or (f)(8» or PM filter system, if the MIL first illuminates after emissions exceed the applicable malfunction criteria specified in sections (e) and (f), the test vehicle shall be retested with the tested system or component adjusted so that the MIL will illuminate before emissions exceed the applicable malfunction criteria specified in sections (e) and (f). If the component cannot be adjusted to meet this criterion because a default fuel or emission control strategy is used when a malfunction is detected (e.g., open loop fuel control used after an 02 sensor malfunction is determined, etc.), the test vehicle shall be retested with the component adjusted to the worst acceptable limit (Le., the applicable monitor indicates the component is performing at or slightly better than the malfunction criteria). For the OBD II system to be approved, the MIL must not illuminate during this test and the vehicle emissions must be below the applicable malfunction criteria specified in sections (e) and (f).

(6.4.2) In testing the catalyst (Le., components monitored under (e)(1), (f)(2) or (f)(8» or PM filter system, if the MIL first illuminates after emissions exceed the applicable emission threshold(s) specified in sections (e) and (f), the tested vehicle shall be retested with a less deteriorated catalyst or PM filter system (Le., more of the applicable engine out pollutants are converted or trapped). For the OBD II system to be approved, testing shall be continued until either of the following conditions are satisfied:

(A) The MIL is illuminated and emissions do not exceed the thresholds specified in 'sections (e) and (f); or

(B) The manufacturer demonstrates that the MIL illuminates within acceptable upper and lower limits of the threshold specified in sections (e) and (f) for MIL illumination. The manufacturer shall demonstrate acceptable limits by continuing testing until the test results show:

(i) The MIL is illuminated and emissions exceed the thresholds specified in sections (e) and (f) by 25 percent or less of the applicable standard (e.g., emissions are less than 2.0 times the applicable standard for a malfunction criterion of 1.75 times the staridard); and

(ii) The MIL is not illuminated and emissions are below the thresholds specified in sections (e) and (f) by no more than 25 percent of the standard (e.g., emissions are between 1.5 and 1.75 times the applicable standard for a malfunction criterion of 1.75 times the standard).

(6.5) If an OBO \I system is determined unacceptable by the above criteria, the manufacturer may recalibrate and retest the system on the same test vehicle. In such a case, the manufacturer must confirm, by retesting, that all systems and components that were tested prior to recalibration and are affected by the recalibration function properly under the OBO II system as recalibrated.

(6.6) Where applicable for diesel vehicles, the emission test results shall be adjusted as required under section (d)(6.2). -

(7) Confirmatory Testing:

(7.1) The ARB may perform confirmatory testing to verify the emission test data submitted by the manufacturer under the requirements of section (h) comply with the requirements of section (h) and the malfunction criteria identified in sections (e) and (f). This confirmatory testing is limited to the vehicle configuration represented by the demonstration vehicle(s). For purposes of section (h)(7), vehicle configuration shall have the same meaning as the term used in 40 CFR 86.082-2.

(7.2) The ARB or its designee may install appropriately deteriorated or malfunctioning components in an otherwise properly functioning test vehicle of a test group represented by the demonstration.test vehicle(s) (or simulate a deteriorated or malfunctioning component) in order to test any of the components or systems required to be tested in section (h). Upon request by the Executive Officer, the manufacturer shall make available a Vehicle and all test equipment (e.g., malfunction simulators, deteriorated components, etc.) . necessary to duplicate the manufacturer's testing. The Executive Officer shall make the request within six months of reviewing and approving the demonstration test vehicle data submitted by the manufacturer for the specific test group.

(7.3) Vehicles with OBO \I systems represented by the demonstration vehicle(s) may be recalled for corrective action if a representative sample of vehicles uniformly fails to meet the requirements of section (h).

(i) *CERTIFICATION DOCUMENTATION.*

(1) When submitting an application for certification of a test group, the manufacturer shall submit the following documentation. If any of the items listed below are· standardized for all of a manufacturer's test groups,the manufacturer may, for each model year, submit one set of documents covering the standardized items for all of its test groups.

(1.1) For the required documentation not standardized across all test groups, the manufacturer may propose to the Executive Officer that documentation covering a specified combination of test groups be used. These combinations shall be known as "OBO II groups". Executive Officer approval shall be granted for those groupings that include test groups using the same aBO II strategies and similar calibrations. If approved by the Executive Officer, the. manufacturer may submit one set of documentation from one or morerepre'sentative test group(s) that are a part of the aBO II group. The Executive Officer shall determine whether a selected test group(s) is representative of the aBO II group as a whole. To be approved as representative, the test group(s) must. possess the most stringent emission standards and aBO II monitoring requirements and cover all of the emission' control devices within the aBO" group.

(1.2) With Executive Officer approval, one or more of the documentation requirements of section (i) may be waived' or modified if the information required would be redundant or unnecessarily burdensome to generate.

(1.3) To the extent possible, the certification documentation shall use SAE J1930 terms, abbreviations, and acronyms.

(2) The following information shall be submitted as "Part 1" of the certification application. Except as provided below for demonstration data, the Executive Officer will not issue an Executive Order certifying the covered vehicles without the information having been provided. The information must include: .

(2.1) A description of the functional operation of the aBO II system including a complete written description for each monitoring strategy that outlines every step in the decision making process of. the monitor. Algorithms, diagrams, samples of data, anq/or other graphical representations of the monitoring strategy shall be included where necessary to adequately describe the information.

(2.2) A table, in the standardized format detailed in Attachment A of ARB Mail-Out #95-20, May 22, 1995, incorporated by reference.

(2.2.1) The table must include the following information for each monitored component or system (either computer-sensed or -controlled) of the emission control system:

(A) corresponding fault code
(B) monitoring method or procedure for malfunction detection
(C) primary malfunction detection parameter and its type of output signal
(D) fault criteria limits used to evaluate output signal of primary parameter
(E) other monitored secondary parameters and conditions (in engineering units) necessary for malfunction detection
(F) monitoring time length and frequency of checks
(G) criteria for storing fault code
(H) criteria for illuminating malfunction indicator light
(I) criteria used for determining out of range values and input component -rationality checks

(2.2.2) Wherever possible, the table shall use the following engineering units:

(A) Degrees Celsius (OC) for all temperature criteria
(B) KiloPascals (KPa) for all pressure criteria related to manifold or atmospheric pressure
(C) Grams (g) for all intake air mass criteria
(D) Pascals (Pa) for all pressure criteria related to evaporative system vapor pressure

(E) Miles per hour (mph) for all vehicle speed criteria

(F) Relative percent (%) for all relative throttle position criteria (as defined in SAE j1979)

(G) Voltage (V) for all absolute throttle position criteria (as defined in SAE J1979)

(H) Per crankshaft revolution (Irev) for all changes per ignition event based criteria (e.g., g/rev instead of g/stroke or g/firing)

(I) Per second (/sec) for all changes per time based criteria (e.g., g/sec)

. (J) Percent of nominal tank volume (%) for all fuel tank level criteria

(2.3) A logic flowchart describing the step by step evaluation of the enable criteria and malfunction criteria for each monitored emission-related component or system.

(2.4) Emission test data, a description of the testing sequence (e.g., the number and types of preconditioning cycles), approximate time (in seconds) of MIL illumination during the test, fault code(s) and freeze frame information stored at the time of detection, corresponding SAE J1979 test results (e.g. Mode/Service $06) stored during the test, and a description of the modified or deteriorated components used for fault simulation with respect to the demonstration tests specified in section (h). The Executive Officer may approve conditional certification of a test group prior to the submittal of this data for ARB review and approval. Factors to be considered by the Executive Officer in approving the late submission of information identified in section (i)(2.4) shall include the reason for the delay in the data collection, the length of time until data will be available, and the demonstrated previous success of the manufacturer in submitting the data prior to certification.

(2,5) For gasoline vehicles, data supporting the misfire monitor, including:

(2.5.1) The established percentage of misfire that can be tolerated without damaging the catalyst over the full range of engine speed and load conditions.

(2.5.2) Data demonstrating the probability of detection of misfire events of the misfire monitoring system over the full engine speed and load operating range for the following misfire patterns: random cylinders misfiring at the malfunction criteria established in section *(e)(3.2.2),* one cylinder continuously misfiring, and paired cylinders continuously misfiring.

(2.5.3) Data identifying all disablement of misfire monitoring that occurs during the FTP and US06 cycles. For every disablement that occurs during the cycles, the data should identify: when the disablement occurred relative to the driver's trace, the number of engine revolutions that each disablement was present for, and which disable condition documented in the certification application caused the disablement. The data shall be submitted in the standardized format detailed in Attachment A: Misfire Disablement and Detection Chart of ARB Mail-Out #06-23, December 21, 2006, incorporated by reference.

(2.5.4) Manufacturers are not required to use the durability demonstration vehicle to collect the misfire data for sections (i)(2.5.1) though (2.5.3).

(2.6) Data supporting the limit for the time between engine starting and attaining the designated heating temperature for after-start heated catalyst systems.

(2.7) For diesel vehicle monitors in section (f) that are required to indicate a malfunction before emissions exceed an emission threshold based on any applicable standard (e.g., 1.5 times any of the applicable standards), the test cycle and standard determined by the manufacturer to be the most stringent for each applicable monitor in accordance with section (d){6.1) and the adjustment factors determined by the manufacturer for each applicable monitor in accordance with section (d)(6.2).

(2.8) A listing of all electronic powertrain input and output signals (including those not monitored by the OBD II system) that identifies which signals are monitored by the OBO II system.

(2.9) A written description of all parameters and conditions necessary to begin closed loop operation.

(2.10) A summary table identifying every test group and each of the OBD II phase-in requirements that apply to each test group.

(2.11) A written identification of the communication protocol utilized by each test group for communication with an SAE J1978 scan tool.

(2.12) A pictorial representation or written description of the diagnostic connector location including any covers or labels.

(2.13) A written description of the method used by the manufacturer to meet the requirements of sections (e){9) and (f){10) for PCV and CV system monitoring including diagrams or pictures of valve and/or hose connections.

(2.14) A coverletter identifying all concerns and deficiencies applicable to the equivalent previous model year test group and the changes and/or resolution of each concern or deficiency for the current model year test group.

(2.15) For diesel engine vehicles, a written description of each AECD utilized by the manufacturer including the identification of each EI-AECD relative to the data required to be tracked and reported in the standardized format specified in section (g){6) (e.g., EI-AECD #1 is "engine overheat protection as determined by coolant temperature greater than…"), the sensor signals and/or calculated values used to invoke each AECD, the engineering data and/or analysis demonstrating the need for such an AECD, the actions taken when each AECD is activated, the expected in-use frequency of operation of each AECD, and the expected emission impact from each AECD activation.

(2.16) A checklist of all the malfunction criteria in sections (e) or (f) and the corresponding diagnostic noted by fault code for each malfunction criterion. The formats of the checklists are detailed in Attachments F and G of ARB Mail-Out #MSC 06-23, December 21, 2006, incorporated by reference.

(2.17) Any other information determined by the Executive Officer to be necessary to demonstrate compliance with the requirements of this regulation.

(3) "Part 2". The following information shall be submitted by January 1st of the applicable model year:

(3.1) A listing and block diagram of the input parameters used to calculate or determine calculated load values and the input parameters used to calculate or determine fuel trim values.

(3.2) A scale drawing of the MIL and the fuel cap indicator light, if present, which specifies location in the instrument panel, wording, color, and intensity.

(4) "Part 3". The following information shall be submitted upon request of the Executive Officer:

(4.1) Data supporting the criteria used to detect a malfunction when catalyst deterioration causes emissions to exceed the applicable malfunction criteria specified in sections (e) and (f).

(4.2) Data supporting the criteria used to detect evaporative system leaks.

(4.3) Any other information determined by the Executive Officer to be necessary to demonstrate compliance with the-requirements of this regulation.

(j) *PRODUCTION VEHICLE EVALUA TION. TESTING.*

(1) Verification of *Standardized Requirements.*

(1.1) Requirement: For 2005 and subsequent model year vehicles, manufacturers shall perform testing to verify that all vehicles meet the requirements of section (g)(3) and (g)(4) relevant to proper communication of required emission-related messages to an SAE J1978 scan tool.

(1.2) Selection of Test Vehicles: Manufacturers shall perform this testing every model year on one production vehicle from every unique calibration within two months of the start of normal production for that calibration. Manufacturers may request Executive Officer approval.to group multiple calibrations together and test one representative calibration per gn;>up. The Executive Officer shall approve the request upon finding that the software designed to comply with the standardization requirements of section (g) in the representative - calibration vehicle is identical (e.g., communication protocol message timing, number of supported data stream parameters, etc.) to all others in the group and that any differences in the calibrations are not relevant with respect to meeting the 'criteria in section (j)(1.4).

(1.3) Test Equipment: For the testing required in section (j)(1), manufacturers shall utilize an off-board device to conduct the testing. Prior to conducting testing, manufacturers are required to request and receive Executive Officer approval of the off-board device that the manufacturer will use to perform the testing. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data, specifications, and/or engineering analysis that demonstrate that the off-board device meets the minimum requirements to conduct testing according to SAE J1699-3 using the software developed and maintained for the SAEJ1699-3 committee and available through www.sourceforge.net and SAE J2534 compliant hardware configured specifically for SAE J1699-3 testing.

(1.4) Required Testing (Le., "static" testing portion of SAE J1699-3):

(1.4.1) The testing shall verify that the vehicle can _properly establish - communications between all emission-related on-board computers and any SAE J1978 scan tool designed to adhere strictly to the communication protocols allowed in section (g)(3);

(1.4.2) The testing shall further verify that the vehicle can properly communicate to any SAE J1978 scan tool:

(A) The current readiness status from all on-board computers required to . support readiness status in accordance with SAE J1979 and section (g)(4.1) while the engine is running;

(B) The MIL command status while the MIL is commanded off and while the MIL is commanded on in accordance with SAE J1979 and section (g)(4.2) while the engine is running, and in accordance with SAE J1979 and sections (d)(2.1.2) during the MIL functional check and, if applicable, (g)(4.1.3) during the MIL readiness status check while the engine is off;

(C) All data stream parameters required in section (g)(4.2) in accordance with SAE J1979 inclUding the identification of each data stream parameter as supported in SAE J1979 (e.g., Mode/Service $01, PID $00);

(D) The CAL 10, CVN, and VIN (if applicable) in accordance with SAE J1979 and sections (g)(4.6) through (4.8);

(E) An emission-related fault code (permanent, confirmed, and pending) in accordance with SAE J1979 (inclUding correctly indicating the number of stored fault codes (e.g., Mode/Service $01, PID $01, Data A)) and section (g)(4.4);

(1.4.3) The testing shall also verify that the vehicle can properly respond to any SAE J1978 scan tool request to clear emission-related fault codes and reset readiness status.

(1.5) Reporting of Results:

(1.5.1) The manufacturer shall notify the Executive Officer within one month of identifying any ve.hicle that does not meet the requirements of section (j)(1.4). The manufacturer shall submit a written report of the problem(s) identified and propose corrective action (if any) to remedy the problem(s) to the Executive Officer for approval. Factors to be considered by the Executive Officer in approving the proposed corrective action shall include the severity of the problem(s), the ability of the vehicle to be tested in an I/M program, the ability of service technicians to access the required diagnostic information, the impact on equipment and tool manufacturers, and the amount qf time prior to implementation of the proposed corrective action.

(1.5.2) Within three months of any passing testing conducted 'pursuant to section (j)(1), a manufacturer shall submit a report of the results to the Executive Officer for review.

(1.5.3) In accordance with section (k)(6), manufacturers may request Executive Officer approval for a retroactive deficiency to be granted for items identified during this testing.

(2) Verification of *Monitoring Requirements.*

(2.1) For 2004 and subsequent model year vehicles, within the first six months after normal production begins, manufacturers shall conduct a complete evaluation of the OBD 1/ system of one or more production vehicles (test vehicles) and submit the results of the evaluation to the Executive Officer.

(2.2) Selection of test vehicles:

(2.2.1) Prior to submitting any applications for certification for a model year, a manufacturer shall notify the Executive Officer of the test groups planned for that model year. The Executive Officer will then select the test group(s), in accordance with sections (j)(2.2.2) and (j)(2.2.3) below, that the manufacturer shall use as test vehicles to provide evaluation test results. This sele,ction process may take place during durability demonstration test vehicle selection specified in section (h).

(2.2.2) A manufacturer shall evaluate one production vehicle per test group selected for monitoring system demonstration in section (h).

(2.2.3) In addition to the vehicles selected in section (j)(2.2.2) above, a manufacturer shall evaluate vehicles chosen from test groups that are not selected for monitoring system demonstration.testing under section (h). The number of additional vehicles to be tested shall be equal to the number of vehicles selected for monitoring system demonstration in section (h).

(2.2.4) The Executive Officer may waive the requirements for submittal of evaluation results from one or more of the test groups if data has been previously submitted for all of the test groups.

(2.3) Evaluation requirements:

(2.3.1) The evaluation shall demonstrate the ability of the OBD II system on the selected production vehicle to detect a malfunction, illuminate the' MIL, ' and store a confirmed fault code when a malfunction is present and the monitoring conditions have been satisfied for each individual diagnostic required by title 13,- CCR section 1968.2.

(2.3.2) The evaluation shall verify that malfunctions detected by non-MIL illuminating diagnostics of components used to enable any other OBD II system diagnostic (e.g., fuel level sensor) will not inhibit the ability of other OBD II system diagnostics to properly detect malfunctions.

(2.3.3) On vehicles so equipped, the' evaluation shall verify that the software used to track the numerator and denominator for purposes of determining in-use monitoring frequency correctly increments as required in section (d)(4)(Le., the "dynamic" testing portion of SAE J1699-3).

(2.3.4) Malfunctions may be mechanically implanted or electronically simulated but internal on-board computer hardware or software changes may not be used to simulate malfunctions. Emission testing to confirm that the ' malfunction is detected before the appropriate emission standards are exceeded is not required.

(2.3.5) Manufacturers shall submit a proposed test plan for Executive'Officer approval prior to evaluation testing being performed. The test plan shall identify the method used to induce a malfunction in each diagnostic. If the Executive Officer determines that the requirements of section (j)(2) are satisfied, the proposed test plan shall be approved.

(2.3.6) Subject to Executive Officer approval, manufacturers may omit demonstration of specific diagnostics. The Executive Officer shall approve a manufacturer's request if the demonstration cannot be reasonably performed without causing physical damage to the vehicle (e.g., on-board computer internal circuit faults). '

(2.3.7) For evaluation of test vehicles selected in accordance with section (j)(2.2.2), manufacturers are not required to demonstrate diagnostics that were previously demonstrated prior to certification as required in section (h). '

(2.4) Manufacturers shall submit a report of the results of all testing conducted pursuant to section (j)(2) to the Executive Officer for review. This report shall identify the method used to induce a malfunction in each diagnostic, the MIL illumination status, and the confirmed fault code(s) stored.

(2.5) In accordance with section (k)(6), manufacturers may request Executive Officer approval for a retroactive deficiency to be granted for items identified during this testing.

(3) *Verification and Reporting of In-use Monitoring Performance.*

(3.1) Manufacturers are required to collect and report in-use monitoring performance data representative of every test group certified by the manufacturer and equipped with in-use monitoring performance tracking software in accordance with section (d)(4) to the ARB within twelve months from either the time vehicles in the test group were first introduced into commerce or the start of normal production for such vehicles, whichever is later. The manufacturer may propose to the Executive Officer that multiple test groups be combined to collect representative data. Executive .officer approval shall be granted upon determining that the proposed groupings include test groups using the same OBD II strategies and similar calibrations and that are expected to have similar in-use monitoring performance. If approved by the Executive Officer, the manufacturer may submit one set of data for each of the approved groupings.

(3.2) For each test group or combination of test groups, the data must include all of the in-use performance tracking data reported through SAE J1979 (Le., all numerators, denominators, and the ignition cycle counter), the date the data was collected, the odometer reading, the vehicle VIN, and the ECM software calibration identification number and be in the standardized format detailed in Attachment D: Rate Based Data of ARB Mail-Out #06-23, December 21, 2006, incorporated by reference.

(3.3) Manufacturers shall submit a plan to the Executive Officer for review and approval of the sampling method, number of vehicles to be sampled, time line to collect the data, and reporting format. The Executive Officer shall approve the plan upon determining that it provides for effective collection of data from a representative sample of vehicles that, at a minimum, is fifteen vehicles, will likely result in the collection and submittal of data within the required twelve month time frame, will generate data that are representative of California drivers and temperatures, and does not, by design, exclude or include specific vehicles in an attempt to collect data only from vehicles with the highest in-use performance ratios.

(3.4) Upon request of the manufacturer, the Executive Officer may reduce the minimum sample size offifteen vehicles set forth in section (j)(3.3) for test groups with low sales volume. In granting approval of a sampling plan with a reduced minimum sample size, the Executive Officer shall consider, among other things, information submitted by the manufacturer to justify the smaller sample size, sales volume of the test group(s), and the sampling mechanism utilized by the manufacturer to procure vehicles. In lieu of defining a fixed minimum sample size for low sales volume test groups, sampling plans approved for collection of data on higher sales volume test groups under section (j)(3.3) shall also be approved by the Executive Officer for low sales test groups if they use the identical sampling mechanism to procure vehicles from the low sales volume test groups.

(k) *DEFICIENCIES.*

(1) For 2004 and subsequent model year vehicles, the Executive Officer, upon receipt of an application from the manufacturer, may certify vehicles even though said vehicles may not comply with one or more of the requirements of title 13, CCR section 1968.2. In granting the certification, the Executive Officer shall consider the following factors: the extent to which the requirements of section 1968.2 are satisfied overall based on a review of the vehicle applications in question, the relative performance of the resultant OBO " system compared to systems fully compliant with the requirements of title 13, CCR section 1968.2, and a demonstrated good-faith effort on the part of the manufacturer to: (1) meet the requirements in full by evaluating and considering the best available monitoring technology; and (2) come into compliance as expeditiously as possible. The Executive Officer may not grant certification -to a vehicle in which the reported noncompliance for which a deficiency is sought would be subject to ordered recall pursuant to section 1968.5 (c)(3)(A).

(2) Manufacturers of non-complying systems are subject to fines pursuant to section 43016 of the California Health and Safety Code. Except as allowed in section (k)(7) for light-duty diesel vehicles, the specified fines apply to the third. and subsequently identified deficiencies, with the exception that fines shall apply to all monitoring system deficiencies wherein a required monitoring strategy is completely absent from the OBO system.

(3) The fines are in the amount of $50 per deficiency per vehicle for non-compliance with any of the monitoring requirements specified in sections (e)(1) through (e)(8), (e)(11), (e)(13)(e)(14), (e)(16), (f)(1) through (f)(9), (f)(13), and (f)(16) and $25 per deficiency per vehicle for non-compliance with any other requirement of section 1968.2. In determining the identified order of deficiencies, deficiencies. subject to a $50 fine are identified first. Total fines per vehicle under section (k) may not exceed $500 per vehicle and are payable to the State Treasurer for deposit in the Air Pollution Control Fund.

(4) Manufacturers must re-apply for Executive Officer approval of a deficiency each model year. In considering the request to carry-over a deficiency, the Executive Officer shall consider the factors identified in section-(k)(1) including the manufacturer's progress towards correcting the deficiency. The Executive Officer may not allow manufacturers to carry over monitoring system deficiencies for more than two model years unless it can be demonstrated that substantial vehicle hardware modifications and additional lead time beyond two years would be necessary to correct the deficiency, in which case the Executive Officer shall allow the deficiency to be carried over for three model years.

(5) Except as allowed in section (k)(6), deficiencies may not be retroactively granted after certification.

(6) Request for retroactive deficiencies

(6.1) Manufacturers may request that the Executive Officer grant a deficiency and amend a vehicle"s certification to conform to the granting of the deficiencies during the first 6 months after commencement of normal production for each aspect of the monitoring system: (a) identified by the manufacturer (during testing required by section (j)(2) or any other testing) to be functioning different than the certified system or otherwise not meeting the requirements of any aspect of section 1968.2; and (b) reported to the Executive Officer. If the Executive Officer grants the deficiencies and amended certification, their approval would be retroactive to the start of production.

(6.2) Executive Officer approval of the request for a retroactive deficiency shall be granted provided that the conditions necessary for a pre-certification deficiency determination are satisfied (see section (k)(1)) and the manufacturer could not have reasonably anticipated the identified problem before commencement of production.

(6.3) In granting the amended certification, the Executive Officer shall include any approved post-production deficiencies together with all previously approved deficiencies in computing Jines in accordance with section (k)(2).

(7) For 2007 through 2009 model year light-duty and 2007 through 2012 model year medium-duty diesel vehicles, in cases where one or more of the deficiencies is for the aftertreatment monitoring requirements of sections (f)(1), (2), (8), or (9) and the deficient monitor is properly able to detect al,1 malfunctions prior to emissions exceeding twice the required monitor threshold (e.g., before emissions exceed 10 times the standard for NMHC if the threshold is 5.0 times the standard for NMHC), the specified fines shall apply to the fourth and subsequently identified deficiencies in lieu of the third and subsequently identified deficiencies. If none of the deficiencies are for the requirements of sections (f)(1), (2), (8), or (9) or if the deficient aftertreatment monitor exceeds twice the required monitor threshold, the specified fines shall apply to the third and subsequently identified deficiencies. In all cases, the exception that fines shall apply to all monitoring system deficiencies wherein a required monitoring strategy is completely absent from the OBO system still applies.

(8) Any.OBO II system installed on a production vehicle that fails to conform with the certified OBO II system for that vehicle or otherwise fails to meet the requirements of section 1968.2 and has not been granted a deficiency pursuant to the provisions of section (k)(1) through (k)(7) are considered non-compliant. The vehicles are subject to enforcement pursuant to applicable provisions of the Health and Safety Code and title 13, CCR section 1968.5.

NOTE: Authority cited: Sections 39600,39601,43000.5,43013,43018,43100, 43101,43104,43105, 431Q5.5, and 43106, Health and Safety Code. Reference: Sections 39002, 39003, 39010, 39018, 39021.5, 39024, 39024.5, 39027, 39027.3, 39028,39029,39031,39032,39032.5,39033,39035,39037.05,39037.5,39038, 39039,39040,39042,39042.5,39046,39047,39053,39054,39058,39059, 39060" 39515, 39600, 39601,43000,43000.5,43004,43006,43013,43016, 43018,43100,43101,43102,43104,43105,_43105.5,43106,43150,43151, 43152,43153,43154,43155,43156,43204,43211, and 43212, Health and Safety Code.

ATTACHMENT C

California Code of Regulations, Title 13, section 1971.5, Enforcement of Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Vehicles and Engines (HD 080)

Set forth below is proposed new California Code of Regulations, Title 13, section 1971.5. The proposed language is shown in plain text with major section headings and definition terms shown in italics.

§ 1971.5. Enforcement of Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines.

(a) *General.*

(1) Applicability.

(A) These procedures shall be used to assure compliance with the requirements of California Code of Regulations (Cal. Code Regs.), title 13, section 1971.1 for all 2010 and sUbsequent model year heavy-duty engines equipped with OBO systems that have been certified for sale in California.

(B) Engines manufactured prior to the 2010 model year are covered by the general enforcement and penalty provisions of the Health and Safety Code, and the specific provisions of Cal. Code Regs., title 13, section 1971 and section 2111 through section 2149.

(2) Purpose.

The purpose of this section is to establish the enforcement protocol that shall be used by the Air Resources Board (ARB) to assure that engines certified for sale in California are equipped with OBO systems that· properly function and meet the purposes and requirements of Cal. Code Regs., title 13, .section 1971.1.

(3) Definitions.

The definitions applicable to these rules include those set forth in Health and Safety Code section 39010 et seq. and in Cal. Code Regs., title 13, section 1900(b) and section 1971.1(c), which are incorporated by reference herein. The following definitions are specifically applicable to section 1971.5 and take precedence over any contrary definitions.

"Days", when computing any period of time, unless otherwise noted, means normal working days that a manufacturer is open for business.

"Engine Class" means a group or set of engines subject to enforcement testing that have been determined by the Executive Officer to share common or similar hardware, software, OBO monitoring strategy,or emission control strategy.

"Engine Manufacturer' means the manufacturer granted certification to sell engines in the State of California.

"Executive Officer' means the Executive Officer of ARB or his or her authorized representative.

"Influenced OBD-Related Recalf' means an inspection, repair, adjustment, or modification program initiated and conducted by a manufacturer as a result of enforcement testing conducted by the ARB or any other information for the purpose of correcting any nonconforming OBO system for which direct notification of vehicle or engine owners is necessary.

"Major Monitor' means those monitors covered by the requirements set forth in Cal. Code Regs., title 13, section 1971.1(e), (f), and (g)(4).

"Nonconforming OBD System" means an OBO system on a production engine that has been determined not to comply with the

requirements of Cal. Code Regs., title 13, section 1971.1. For purposes of section 1971.5, an engine class shall be considered nonconforming irrespective of whether engines in the engine class, on average, meet applicable tailpipe or evaporative emission standards.

"OBD Emission Testing" refers to testing conducted to determine compliance with the malfunction criteria in Cal. Code Regs., title 13, section 1971.1 (e) through (g) that are based on a multiple of, or an additive to, a tailpipe emission standard or an absolute measurement from an applicable emission test cycle (e.g., 1.5 times the applicable federal test procedure (FTP) emission standards, PM standard plus 0.02 g/bhp-hr, PM level of 0.03 g/bhp-hr as measure from an applicable emission test cycle).

"OBD Ratio Testing" refers to testing conducted to determine compliance with the required in-use monitor performance ratio in Cal. Code Regs., title 13, section 1971.1(d)(3.2.2).

"Ordered OBD-Related Recalf' means an inspection, repair, adjustment, or modification program required by ARB to be conducted by the manufacturer to correct any honconforming OBO system for which direct notification of vehicle or engine owners is necessary.

"Quarterly Reports" refer to the following calendar periods: January 1 - March 31; April 1 - June 30; July 1 - September 30; October 1 - December 31.

"Test Sample Group" means a group of production engines in a designated engine class that are equipped with OBO systems and are selected and tested as part of the enforcement testing program set forth in sections (b) and (c).

"Voluntary OBD-Related Recalf' means an inspection, repair, adjustment, or modification program voluntarily initiated and conducted by a manufacturer to correct any nonconforming OBO system for which direct notification of vehicle or engine owners is necessary.

(b) *Testing Procedur:es for ARB-Conducted Testing.*

(1) *Purpose.* ,

To assure that OBO systems on production engines comply with the requirements of Cal. Code Regs., title 13, section 1971.1, ARB may periodically evaluate engines from an engine class.

(2) Preliminary Testing and Evaluation.

(A) As part of his or her evaluation of engines to determine compliance with the requirements of Cal. Code Regs., title 13, section 1971.1, the Executive Officer may routinely conduct testing' on any production engines that have been certified for sale in California.

(B) Based upon such testing or any other information, including data from California or other state heavy duty inspection programs, warranty information reports, and field information reports, the Executive Officer may conduct enforcement testing pursuant to sections (b)(3)through (5) below.

(3) Engine Selection for ARB-Conducted Enforcement Testing.

(A) Oetermining the Engine Class.

(i) Upon deciding to conduct enforcement testing, the Executive Officer shall determine the engine class to be tested. In determining the scope of the engine c1ass.to be tested, the Executive Officer shall consider the similarities and differences in the OBO systems of potentially affected engines. Among other things, the Executive Officer shall consider whether engines share similar computer hardware and software, calibrations, or OBO monitoring and emission control strategies.

(ii) The default engine class is the engine family or OBO group used by the manufacturer to certify the engines to be tested. However, upon concluding that a subgroup of engines differs from other engines in the identified engine family or OBO group and that a reasonable basis exists to believe that the differences may directly impact the type of testing that will be performed, the Executive Officer may determine that a subgroup of the engine family or OBO group is the appropriate engine class for festing.

(iii) Similarly, upon concluding that engines from several engine families or OBD groups (which may include engine families or OBO groups from different model years) share such common characteristics that a reasonable basis exists to believe that results of enforcement testing may be applicable to an engine class larger than a specific engine family or OBO group, the Executive Officer may determine that the appropriate engine class includes more than one engine family or OBO group.

(iv) Except for testing to determine if an OBO system has been designed to deactivate based on age and/or mileage (Cal. Code Regs., title 13, section 1971.1(d)(1.3)), the Executive Officer may not conduct testing of an engine class whose engines, on average, exceed the defined full useful life of the engine class. For purposes of the determination of this average, the Executive Officer shall use the accrual rates appropriate for engines in the engine class considering the vehicle weight class, usage type, and other subcategories as defined and used by EMFAC2007, which is incorporated by reference herein.

(B) Size of Test Sample Group.

After determining the engine class to be tested, the Executive Officer shall determine the appropriate number of engines to include in the test sample group for enforcement testing in accordance with the following guidelines:

(i) For OBO emission testing, the Executive Officer shall follow the provisions of Cal. Code Regs., title 13, section 2137 regarding test sample size. In accordance with section 2137, the Executive Officer shall test.1 0 engines that have been procured following the protocol of section (b)(3)(C) below and meet the selection criteria of section (b)(3)(O)(i) below to determine the emissions characteristics of the engine class being tested.

(ii) For OBO ratio testing, the Executive Officer shall collect data from a test sample group of 30 engines that have been procured following the protocol of section (b)(3)(C) below and meet the selection criteria of section (b)(3)(O)(ii) below to determine the in-use OBO monitoring performance of the engine class being tested.

(iii) In determining compliance with any other requirements of Cal. Code Regs., title 13, section 1971.1 (e.g., diagnosticconnectbr location, communication protocol standards, MIL illumination protocol, evaporative system diagnostics, etc.), the Executive Officer shall determine, on a case by case basis, the number of engines meeting the selection criteria of section (b)(3)(O)(iii) needed to assure that the results of such testing may be reasonably inferred to the engine class. The Executive Officer's determination shall be based upon the nature of the nonconformance and the scope of the engine class. The test sample group could be as few as two test engines.

(C) Protocol for Procuring Engines for Test Sample Group.

(i) For OBO emission and ratio testing, the Executive Officer shall determine the appropriate manner for procuring engines. In making his or her determination, the Executive Officer shall consider the nature of the nonconformance and the scope of the engine class. The method used shall ensure that engines are recruited from more than one source. Methods used may include obtaining lists of engine owners from specific sources (e.g., engine manufacturers, motor vehicle registration records) and soliciting participation from owners, discussing with fleet or rental operations to locate engines in the engine class, or using methods used by the manufacturer to procure engines for the manufacturer-run heavy duty diesel in-use testing program established pursuant to 70 Federal Register 34594 procure engines consistent with the procurement process followed by the Executive Officer under Cal. Code Regs., title 13, section 2137 (e.g., obtaining lists of all vehicles in the motor vehicle class within a specified geographical area, mailing postcards soliciting participation of vehicles within the specified area, selecting vehicles from those that responded to the solicitation, inspecting selected vehicles to determine whether appropriate to include in sample group, etc.). In selecting engines for OBD"emission testing, the Executive Officer shall include only engines meeting the criteria set forth in section (b)(3)(O)(i) below. For OBO ratio testing, the Executive Officer shall include only engines meeting the criteria set forth in section (b)(3)(O)(ii) below.

(ii) For all other testing, the Executive Officer shall, on a case by case basis, determine the appropriate manner for procuring engines. In making his or her determination, the Executive Officer shall consider the nature of the nonconformance and the scope of the engine class. The Executive Officer may procure engine(s) by any means that assures effective collection and testing of engines (e.g., rental car agencies, fleet vehicles, etc.), but shall not include any vehicle for which a reasonable basis exists that a vehicle operator's driving or maintenance habits would substantially impact test results to determine nonconformance. In all cases, however, the selection process must ensure proper selection of engines in accord with section (b)(3)(0)(iii) below.

(D) Engines to be included in a Test Sample Group.

(i) In selecting engines to be included in a test sample group for enforcement OBO emission testing, the Executive Officer shall include only engines that:

a. Are certified to the requirements of Cal. Code Regs., title 13, section 1971.1 and California exhaust emission standards.
b. Are.registered for operation in the United States.
c. Have mileage that is less than 75 percent of the certified full useful life mileage and have an age of less than the certified full useful life age for the subject vehicles.
d. Have not been tampered with or equipped with add-on or modified parts that would cause the OBO system not to comply with the requirements of Cal. Code Regs., title 13, section 1971.1 or would have a permanent effect on exhaust emission performance
e. Have not been subjected to abuse (e.g., racing, overloading, misfueling), neglect, improper maintenance, or other factors that would cause the aBO system not to comply with the requirements of Cal. Code Regs., title 13, section 1971.1 or would have a permanent effect on exhaust emission performance.
f. Have no detected or known malfunction(s) unrelated to the monitor or system being evaluated that would affect the performance of the OBO system. At its discretion, ARB may elect to repair an engine with a detected or known malfunction and then include the engine in the test sample group.
g. Have had no major repair to the engine resulting from a collision.
h. Have no problem that might jeopardize the safety of laboratory personnel.

(ii) In selecting engines to be included in a test sample group for enforcement OBO ratio testing, the Executive Officer shall include only engines that:

a. Are certified to the requirements of Cal. Code Regs., title 13, section 1971.1.
b. Have collected sufficient engine operation data for the monitor to be tested. For monitors required to meet the in-use monitor

performance ratio and to track and report ratio data pursuant to Cal. Code Regs., title 13, section 1971.1 (d)(3.2), sufficient engine operation data shall mean the denominator meets the criteria setforth in sections (b)(3)(D)(ii)1. through 5. below. For monitors required to meet the in-use monitor performance ratio but not required to track and report ratio data pursuant to Cal. Code Regs., title 13, section 1971.1 (d)(3.2), sufficient engine operation data shall mean that engines that have a denominator that meets the criteria set forth in sections (b)(3)(D)(ii)1. through 5. below after undergoing testing as set forth in section (b)(4)(C)(ii) below. Spe.cifically; the denominator, as defined in Cal. Code Regs., title 13, section 1971.1(d)(4.3), for the monitor to be tested must have'a value equal to or greater than:

1. 150 for gasoline evaporative system and secondary air system monitors, and gasoline monitors utilizing a denominator incremented in accordance with Cal. Code Regs., title 13, section 1971.1(d)(4.3.2)(D), (E), and (F) (e.g." cold start monitors, variable valve timing and/or control system monitors, etc.), or
2. 300 for gasoline catalyst, oxygen sensor, EGR, and all other component monitors.
3. 50 for diesel PM filter and NMHC converting catalyst monitors, and other diesel monitors using a denominator incremented in accordance with Cal:. Code Regs., title 13, section 1971.1 (d)(4;3.2)(G) or (H), or
4. 150 for diesel monitors utilizing a denominator incremented in accordance With Cal. Code Regs;, title 13, section 1971.1 (d)(4.3.2)(D), (E), or (F) (e.g., cold start monitors, comprehensive component output component monitors, etc.), or
5. 300 for all other diesel monitors riot covered under sections (b)(3)(D)(ii)3. and 4. above.

c. Have not been tampered with or equipped with add-on or modified parts that would cause the aBO system not to comply with the" requirements of Cal. Code Regs., title 13, section 1971.1.

d. Have mileage and age that are less than or equal to the certified full useful life mileage and age for the subject engines.

(iii) In selecting engines to be included in a test sample group for enforcement testing of any other requirement of Cal. Code Regs., title 13, section 1971.1 (not covered by sections (b)(3)(D)(i) or (ii) above), the Executive Officer shall include only engines that:

a. Are certified to the requirements of Cal: Code Regs., title 13, section 1971.1.

b. Have not been tampered with or equipped with add-on or modified parts that would cause the aBO system not to comply with the requirements of Cal. Code Regs., title 13, section 1971.1.

c. Have no detected or known malfunction(s) unrelated to the monitor or system being evaluated that would affect the performance of the OBO system. At its discretion, ARB may elect to repair an engine with a detected or known malfunction and then include the engine in the test sample group.

d. Have mileage and age that are less than or equal to the certified full useful life mileage and age for the subject engines.

(iv) If the Executive Officer discovers, by either evidence presented by the manufacturer as provided in section (b)(7) or on his or her own, that an engine fails to meet one or more of the applicable criteria of section (b)(3)(0)(i) through (iii), the Executive Officer shall remove the engine from the test sample group. The Executive Officer may replace any engine removed with an additional engine selected in accordance with sections (b)(3)(C) and (0) above. Test results relying on data from the removed engine shall be recalculated without using the data from the removed engine.

(4) Enforcement Testing Procedures.

(A) Prior to conducting any testing under section (b)(4), the Executive Officer may replace components monitored by the OBO system with components that are sufficiently deteriorated or simulated to cause malfunctions that exceed the malfunction criteria established pursuant to Cal. Code Regs., title 13, section 1971.1 (e) through (g) in a properly operating system. The Executive Officer may not use components deteriorated or simulated to represent failure modes that could not have been foreseen to occur by the manufacturer (e.g., the use of leaded gasoline in an unleaded gasoline engine, etc.). Upon request by the Executive Officer, the manufacturer shall make available all test equipment used by the manufacturer in development, calibration, or demonstration testing (e.g., malfunction simulators, deteriorated "threshold" components, etc.) necessary to duplicate testing done by the manufacturer to determine the malfunction criteria used for major monitors subject to OBO emission testing.

(B) OBO Emission Testing. After the test sample group has been selected and procured, the Executive Officer may perform one or more of the .following tests: .

(i) Emission testing with the test procedures used by the Executive Officer for in-use testing of compliance with exhaust emission standards in accordance with Cal. Code Regs.'- title 13, section 1956.8(b) and (d).

(ii) On-road or engine or chassis dynamometer testing with the engine being operated in a manner that reasonably ensures that all of the monitoring conditions disclosed in the manufacturer's certification application for. the tested monitor are encountered.

(C)OBO Ratio Testing.

(i) For OBO ratio testing of monitors required to meet the in-use . monitor perfqrmance ratio and track and report ratio data pursuant to Cal. Code Regs., title 13, section 1971.1(d)(3.2), after the test sample group has been selected and procured, the Executive Officer shall download the data from monitors required to track and report such data.

(ii) For OBO ratio testing of monitors required to meet the in-use monitor performance ratio but not required to track and report ratio data pursuant to Cal. Code Regs., title 13, section 1971.1 (d)(3.2), after the test sample group has been selected and procured, the Executive Officer shall collect data by installing instrumentation or data-logging equipment on the engines/vehicles. After installation of the equipment, the engines/vehicles shall be returned to the engine/vehicle owner/operator to continue to operate the engine/vehicle until the minimum denominator criteria (see section (b)(3)(O)(ii)b.) are satisfied. The Executive Officer shall then calculate the ratio from the data collected in accordance with the requirements of Cal. Code Regs., title 13, section 1971.1(d)(3.2)to allow the Executive Officer to effectively determine the in-use monitor performance ratio.

(D) Testing for compliance with any other requirement of Cal. Code Regs., title 13; section 1971.1. After the test sample group has been selected and procured, the Executive Officer may perform one or more of the following tests:

(i) Emission testing on the applicable FTP or supplemental emission test (SET) cycle or other applicable emission test cycle used for measuring exhaust or evaporative emissions;

(ii) On-road or engine or chassis dynamometer testing with the engine being operated in a manner that reasonably ensures that all of the monitoring conditions disclosed in the manufacturer's certification application for the tested monitor are encountered; or

(iii) Any other testing determined to be necessary by the Executive Officer. This may include, but is not limited to, the use of special test equipment to verify compliance with standardization requirements.

(5) Additional Testing.

(A) Based upon testing of the engine class in section (b)(4) above and after review of all evidence available at the conclusion of such testing, the Executive Officer may elect to conduct further testing of a subgroup of engines from the. engine class if the Executive Officer has determined that:

(i) A subgroup of tested engines differs sufficiently enough from other engines in the tested engine class, and

(ii) A reasonable basis exists to believe that the identified differences may indicate that the subgroup maybe nonconforming whereas the tested engine class as a whole is not.

(B) Hereinafter all references to engine class shall be applicable to the subgroup meeting the conditions of section (b)(5)(A) above.

(C)In any testing of a subgroup of engines under section (b)(5), the Executive Officer shall follow the engine selection and testing procedures set forth in sections (b)(3) and (4) above.

(6) Finding of *Nonconformance after Enforcement Testing.*

After conducting enforcement testing pursuant to section (b)(4) above, the Executive Officer shall make a finding of nonconformance of the aBO system in the identified engine class under the respective tests for the applicable model year(s) as follows:

(A) aBO Emission Testing.

(i) For 2010 through 2012 model year engines:

a. Engines certified as an aBO parent rating (Le., the engine rating subject to the "full aBO" requirement under Cal. Code Regs., title 13, section '1971.1 (d)(7.1.1)), shall be considered nonconforming if the emission test results indicate that 50 percent ormore of the engines in the test sample group do not properly illuminate the MIL when emissions exceed 2.0 times the malfunction criteria (e.g., 5.0 times the standard if the malfunction criterion is 2.5 times the standard) on the applicable standard (Le., FTP or SET).

b. In determining an engine to be nonconforming, the Executive Officer shall use: .

1. The test cycle and standard determined and identified by the manufacturer at the time of certification in accordance with Cal. Code Regs., title 13, section 1971.1 (d)(6.1) as the most . stringent for purposes of determining aBO system . nonconformance with the applicable standard in section (b)(6)(A)(i)a. and .

2.The adjustment factors determined by the manufacturer at the time of certification in accordance with Cal. Code Regs., title 13, section 1971.1 (d)(6.2) for purposes of determining aBO system' nonconformance in section (b)(6)(A)(i)a.

c. Engines certified as an aBO child rating (Le., the engine ratings SUbject to the "extrapolated aBO" requirement under Cal. Code Regs., title 13, section 1971.1(d)(7.1.2)), may not be considered nonconforming based on testing emission levels.

(ii) For 2013 through 2015 model year engines:

a. All engines classified as aBO parent and child ratings subject to Cal. Code Regs., title 13, section 1971.1 (d)(7.2.2) shall be considered to be nonconforming if the emission test results indicate that 50 percent or more of the engines in the test . sample group do not properly illuminate the MIL when emissions exceed 2.0 times the malfunction criteria (e.g., 4.0 times the standard if the malfunction criterion is 2.0 times the standard) on the applicable standard (Le., FTP or SET).

b. In determining compliance, the Executive Officer shall use only the test cycle and standard determined and identified by the manufacturer at the time of certification in accordance with Cal. Code Regs., title 13, section 1971.1(d)(6.1) as the most stringent for purposes of determining OBO system nonconformance with the applicable standard in section (b)(6)(A)(ii)a.

c. All other engines and engine ratings may not be considered nonconforming based on the emission levels of the tests.

(iii) For 2016 through 2018 model year engines:

a. PM filter monitors on engines subject to the malfunction criteria of Cal. Code Regs., title 13, section 1971.1 (e)(8.2.1)(C) shall be considered to be nonconforming if the emission test results indicate that 50 percent or more of the engines in the test sample group do not properly illuminate the MIL when emissions exceed 2.0 times the malfunction criteria (e.g., PM emission level of 0.06 g/bhp-hr if the malfunction criterion is 0.03 g/bhp-hr) on either of the applicable standards (Le., FTP or SET).

b. Monitors on engines and engine ratings previously certified to Cal. Code Regs., title 13, section 1971.1 (d)(7.2.3) for extrapolated OBO in the 2013 through 2015 model years shall be considered nonconforming if the emission test results indicate that 50 percent or more of the engines in the test sample group do not properly illuminate the MIL when emissions exceed 2.0 times.the malfunction criteria (e.g., 4.0 times the standard if the malfunction criterion is 2.0 times the standard) on either of the applicable standards (Le., FTP or SET).

c. Monitors on engines not covered under sections (b)(6)(A)(iii)a. and b. above shall be considered nonconforming if the emission test results indicate that 50 percent or more of the engines in ,the test sample group do not properly illuminate the MIL when emissions exceed the malfunction criteria on either of the applicable standards (Le., FTP or SET).

(iv) For 2019 and subsequent model year engines, any engine shall be considered nonconforming if the results of the tests indicate that 50 percent or more of the engines in the test sample do not properly illuminate the MIL when emissions exceed the malfunction criteria on eitlier of the applicable standards (Le., FTP or SET).

(v) The Executive·Officer may not consider an OBO system nonconforming solely due to a failure or deterioration mode of a monitored component or system that could not have been reasonably foreseen to occur by the manufacturer.

(B)OBO Ratio Testing.

(i) 2013 through 2015 model year engines certified to a ratio of 0.100 in accordance with Cal. Code Regs., title 13, section 1971.1 (d)(3.2.2) shall be considered nonconforming if the data collected from the engines in the. test sample group indicate either that the average in-use monitor performance ratio for one or more of the monitors in the test sample group is less than 0.050 or that 66.0 percent or more of the engines in the test sample group have an in-use monitor performance ratio of less than 0.050 for the same monitor.

(ii)·2016 and subsequent model year engines certified to a ratio of 0.100 in accordance with Cal. Code Regs., title 13, section 1971.1 (d)(3.2.2) shall be considered nonconforming if the data collected from. the engines in the test sample group indicate either that the average in-use monitor performance ratio for one or more of the monitors in the test sample group is less than 0.088 or that 66.0 percent or more of the engines in the test sample group have an in-use monitor performance ratio of less than 0.100 for the same monitor.

(C)All Other OBO Testing.

(i) Engines shall be considered nonconforming if the results of the testing indicate that at least 30 percent of the engines in the test sample group do not comply with the same requirement of Cal. Code Regs., title 13, section 1971.1.

(ii) Engines shall be considered nonconforming if the results of the testing indicate that at least 30 percent of the engines in the test sample group do not comply with one or more of the requirements of Cal. Code Regs., title 13, section 1971.1 while the engine is running and while in the key on,engine off position such that off-board equipment designed to access the following parameters via the standards referenced in Cal. Code Regs., title 13, section 1971.1 for 2013 and subsequent model year engines cannot obtain valid and correct data for the following parameters:

a. The current readiness status from all on-board computers required to support readiness status in accordance with Society of Automotive Engineers J1979 (SAE J1979) or J1939 (SAE J1939) as incorporated by reference in Cal. Code Regs., title 13, section 1971.1(h)(1) and section 1971.1(h)(4.1);

b. The current MIL command status while the MIL is commanded off and while the MIL is commanded on in accordance with SAE J1979/J1939 and Cal. Code Regs., title 13, section 1971.1(h)(4.2), and in accordance with SAE J1979/J1939 and Cal. Code Regs., title 13, section 1971.1(d)(2.1.2) during the MIL functional check and, if applicable Cal. Code Regs., title 13, section 1971.1 (h)(4.1.3) during the MIL readiness status check;

c. The current permanent fault code(s) in accordance with SAE J1979/J1939 and Cal. Code Regs., title 13, section 1971.1 (h)(4.4);

d. The data stream parameters for: engine speed and OBD requirements to which the engine is certified as required in Cal. Code Regs., title 13, section 1971.1(h)(4.2) and in accordance with SAE J1979/J1939;
e. The CAL ID, CVN, ESN, and VIN as required in Cal. Code Regs., title 13, sections 1971.1(h)(4.6), (h)(4.7), and (h)(4.8) and in accordance with SAE J1979/J1939; or
f. The proper identification of all data identified in (b)(6)(C)(ii)a. through (b)(6)(C)(ii)e. as supported or unsupported as required in Cal. Code Regs., title 13, section 1971.1(h)(4) and in accordance with SAE J1979/J1939.

(iii) If the finding of nonconformance under section (b)(6)(C)(i) above concerns engines that do not comply with the requirements of Cal. Code Regs., title 13, section 1971.1(d)(4) or (5) (e.g., numerators or denominators are not properly being incremented), it shall be presumed that the nonconformance would result in an OBD ratio enforcement test result that would be subject to an ordered OBD-related recall in accord with the criterion in section (d)(3)(A)(i). The manufacturer may rebut such a presumption by presenting evidence in accord with section (b)(7)(C)(iii) below that demonstrates to the satisfaction of the Executive Officer that the identified nonconformance would not result in an ordered OBD-related recall under section (d)(3)(A)(i).

(7) *Executive Officer Notification to the Manufacturer Regarding Determination of Nonconformance.*

(A) Upon making the determination of nonconformance in section (b)(6) above, the Executive Officer shall notify the manufacturer in writing.

(B) The Executive Officer shall include in the notice:

(i) a description of each group or set of engines in the engine class covered by the determination;

(ii) the factual basis for the determination, including a summary of the test results relied upon for the determination;

(iii) a statement that the Executive Officer shall provide to the manufacturer, upon request and consistent with the California Public Records Act, Government Code section 6250 et seq., all records material to the Executive Officer's determination;

(iv) a provision allowing the manufacturer no less than 90 days from the date of issuance of the notice to provide the Executive Officer with any information contesting the findings set forth in the notice; and

(v) a statement that if a final determination is made that the engine class is equipped with a nonconforming OBD system, the manufacturer may be subject to appropriate remedial action, including recall and monetary penalties.

(C) Within the time period set by the Executive Officer in section (b)(7)(B)(iv) and any extensions of time granted under section (b)(7)(H), the manufacturer shall provide the Executive Officer, consistent with paragraphs (i) through (iii) below, with any test results, data, or other information derived from engine testing that may rebut or mitigate the results of ARB testing, including any evidence that an engine class, if determined to be nonconforming, should be exempted from mandatory recall. (See section (d)(3)(B) below.).

(i) For OBO emission testing and OBO ratio testing:

a. The manufacturer may submit evidence to demonstrate that engines in the test sample group used by the Executive Officer were inappropriately selected; procured, or tested in support of a request to have engines excluded from the test sample group in accordance with section (b)(3)(O)(iv).

b. If the manufacturer elects to conduct additional testing of engines in the engine class and submit the results of such testing to the Executive Officer, the manufacturer shall:

1. Present evidence that it has followed the procurement and test procedures set forth in sections (b)(3) and (4) above, or

2. If the manufacturer elects to use different procuremerit and testing procedures, submit a detailed description of the procedures used and evidence that such procedures provide an equivalent level of assurance that the results are representative of the engine class.

(ii) If the manufacturer objects to the size of the test sample group or the method used to procure engines in the test sample group used by the Executive Officer pursuant to section (b)(3)(B)(iii) or (b)(3)(C)(ii), the manufacturer shall set forth what it considers to be the appropriate size and procurement method, the reasons therefore, and test data from engines that confirm the manufacturer's position.

(iii) If the manufacturer elects to present evidence to overcome the presumption of nonconformance in section (b)(6)(C)(iii) above, the manufacturer shall demonstrate that the engines in .the engine class comply with in-use monitor performance ratio requirements of Cal. Code Regs., title 13, section 1971.1(d)(3.2) by presenting:

a. Evidence in accord with the procurement and testing requirements of sections (b)(3) and (4).

b. Any other evidence that provides an equivalent level of proof that engines operated in California comply with the in-use monitor performance ratio requirements.

. (O)The Executive Officer may accept any information submitted by a manufacturer pursuant to section (b)(7)(C) above after the time established for submission of such information has passed if the manufacturer could not have reasonably foreseen the need for providing the information within the time period provided. Otherwise, the Executive Officer is not required to accept late information. In determining whether to accept late information, the Executive Officer will consider the lateness of the" submission, the manufacturer's reasons for why such information was not timely presented, the materiality of the information to the Executive Officer's final determination, and what effect any delay may have on effective enforcement and the health and welfare of the. State. .

(E) The requirements of section (b)(7) shall not be construed to abridge the manufacturer's right to 'assert any privilege or right provided under California law.

(F) After receipt of any information submitted by the manufacturer pursuant to section (b)(7)(C) above, the Executive Officer shall consider all information submitted by the manufacturer and may conduct any additional testing that he or she believes is necessary.

(G) Final Determination.

(i) Within 60 days after completing any additional testing that the Executive Officer deemed necessary under section (b)(7)(F) above, the Executive Officer shall notify the manufacturer of his or her final determination regarding the finding of nonconformity of the OBO system in the engine class. The determination shall be made after considering all of the information collected and received, including all information that has been received from the manufacturer.

(ii) The notice must include a description of each engine family(ies), OBO group(s), or subgroups thereof, that has been determined to have a nonconforming OBO system and set forth the factual bases for the determination.

(H) Extensions. The Executive Officer may for good cause extend the time requirements set forth "in section (b)(7). In granting additional time to a manufacturer, the Executive Officer shali consider, among other things, any documentation submitted by the manufacturer regarding the time that it reasonably believes is necessary to conduct its own testing, why such information could not have been more expeditiously presented, and what effect any delay caused by granting the extension may have on effective enforcement and the health and welfare of the State. The Executive Officer shall grant a manufacturer a reasonable extension of time upon the manufacturer demonstrating that despite the exercise of reasonable diligence, the manufacturer has been unable to produce relevant evidence in the time initially provided.

(c) *Manufacturer Self-Testing.*

(1) *Purpose.*

To assure that OBO systems on production engines certified on an engine dynamometer are able to detect a fault before emissions exceed the malfunction criteria established in Cal. Code Regs., title 13, sections *"1971.1 (e)* through (g), engine manufacturers shall evaluate engines for each model year,starting with the 2010 model year.

(2) Engine Selection for Manufacturer Self-Testing.

(A) After OBO certification of all engines in the model year, a manufacturer shall submit a listing to the Executive Officer of all of the engine families and engine ratings within each family certified for that model year. The Executive Officer will then select the engine family(ies) and the specific engine rating within the engine family(ies) that the manufacturer shall use as a test engine for the test sample group to provide emission test data.

(i) For 2013 through 2015 model year engines, the Executive Officer may not select engines from OBO child ratings subject to "extrapolated OBO" under Cal. Code Regs., title 13, section 1971.1 (d)(7.2.3).

(B) Number of test engines.

(i) For the 2010 model year, a manufacturer shall provide emission test data of a test engine from the OBO parent rating.

(ii) For the 2013 and subsequent model years, a manufacturer certifying one to five engine families in a model year shall provide emission test data of a test engine from one engine rating. A manufacturer certifying six to ten engine families in a model year shall provide emission test data from test engines from two engine ratings. A manufacturer certifying eleven or more engine families in a model year shall provide emission test data of test engines from three engine ratings. The Executive Officer may waive the requirement for submittal of data of one or more of the test engines if data have been previously submitted for all of the engine ratings.

(C) Engines to be included in test sample group.

(i) In selecting engines to be included in a test sample group for manufacturer self-testing, the manufacturer shall include only engines that:

a. Are certified to the requirements of Cal.' Code Regs., title 13, section 1971.1 and California exhaust emission standards.

b. Are used in vehicles registered for operation in the United States.

c. Have mileage that is between 70 to 80 percent of the certified full useful life mileage and an age of less than the certified full useful life age for the subject engines.

d. Have not been tampered with or equipped with add-on or modified parts that would cause the OBO system not to comply with the requirements of Cal. Code Regs., title 13, section 1971.1 or would have a permanent effect on exhaust emission performance.

e. Have not been SUbjected to abuse (e.g., overloading, misfueling) neglect, improper maintenance, or other factors that would cause the OBO system not to comply. with the requirements of Cal. Code Regs., title 13, section 1971.1 or would have a permanent effect on exhaust emission performance.

f. Have no detected or known malfunction(s) unrelated to the monitor or system being evaluated that would affect the performance of the OBO system. With request to and approval from the Executive Officer, the manufacturer may elect to repair an engine with a detected or known malfunction and then include the engine in the test sample group.

g. Have had no major repair to the engine resulting from a collision.

h. Have no problem that might jeopardize the safety of laboratory personnel.

(ii) If the manufacturer discovers, by either evidence presented by the Executive Officer or on its own, that an engine fails to meet one or more of the applicable criteria of section (c)(2)(C)(i), the manufacturer shall notify the Executive Officer of its findings and request approval to remove the engine from the test sample group. If approved by the Executive Officer, the manufacturer shall replace any engine removed with an additional engine selected in accordance with section (c)(2)(C)(i). Test results relying on data from the removed engine shall be recalculated without using the data from the removed engine.

(3) Compliance/Enforcement Testing Procedures.

(A) Within'three calendar years after the model year of the engine,(e.g., by the end of calendar year 2013 for a 2010 model year engine), the engine manufacturer shall complete the testing required under section (c)(3).

(B) Prior to conducting any testing under section (c)(3), the engine manufacturer shall replace components monitored by the OBO system with components that are sufficiently deteriorated or simulated to cause malfunctions that exceed the malfunction criteria established pursuant to Cal. Code Regs., title 13, sections 1971.1(e) through (g) in a properly operating system. The engine manufacturer may not use components deteriorated or simulated to represent failure modes that could not have been foreseen to occur by the manufacturer (e.g., the use of leaded gasoline in an unleaded engine, etc.).

(C) After the test engine(s) has been selected and procured under section (c)(2) above, the engine manufacturer shall perform emission testing for all applicable components/systems according to the certification demonstration testing requirements of Cal. Code Regs., title 13, sections 1971.1 (i)(3) and (i)(4).

(O) No modifications or replacement of componerits to make the engine compatible with engine dynamometer testing (e.g., replacement of an air-to-air charge cooler with a water-to-air charge cooler) shall be done without approval by the Executive Officer. The Executive Officer shall approve such requests upon the manufacturer documenting the technical need for such a modification or replacement and providing engineering data or analysis demonstrating that any such modified part will be configured to simulate the current performance of the actual part removed from the engine (e.g., the water-to-air cooler must be configured to perform similarly to the air-to-air coolerin its current state of aging/deterioration, not to the performance specifications of the air-to-air cooler When new or to the manufacturer's specifications or performance characteristics used on the water-to-air cooler when the engine was originally certified).

(E) Upon request of the manufacturer,the Executive Officer may extend the deadline set forth in section (c)(3)(A) or reduce the minimum mileage required in section (c)(2)(C)(i)c. upon finding that the manufacturer has demonstrated good cause for the requested extension or mileage reduction..

(F) Upon request of the manufacturer, the Executive Officer may approve other compliance/enforcement testing protocols for (c)(3). The Executive Officer shall approve the request upon the manufacturer demonstrating that other testing protocol will provide comparable assurance that the in-use engines comply with the malfunction criteria established pursuant to Cal. Code Regs., title 13, sections 1971.1(e) through (g).

(4) *Additional Testing.*

(A) If the results of the aBO emission tests conducted under section (c)(3) indicate that the aBO system properly illuminates the MIL for all component/system monitors before emissions exceed the malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1(e) through (g), no further testing is required.

(B) If the results of the aBO emission tests conducted under section (c)(3) indicate that aBO system does not properly illuminate the MIL for one or more of the component/system monitor(s) before emissions exceed the malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1 (e) through (g), the engine manufacturer shall conduct further testing on additional engines.

(i) Within six months after the completion of testing required in section .(c)(3), the engine manufacturer shall emission test an additional four engines from the same engine rating and engine family as the test engine.

(ii) The engine manufacturer shall only be required to test the component/system monitor(s) for which the aBO emission test results in (b)(3) exceeded the malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1(e) through (g).

(C) For manufacturers subject to section (c)(4)(B) above, no further testing is required if the results of the aBO emission tests conducted under section (c)(4)(B) indicate that aBO system properly illuminates the MIL for the tested component/system monitor(s) before emissions exceed the malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1 (e) through (g) on three or more of the additional test engines.

(D) For manufacturers subject to section (c)(4)(B) above, if the results of the OBO emission tests conducted under section (c)(4)(B) indicate that the OBO system does not properly illuminate the MIL for one or more of the tested component/system monitor(s) before emissions exceed the malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1 (e) through (g) on two or more of the additional test engines, the engine manufacturer shall conduct further testing.

(i) Within six months after the completion of testing required in section (c)(4)(B), the engine manufacturer shall test an additional five engines from the same engine rating and engine family as the previously tested engines.

(ii) The engine manufacturer shall test only the component/system monitor(s) for which the OBO emission test results exceeded the malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1 (e) through (g).

(E) In any testing of the additional engines under section (c)(4), the engine manufacturer shall follow the engine selection and testing procedures set forth in sections (c)(2) and (c)(3) above.

(5) ARB Authority to Observe Testing. The Executive Officer may elect to have ARB personnel observe the testing under sections (c)(3) and (c)(4) above.

(A) During conducting of the testprocedures described in sections (c)(3) and (c)(4) above, an engine manufacturer, upon receipt of prior notice, must admit or cause to be admitted during operating hours any ARB personnel that has presented proper credentials to any of the following:

(i) Any facility where tests or procedures or activities connected with such tests or procedures are performed;

(ii) Any facility where a manufacturer procures, inspects, screens, removes from vehicles, works on, configures, or modifies engines for testing; and

(iii) Any facility where any record or other document relating to any of the above is located.

(B) Upon admission to any facility referred to in section (c)(5)(A) above, any ARB personnel must be allowed to:

(i) Inspect and monitor al'ly part or aspect of such procedures, activities, and testing facilities, including monitoring engine preconditioning, emissions tests, and break-in, maintenance, and engine storage procedures;

(ii) Verify correlation or calibration of test equipment;

(iii) Inspect and make copies of any such records, designs, or other documents; and

(iv) Inspect and/or photograph any part or aspect of any such tested engine and any components or equipment used in the testing thereof.

(C) Any ARB personnel must be furnished by those in charge of a facility being inspected with such reasonable assistance as may be necessary to discharge any function listed in section (c)(5)(B) above. The engine manufacturer is required to cause those in charge of a facility operated for its benefit to furnish such reasonable assistance without charge to ARB irrespective of whether or not the engine manufacturer controls the facility.

(D) The duty to admit or cause to be admitted any ARB personnel applies whether or not the engine manufacturer owns or controls the facility in question and applies both to the domestic and foreign engine manufacturers and facilities. If ARB personnel are prohibited from admission, the Executive Officer may reject any data produced by the manufacturer and may presume that the tested engines do not conform to certification standards. 'In such circumstances, the Executive Officer may suspend or revoke the engine's. certification or take other necessary corrective action.

(E) For purposes of section (c)(5):

(i) "Presentation of credentials" means a display of a document designating a person as an ARB employee.

(ii) Where engine, component, or engine storage areas or facilities are concerned, "operating hours" means all times during which employees are at work in the vicinity of the area or facility and have access to it. .

(iii) Where facilities or areas other than those covered by paragraph (c)(5)(E)(ii) above are concerned, "operating hours" means all times during which an assembly line is in operation or during which testing, maintenance, break-in procedu're, production or compilation of records, or any other procedure or activity is being conducted related to certification testing, translation of designs from the test stage to the production stage, or engine manufacture or assembly.

(iv) "Reasonable assistance" includes providing clerical, copying, interpretation and translation services, making personnel available upon request to inform ARB personnel of how the facility operates and to answer questions, and performing requested emissions test on any engine that is being, has been, or will be used for certification testing. Such tests must be nondestructive, but may require appropriate break-in. Upon service of a written request from the Executive Officer for the appearance of any employee at a facility qualified for reasonable assistance, the engine manufacturer shall cause the personal appearance of such qualified employee to appear before and assist ARB personnel.

(6) Manufacturer Reporting of Self-Testing Results to 'the Executive Officer.

(A) Within 30 days after completing the testing under section (c)(3), the manufacturer shall submit a report of the results of all the testing to the Executive Officer for review. If further testing is required under section (c)(4), an additional report shall be submitted within 30 days of completing the additional testing. The report(s) must include the following:

(i) A description of each test engine and the engine family and engine rating to which the test engine belongs to;

(ii) A description of the test sequence (e.g., the number and types of preconditioning cycles) used for each testing;

(iii) A description of the modified or deteriorated components used for fault simulation with respect to each testing; and

(iv) The test results of all testing done under sections (c)(3) and (c)(4) for each test engine, consisting of:

a. the weighted emission test results for all measured pollutants for each test; and

b. the OBO data specified by Cal. Code Regs., title 13, section 1971.1 (i)(4.3.2) collected prior to (or immediately after) each engine shut-down during the testing of sections. (c)(3) and (c)(4) including the preconditioning cycles.

(7) Finding of *Nonconformance after Manufacturer Self-Testing.*

After the engine manufacturer has conducted testing pursuant to sections (c)(3) and (c)(4) and the Executive Officer has received the test results pursuant to section (c)(6) above, the Executive Officer shall make a finding of nonconformance of the OBO system in the engine class according to the criteria of section (b)(6)(A).

(8) Executive Officer Notification to the Manufacturer Regarding Determination of *Nonconformance.*

Upon making the determination of nonconformance in section (c)(7) above, the Executive Officer shall follow the procedures and requirements of section (b)(7).

(d) *Remedial Action.*

(1) Voluntary OBD-Related Recalls.

If a manufacturer initiates a voluntary OBO-related recall campaign, the manufacturer shall notify the Executive Officer of the recall at least 45 days before owner notification is to begin. The manufacturer shall also submit 'a voluntary OBO-related recall plan for approval, as prescribed under section *(e)(1)* below. A voluntary recall plan shall be deemed approved unless disapproved by the Executive Officer within 30 days after receipt of the recall plan.

(2) Influenced OBD-Related Recalls.

(A) Upon being notified by the Executive Officer, pursuant to section (b)(7)(G), that an engine class is equipped with a nonconforming OBO system, the manufacturer may, within 45 days from the date of service of such notification, elect to conduct an influenced OBD-related recall of all engines within the engine class for the purpose of correcting the nonconforming OBO systems. Upon such an election, the manufacturer shall submit an influenced OBO-related recall plan for approval, as prescribed under section *(e)(1)* below.

(B) If a manufacturer.does not elect to conduct an influe'nced aBO-related recall under section (d)(2)(A) above, the Executive Officer may order the manufacturer to undertake appropriate remedial action, up to and including the recall and repair of the nonconforming aBO systems.

(3) Ordered Remedial Action-Mandatory Recall.

(A) Except as provided in sections (d)(3)(B) below, the Executive Officer shall order the recall and repair of all engines in an engine class that have been determined to be equipped with a nonconforming aBO system if enforcement testing conducted pursuant to sections (b) or (c) above or information received from the manufacturer indicates that:

(i) For major monitors required to meet the in-use performance ratio pursuant to Cal. Code Regs., title 13, section 1971.1 (d)(3.2) on 2016 and subsequent model year engines, the average in-use , monitor performance ratio for one or more of the major monitors in the test sample group is less than or equal to 33.0_percent of the applicable required minimum ratio established in Cal. Code Regs., title 13, section 1968.2(d)(3.2.2) (e.g., if the required ratio is 0.100, less than or equal to a ratio of 0.033) or 66.0 percent or more of the vehicles in the test sample group have an in-use monitor performance ratio of less than or equal to 33.0 percent of the applicable required minimum ratio established in Cal. Code Regs., title 13, section 1968.2(d}(3.2.2) for the same' major monitor.

(ii) For major monitors required to indicate a malfunction before emissions exceed a certain emission threshold, when the engine is tested in a vehicle and operated so as to reasonably encounter all monitoring conditions disclosed in the manufacturer's certification application, the aBO system is unable to detect and illuminate the MIL for a malfunction of a component/system monitored by the major monitor prior to emissions exceeding:

a. For 2013 through 2015 model year aBO parent and child ratings subject to the "full aBO" requirement under Cal. Code Regs., title 13, section 1971.1(d)(7.2.2), three times the applicable major monitor malfunction criteria (e.g., if the malfunction criteria is 2.5 times the applicable standard, recall would be required when emissions exceed 7.5 times the applicable standard, or if the malfunction criteria is the PM standard plus 0.02 g/bhp-hr and the PM standard is 0.01 g/bhp-hr, recall would be required when emissions exceeded 0.09 g.-bhp-hr).

b. For 2016 through 2018 model year engines:

1. For engine ratings previously certified to Cal. Code Regs.,' title 13, section 1971.1(d)(7.2.3) for "extrapolated aBO" in the 2013 through 2015 model years, three times the applicable majormonitor malfunction criteria (e.g., if the malfunction criteria is 2.5 times the applicable standard, recall would be required when emissions exceed 7.5 times

the applicable standard, or if the malfunction criteria is the' PM standard plus 0.02 g/bhp-hr and the PM standard is 0.01 g/bhp-hr, recall would be required when emissions exceeded 0.09 g-bhp-hr), and

2. For all other engine ratings, three times the malfunction criteria for PM filter monitors subject to Cal. Code Regs., title 13, section 1971.1(e)(8.2.1)(C) (e.g., if the malfunction criteria is the PM standard plus 0.02 g/bhp-hr and the PM standard is 0.01 g/bhp-hr, recall would be required when emissions exceeded 0.09 g-bhp-hr) and two times the malfunction criteria for all other appljcable major monitors.

c. For 2019 and subsequent model year engines, two times the applicable major monitor malfunction criteria (e.g., if the malfunction criteria is 2.5 times the applicable standards, recall would be required when emissions exceed 5.0 times the applicable standards).

(iii) For 2016 and subsequent model year gasoline engines, the monitor for misfire causing catalyst damage is unable to properly detect and illuminate the MIL for misfire rates that are more than 20 percentage points greater than the misfire rates disclosed by the manufacturer in its certification application as causing catalyst damage (e.g., if the disclosed misfire rate is 12 percent, recall would be required if the misfire rate is greater than 32 percent without proper detection).-

(iv) For 2016 and subsequent model year gasoline engines, when the engine is tested in a vehicle and operated so as to reasonably encounter all monitoring conditions disclosed in the manufacturer's certification application, the evaporative system monitor is unable to detect and illuminate the MIL for a cumulative leak or leaks in the evaporative system equivalent to that caused by an orifice with a diameter of at least 1.5 times the diameter of the required orifice in Cal. Code Regs., title 13, section 1971.1(f)(7.2.2)(B).

(v) When the engine is tested in a vehicle and operated so as to reasonably encounter all monitoring conditions disclosed in the manufacturer's certification application, the OBO system cannot detect and illuminate the MIL for a malfunction of a component that effectively disables a major monitor and the major monitor, by being disabled, meets the criteria for.recall identified in sections (d)(3)(A)(ii) or (iv) above (e.g. is unable to detect and illuminate the MIL for malfunctions that cause FTP emissions to exceed two times the malfunction criteria).

(vi) The engine class cannot be tested so as to obtain valid test results in accordance with the criteria identified in ·section (b)(6)(C)(ii) due to the nonconforming OBO II system.

(B) An engine class shall not be subject to mandatory recall if the Executive Officer determines that, even though a monitor meets a criterion set forth in section (d)(3)(A)(i)-(vi) for mandatory recall:

(i) The OBO system can still detect and illuminate the MIL for all malfunctions monitored by the nonconforming monitor (e.g., monitor "A" is non-functional but monitor "B" is able to detect all malfunctions of the component(s) monitored by monitor "A").

(ii) The monitor meets the criterion solely due to a failure or deterioration mode of a monitored component or system that could not have been reasonably foreseen to occur by the manufacturer.

(iii) The failure or deterioration of the monitored component or system that cannot be properly detected causes the engine to be unoperable (e.g., engine stalls continuously or the transmission will not shift out of first gear, etc.) or causes an overt indication such that the operator is certain to respond and have the problem corrected (e.g., illumination of an over-temperature warning light or charging system light that uncorrected will result in an undriveable vehicle, etc.).

(C) A motor vehicle class that is not subject to mandatory recall pursuant to paragraph (d)(3)(B) may still be subject to remedial action pursuant to section (d)(4) below.

(4) Other Ordered Remedial Action.

(A) If the Executive Officer has determined based upon enforcement testing conducted pursuant to sections (b) or (c) above or information received from the manufacturer that an engine class is equipped with a nonconforming OBO system and the nonconformance does not fall within the provisions of section (d)(3), he or she may require the manufacturer to undertake remedial·action up to and including recall of the affected engine class.

(B) In making his or her findings regarding remedial action, the Executive Officer shall consider the capability of the aBO system to properly function. This determination shall be based upon consideration of all relevant circumstances including, but not limited to, those set forth below.

(i) Whether the manufacturer identified and informed ARB about the nonconformance(s) or whether ARB identified the nonconformance(s) prior to being informed by the manufacturer.

(ii) The number of nonconformances.

(iii) If the identified nonconformance(s) is with a major monitor(s), the nature and extent of the nonconformance(s), including:

a. the degree to which the in-use monitor performance ratio(s) is .below the required ratio(s).specified in Cal. Code Regs., title 13, section 1971.1 (d)(3.2.2), and

b. the amount of the emission exceedance(s) over the established malfunction criteria set forth in Cal. Code Regs.,. title 13, sections 1971.1 (e) through (g) before a malfunction is detected and the MIL is illuminated.

(iv) If the identified nonconformance(s) is with a non-major monitor, the nature and extent of the nonconformance(s), including:

a. the degree to which the in-use monitor performance ratio(s) (where applicable) is below the required ratio(s) specified in Cal. Code Regs., title 13, section 1971.1(d)(3.2.2),

b. the degree to which the monitored component must be malfunctioning or exceed the established malfunction criteria set forth in Cal. Code Regs., title 13, sections 1971.1(e) through (g) before a malfunction is detected and the MIL is illuminated, and

c. the effect that the nonconformance(s) has on the operation of a major monitor(s).

(v) The impact of the nonconformance on vehicle or engine owners (e.g., cost of future repairs, driveability,. etc.) and the ability of the service and repair industry to make effective repairs (e.g., difficulty in accessing fault information, diagnosing the root cause of a failure, etc.).

(vi) The degree to which the identified nonconformance(s) complicates, interferes with, disrupts, or hampers a service technician's or inspector's ability to perform a California heavy-duty vehicle or engine inspection.

(vii) The failure of the data link connector of the engine class to meet the requirements of Cal. Code Regs., title 13, section 1971.1 (h)(2).

(viii) The failure of the crankcase ventilation system in the engine class to comply with the requirements of Cal. Code Regs., title 13, section 1971.1 (g)(2).

(ix) The failure of the cooling system monitor in the engine class to properly verify that the cooling system reaches the highest enable temperature used for any other monitor when the engine is operated in a vehicle in the monitoring conditions disclosed in the manufacturer's certification application, or failure to comply with any requirement in Cal. Code Regs., title 13, section 1971.1(g)(1).

(x) The estimated frequency that a monitor detects a malfunction and illuminates the MIL when no component malfunction is present (Le., false MILs).

(xi) The estimated frequency that a monitor fails to detect a malfunction and illuminate the MIL when the monitoring conditions, as set forth in the manufacturer's approved certification application, have been satisfied and a faulty or deteriorated monitored component is present (Le., false passes).

(xii) Whether the manufacturer submitted false, inaccurate, or incomplete documentation regarding the identified nonconformance at the time of certification pursuant to Cal. Code Regs., title 13, section 1971.1 (j) and the extent to which the false, inaccurate, or incomplete documentation was material to the granting of certification.

(C) In making the determination, the average tailpipe and evaporative emissions of engines within the affected engine class shall not be considered.

(5) *Assessment of Monetary Penalties.*

The Executive Officer may seek penalties pursuant to the applicable provisions of the Health and Safety Code for violations of the requirements of Cal. Code Regs., title 13, section 1971.1 or for production engines otherwise failing to be equipped with OBO systems that have been certified by ARB. In determining the penalty amounts that ARB may seek, the Executive Officer shall consider all relevant circumstances including the factors set forth below:

(A) Whether the manufacturer self-reported the nonconformity or ARB discovered the nonconformity independent of the manufacturer.

(B) The nature and degree of the nonconformity and whether the manufacturer should reasonably have discovered the nonconformity and taken corrective action by voluntary OBO-related recall or running changes during the production year.

(C) The economic benefits, if any, gained by the manufacturer from not complying with the provisions of Cal. Code Regs., title 13, section 1971.1.

(O) The manufacturer's history of compliance with the OBO requirements.

(E) The preventative .efforts taken by the manufacturer to avoid nonconformance, including any programs followed by the manufacturer to ensure compliance.

(F) The manufacturer's efforts to correct the nonconformity once it was identified.

(G) The innovative nature and magnitude of effort, including the cost of any other proposed remedial action, necessary to correct the nonconformity.

(H) The deterrent effect of the penalty.

(I) Whether the manufacturer has failed to provide complete and accurate information required to be submitted at the time of certification pursuant to Cal. Code Regs., title 13, section 1971.1(j).

(J) The nature and degree that OBO systems on production engines differ from the systems that have been certified by ARB.

(6) *Notice to Manufacturer for an Ordered Remedial Action.*

(A) The Executive Officer shall immediately notify the manufacturer upon the Executive Officer determining the type of remedial action to be taken.

(B) For remedial actions other than the assessment of monetary penalties, the notice must:

(i) specifically set forth the remedial action that is being ordered,

(ii) include a description of the engine family(ies), OBO group(s), or subgroup(s) thereof, that has been determined to have a nbnconforming OBO system,

(iii) set forth the factual bases for the determination, and

(iv) designate adate at least 45 days from the' date of receipt of such notice by which the manufacturer shall submit a plan, pursuant to section (e)(1) below, outlining the remedial action to be undertaken consistent with the Executive Officer's order. Except as provided in section (d)(7)(C) below, all plans shall be submitted to the Chief, Mobile Source Operations Division, 9528 Te1star Avenue, Suite 4, El Monte, California 91731, within the time limit specified in the notice. The Executive Officer may grant the manufacturer an extension of time for good cause.

(C) For cases in which ARB elects to seek monetary penalties pursuant to authority granted under the Health and Safety Code, the Executive Officer shall issue a notice to the manufacturer that he or she will be filing a complaint in the appropriate administrative or civil court forum seeking penalties against the manufacturer for violations of *Cal.* Code Regs., title 13, section 1971.1. The notice must include a description of the engine family(ies), OBO group(s), or subgroup(s) thereof, that have been determined to have a nonconforming OBO system and set forth the factual bases for the determination.

(7) Availability of Public Hearing to Contest Remedial Actions Other than Determination to Seek Monetary Penalties.

(A) Within 45 days from the date of receipt of the notice that is required under section (d)(6) above, the manufacturer may request a public hearing pursuant to the procedures set forth in Cal. Code Regs., title 17, section 60055.1, et seq., to contest the findings of nonconformity, the necessity for, or the scope of any ordered 'remedial action. Pursuant to those procedures, the Executive Officer has the initial burden of presenting evidence- that those parts of the Executive Officer's determination specifically challenged are supported by the facts and applicable law. (Cal. Code Regs., title 17, §60055.32(d)(1).) Each issue of controversy shall be decided based upon the preponderance of the evidence presented at the hearing. (Cal. Code Regs., title 17, §60055.32(h).)

(B) Notwithstanding the provisions of Cal. Code Regs., title 17, section 60055.17(a)(1), administrative hearings conducted pursuant to a request filed under section (c)(7)(A) above shall be referred to the Office of Administrative Hearings, which shall otherwise follow the procedures established in Cal. Code Regs., title 17, section 60055.1 et. seq.

(C) If a manufacturer requests a public hearing pursuant to section (d)(7)(A) above and if the Executive Officer's determination of nonconformity is confirmed at the hearing, the manufacturer shall submit the required remedial action plan in accordance with section (e)(1) below within 30 days after receipt of the Board's decision.

(e) *Requirements for Implementing Remedial Actions.*

(1) Remedial Action Plans.

(A) A manufacturer initiating a remedial action (voluntary, influenced, or ordered), other than payment of monetary penalties, shall develop a remedial action plan that contains the following information, unless otherwise specified:

(i) A description of each engine family, OBO group, or subgroup thereof covered by the remedial action, including the number of engines, the engine families, or subgroups within the identified c1ass(es), the make(s), model(s), and model years of the covered engines, and such other information as may be required to identify the covered engines.

(ii) A description of the nonconforming OBO system and, in the case of a recall (whether voluntary, influenced, or ordered), the specific modifications, alterations, repairs, adjustments, or other changes to correct the nonconforming OBO system, including data and/or engineering evaluation supporting the specific corrections.

(iii) A description of the method that the manufacturer will use to determine the names and addresses of vehicle or engine owners and the manufacturer's method and schedule for notifying the service facilities and vehicle or engine owners of the remedial action.

(iv) A copy of all instructions that the manufacturer will use to notify service facilities about the required remedial action and the specific corrections, if any, that will be required to be made to the nonconforming OBO systems.

(v) A description of the procedure to be followed by vehicle/engine owners to obtain remedial action for the nonconforming OBO system. This must include the date on or after which the owner can have required remedial action performed, the time reasonably necessary to perform the labor to remedy the nonconformity, and the designation of facilities at which the nonconformity can be remedied.

(vi) If some or all of the nonconforming OBO systems are to be remedied by persons other than dealers or authorized warranty agents of the manufacturer, a description of such class of service agents and what steps, including a copy of all instructions mailed to such service agents, the manufacturer will take to assure that such agents are prepared and equipped to perform the proposed remedial action.

(vii) A copy of the letter of notification to be sent to vehicle or engine owners.

(viii) A proposed schedule for implementing the remedial action, including identified increments of progress towards full implementation.

(ix) A description of the method that the manufacturer will use to assure that an adequate supply of parts will be available to initiate the remedial action campaign on the date set by the manufacturer and that an adequate supply of parts will continue to be available throughout the campaign.

(x) A description and test data of the emission. impact, if any, that the proposed remedial action may cause to a representative engine from the engine class to be remedied.

(xi) A description of the impact, if any, and supporting data and/or engineering evaluatibn that the proposed remedial action will have on fuel economy, driveability, performance, and safety of the engine class covered by the remedial action.

(xii) Any other information, reports, or data which the Executive Officer may reasonably determine to be necessary to evaluate the remedial action plan.

(B) Approval and Implementation of Remedial Action Plans.

(i) If the Executive Officer finds that the remedial action plan is designed effectively to address the required remedial action and complies with the provisions in section (e)(1)(A) above, he or she shall notify the manufacturer in writing within 30 days of receipt of the plan that the plan has.been approved.

(ii) The Executive Officer shall approve a voluntary, influenced, or ordered remedial action plan if the plan contains the information specified in section (e)(1)(A) above and is designed to notify the vehicle or engine owner and implement the remedial action in an expeditious manner.

(iii) In disapproving an ordered remedial action plan, the Executive Officer shall notify the manufacturer in writing of the disapproval and the reasons for the determination. The manufacturer shall resubmit a revised remedial action plan that fully addresses the reasons for the Executive Officer's disapproval within 10 days of receipt of the disapproval notice.

(iv) Upon receipt of the approval notice of the ordered remedial action plan from the Executive Officer, the manufacturer shall, within 45 days of receipt of the notice, begin to notify vehicle or engine owners and implement the remedial action campaign.

(v) If the Executive Officer disapproves a voluntary or influenced remedial action plan, the manufacturer shall either accept the proposed modifications to the plan as suggested by the Executive Officer, resubmit a revised remedial action plan that fully addresses the reasons for the Executive Officer's disapproval within 30 days or be subject to an Executive Officer order that the manufacturer undertake appropriate remedial action pursuant to section (d)(2)(B) above.

(vi) Upon receipt of the voluntary or influenced remedial action approval notice from the Executive Officer, the manufacturer shall begin to notify vehicle or engine owners and implement the remedial action campaign according to the schedule indicated in the remedial action plan.

(2) Eligibility for Remedial Action.

(A) The manufacturer may not condition a vehicle or engine owner's eligibility for remedial action required under section 1971.5 on the proper maintenance or use of the engine.

(B) The manufacturer shall not be obligated to repair a component which has been modified or altered such that the remedial action cannot be performed without additional cost.

(3) Notice to Owners.

(A) The manufacturer shall notify owners of vehicles or engines in the engine class covered by the remedial order. The notice must be made by first-class mail or by such other means as approved by the Executive Officer. When necessary, the Executive Officer may require the use of certified mail for ordered remedial actions to assure effective notification.

(B) The manufacturer shall use all reasonable means necessary to locate vehicle or engine owners, including motor vehicle registration lists available from the California Department of Motor Vehicles and commercial sources such as R.L. Polk & Co..

(C) The notice must contain the following:

(i) For ordered remedial actions, a statement: "The California Air Resources Board has determined that your (vehicle or engine) (is or may be) equipped with an improperly functioning on-board emission-related diagnostic system that violates established standards and regulations that were adopted to protect your health and welfare from the dangers of air pollution."

(ii) For voluntary and influenced remedial actions, a statement: "Your (vehicle or engine) (is or may be) equipped with an improperly functioning on-board emission-related diagnostic system that violates (California or California and Federal) standards and regulations" if applicable as determined by the Executive Officer.

(iii) A statement that the nonconformity of any such engines will be remedied at the expense of the manufacturer.

(iv) A statement that eligibility for remedial action may not be denied solely on the basis that the vehicle or engine owner used parts not manufactured by the original equipment engine manufacturer, or had repairs performed by outlets other than the engine manufacturer's franchised dealers.

(v) Instructions to the vehicle or engine owners on how to obtain remedial action, including instructions on whom to contact (Le., a description of the facilities where the vehicles or engines should be take'n for the remedial action), the first date that a vehicle or engine may be brought in for remedial action, and the time that it will reasonably take to correct the nonconformity.

(vi) The statement: "In order to assure your full protection under the emission warranty provisions; it is recommended that you have your (vehicle or engine) serviced as soon as possible. Failure to do so could be determined as lack of proper maintenance of your (vehicle or engine)."

(vii) A telephone number for vehicle or engine owners to call to report difficulty in obtaining remedial action.

(viii) A card to be used by a vehicle or engine owner in the event the vehicle or engine to be recalled has been sold. Such card should be addressed to the manufacturer, have postage paid, and shall provide a space in which the owner may in"dicate the name and address of the person to whom the vehicle or engine was sold or transferred.

(ix) If the remedial action involves recall, the notice must also provide:

a. A clear description of the components that will be affected by the remedial action and a general statement of the measures to be taken to correct the nonconformity.

b. A statement that such non'conformity, if not corrected, may cause the vehicle or engine to fail an emission inspection.

c. A statement describing the adverse effects, if any, of an uncorrected nonconforming aBO system on the performance, fuel economy, or durability of the engine.

d. A statement that after remedial action has been taken, the manufacturer will have the service facility issue a certificate showing that the engine has been corrected under the recall program, and that such a certificate will. be required to be provided to the Department of Motor Vehicles as a condition for . vehicle registration.

(D) A notice sent pursuant to this section or any other communication sent to vehicle or engine owners or dealers may not contain any statement, expressed or implied, that the aBO system is compliant or that the aBO system will not degrade air quality.

(E) The Executive Officer shall inform the manufacturer of any other requirements pertaining to the notification und.er section (e)(3) which the Executive Officer has determined as reasonable and necessary to assure the effectiveness of the recall campaign.

(4) *Label Indicating that Recall Repairs Have Been Performed.*

. (A) If the required remedial action involves recall of engine family(ies), aBO group(s), or sUbgroup(s) thereof, the manufacturer shall require those who perform inspections and/or recall repairs to affix a label to each vehicle that has been inspected and/or repaired.

(B) The label must be placed in a location approved by the Executive Officer and must be fabricated of a material suitable for such location in which it is installed and which is not readily removable.
(C) The label must contain the remedial action campaign number and a code designating the facility at which the remedial action or inspection to determine the need for remedial action was performed.

(5) *Proof of Performance of Remedial Action Certificate.*
If the required remedial action involves a recall, the manufacturer shall provide, through its service agents, to owners of vehicles or engines that have had the remedial action performed a certificate that confirms that the engine has been recalled and that required inspection and/or repairs have been performed. The Executive Officer shall prescribe a format for the certificate, which shall be consistent with the format required in Cal. Code Regs., title 13, section 2117 and section 2129.

(6) *Record Keeping and Reporting Requirements.*
(A) The manufacturer shall maintain sufficient records to enable the Executive Officer to conduct an analysis of the adequacy of the remedial action..
(B) Unless otherwise specified by the Executive Officer, the manufacturer shall report on the progress of the remedial action campaign by submitting reports for eight consecutive quarters commencing with the quarter immediately after the recall campaign begins. The reports shall be submitted no later than 25 days after the close of each calendar quarter to: Chief, Mobile Source Operations Division, 9528 Telstar Avenue, Suite 4, El Monte, California 91731. For each recall campaign, the quarterly report must contain the following:
(i) The engine family and the remedial action campaign number designated by the manufacturer and a brief description of the nature of the campaign.
(ii) The date owner notifications began and date completed.
(iii) The number of engines involved in the remedial action campaign.
(iv) The number of engines known or estimated to be equipped with the nonconforming OBD system and an explanation of the means by which this number was determined.
(v) The number of engines inspected during the campaign since its inception..
(vi) The number of engines found to be affected by the nonconformity during the campaign since its inception.
(vii) The number of engines receiving remedial action during the campaign since its inception-.
(viii) The number of engines determined to be unavailable for inspection or remedial action, during the campaign since its inception, due to exportation, theft, scrapping, or other reasons (specify).

(ix) The number of engines, during the campaign since its inception, determined to be ineligible for remedial action under section (e)(2)(B).

(x) An initial list, using the following data elements and designated positions, indicating all vehicles or engines subject to recall that the manufacturer has not been invoiced for, or a subsequent list indicating all engines subject to the recall that the manufacturer has been invoiced for since the previous report. The list must be supplied in a standardized computer format to be specified by the Executive Officer. The data elements must be written in "ASCII" code without a comma separating each element. For example: XTY32A71234E-9456123408-25-91A. The add flag (see below) should reflect the vehicles or engines for which the manufacturer has not been invoiced and the delete flag should reflect changes since the previous report. The Executive Officer may change the frequency or format of this submittal depending on the needs of enforcement. The Executive Officer may not, however, require a frequency or format for this submittal that is different in any way from the frequency or format determined by the Executive Officer as required for reporting of data in Cal. Code Regs., title 13, section 2119(a)(10) and section 2133(a)(10).

Data Elements	Positions
• File Code (designated by DMV)	1
• License Plate Number	2-8
• last three VIN positions	9-11
• Recall 10 Number.	12-17
• Mfg. 10 Number (Mfg. Occupational License Number)	18-22
• Recall Start Date (mmddyyyy)	23-30
• Add or Delete Flag *(AID)*	31
• Complete VIN if personalized license plate (File Code "I" or "S")	32-48

(xi) A copy of any service bulletins issued during the reporting period by the manufacturer to franchised dealerships or other service agents that relate to the nonconforming OBD system and the remedial action and have not previously been reported to the Executive Officer.

(xii) A copy of all communications transmitted to vehicle or engine owners that relate to the nonconforming OBD systems and the required remedial action and have not been previously reported to the Executive Officer.

(C) If the manufacturer determines that any of the information submitted to the Executive Officer pursuant to section (e) has changed or is incorrect, the manufacturer shall submit the revised information, with an explanation.

(D) The manufacturer shall maintain in a form suitable for inspection, such as computer information, storage devices, or card files, and shail make available to the Executive Officer or his or her authorized representative up'on request, the names and addresses of vehicle or engine owners:

(i) To whom notification was sent;

(ii) Whose engines were repaired or inspected under the recall campaign;

(iii) Whose engines were determined not to be eligible for remedial action because the engines were modified, altered, or unavailable due to exportation, theft, scrapping, or other reason specified in the answer to sections (e)(6)(B)(viii) and (ix).

(E) The information gathered by the manufacturer to compile the reports required by these procedures must be retained for no less than one year beyond the useful life of the engines and must be made available to authorized personnel of ARB upon request.

(F) The filing of any report under the provisions of these procedures must not affect the manufacturer's responsibility to file reports or applications, obtain approval, or give notice under any other provisions of law.

(7) Extension of *Time.*

Upon request of the manufacturer, the Executive Officer may extend any deadline set forth in section 1971.5(e) upon finding that the manufacturer has demonstrated good cause for the requested extension.

(f) *Penalties for Failing to Comply with the Requirements* of *Section (e).*

(1) In addition to the penalties that may be assessed by the Executive Officer pursuant to section (d) because of a manufacturer's failure to comply with the requirements of Cal. Code Regs., title 13, section 1971.1, a manufacturer may be subject to penalties pursuant to section 43016, Health and Safety Code for failing to comply with the requirements of section (e).

(2) If a manufacturer fails to comply with a voluntary or influenced remedial action plan"the Executive Officer may order remedial action pursuant to section (d) above.

NOTE: Authority cited: Sections 39600, 39601, 43000.5, 43013, 43016, 43018, 43100,43101,43104,43105,43105.5,43106,43154,43211, and 43212, Health and Safety Code. Reference: Sections 39002, 39003, 39010, 39018, 39021.5, 39024,39024.5,39027,39027.3,39028,39029,39031,39032,39032.5,39033, 39035,39037.05,39037.5,39038,39039,39040,39042,39042.5,39046, 39047,39053,39054,39058,39059,39060,39515,39600,-39601,43000, 43000.5,43004,43006,43013,43016,43018,43100,43101,43102,43104, 43105,43105.5,43106,43150,43151,43152,43153,43154,43155,43156, 43204,43211, and 43212, Health and Safety Code.

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NOTICE OF CONTINUATION

TITLE 13. CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC HEARING TO CONSIDER PLUG-IN HYBRID ELECTRIC VEHICLE TEST PROCEDURE AMENDMENTS AND AFTERMARKET PARTS CERTIFICATION REQUIREMENTS ADOPTION

The Air Resources Board (the Board or ARB) will conduct a continuation of a public hearing at the time and place noted below to consider amendments to motor vehicle test procedures for exhaust emissions, evaporative emissions, and refueling emissions, and new requirements for certification of aftermarket conversion systems for plug-in hybrid electric vehicles.

This item was considered by the Board at its January 22-23, 2009,- hearing at which time the Board received all timely written comments and heard oral testimony from all witnesses. At the January hearing, the Board approved the test procedures for the exhaust, evaporative, and refueling emissions with the modifications proposed by staff, subject to a 15-day supplemental comment period. The Board also directed staff to engage in additional review of the new requirements for certification of aftermarket conversion systems for plug-in hybrid electric vehicles (conversion regulation) and to report back to the Board at a future hearing. Although the public comment period was closed at-the end of the January hearing, the record will be reopened and the Board will accept written comments and public testimony on the conversion regulation. After considering the staffs supplemental report and presentation, _and public testimony and written comments, the Board plans to take appropriate action on the conversion . regulation. The Board's continued hearing will be conducteq at the date, time, and place listed below.

DATE:	May 28,2009
TIME:	9:00 a.m.
PLACE:	California Environmental Protection Agency Air Resources Board Byron Sher Auditorium, Second Floor 1001 I Street Sacramento, California 95814

This item will be considered ata two-day meeting of the Board, which will commence at 9:00 a.m. on Thursday, May 28,2009, and may continue at 8:30 a.m., May 29,2009: This item may not be considered until May 29, 2009. Please consult the agenda for the meeting, which will be available at least 10 days before May 28,2009, to determine the day on which this item will be considered.

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If you require special accommodations or language needs, please contact the Clerk of the Board at (916) 322-5594 or by FAX at (916) 322-3928 as soon as possible, but no later than 10 business days before the scheduled Board hearing. TTYrrDD/Speech-to-Speech users may dial 711 for the California Relay Service.

THE CONTINUED HEARING

The continued hearing will be conducted as described in the original notice, California Regulatory Notice Register, Volume No. 49-2, Notice File No. Z2008-1125-06 (December 5,2008), except that the public comment period will be reopened on May 12, 2009 for written comments on the staffs supplemental report. To be considered by the Board, written submissions not physically submitted at the meeting must be received **no later than 12:00 noon, May 27, 2009,** and addressed to the following:

Postal mail:	Clerk of the Board, Air Resources Board 1001 I Street, Sacramento, California 95814
Electronic submittal:	http://www.arb.ca.gov/lispub/comm/bclist.php
Facsimile submittal:	(916) 322-3928

Please note that under the California Public Records Act (Government Code section 6250 et seq.), your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email, etc.) become part of the public record and can be released to the public upon request. Additionally, this information may become available via Google, Yahoo, and any other search engines.

All comments submitted for the hearing on January 22-23, 2009, will remain part of the rulema.king record. The original notice, the ISOR, the supplemental report, and all subsequent regulatory documents, including the FSOR, when completed, are available on the ARB Internet site for this rulemaking at http://www.arb.ca.gov/regact/2008/phev09/phev09.htm. If the Board decides to approve the originally noticed conversion regulation with modifications, staff will prepare the modified regulatory text and a supplemental comment period of at least 15 days will be opened during which the public will have the opportunity to submit written comments on the modifications to the Executive Officer before final action.

The public may request a copy of the supplemental report and the modified regulatory text when released from the ARB's Public Information Office, Air Resources Board, 1001 I Street, Visitors and Environmental Services Center, 1st Floor, Sacramento,. . CA 95814, (916) 322-2990.

Inquiries concerning the substance of the proposed regulation may be directed to the designated agency contact persons, Ms. Lesley Crowell, Air Resources Engineer, by email tolcrowell@arb.ca.gov or by phone at (916) 323-2913, or to Ms. Elise Keddie, Manager, ZEV Implementation Section, by email toekeddie@arb.ca.gov or by phone at (916) 323-8974.

Further, the agency representative and designated back-up contact persons to whom nonsubstantive inquiries concerning the proposed administrative action may be directed are Ms. Lori Andreoni, Manager, Board Administration & Regulatory Coordination Unit, (916) 322-4011, or Ms. Amy Whiting, Regulations Coordinator, (916) 322-6533. The Board has compiled a record for this rulemaking action, which includes all the information upon which the proposal is based. This material is available for inspection upon request to the contact persons.

CALIFORNIA AIR RESOURCES BOARD

James N. Goldstene
Executive Officer

Date: April 17, 2009

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
AIR RESOURCES BOARD·

SUPPLEMENTAL STAFF REPORT: PROPOSED RULEMAKING FOR PLUG-IN HYBRID-ELECTRIC VEHICLES

MODIFICATIONS TO THE PROPOSED AFTERMARKET PARTS CERTIFICATION REQUIREMENTS

Location:
Byron Sher Auditorium
Air Resources Board, Cal/EPA Headquarters
1001 I Street
Sacramento, CA 95812

Date of Release: May 12, 2009
Scheduled for Consideration: May 28-29, 2009

Executive Summary

In January 2009, staff presented certification test procedures for plug-in hybrid electric vehicles (PHEVs) along with certification procedures for aftermarket PHEV conversion systems. The Board adopted the certification test procedures for new PHEVs, but asked that staff return with a proposal for the conversion system requirements that allowed more flexibility and created a phased approach to certification that encouraged development of systems. Staff is returning to the Board with this proposal which creates a tiered approach to certification of PHEV conversion systems starting with application and engineering analysis that shows that there are no emission increases compared to the unconverted vehicle for the first ten units; requiring emission testing for the subsequent 90 units; and full certification for units thereafter. Warranty requirements for systems are also phased in. Staff,is proposing to limit use of this tiered certification program to the first 5,000 units industry wide in order to allow the industry to get started with the expectation that technology maturity will develop sufficiently by the time 5,000 units are certified that traditional aftermarket certification requirements can be used thereafter.

Staff has identified some risk to emissions performance associated with this certification approach. It is staff's expectation that the initial engineering analysis included in the first tier of the certification process will identify how the systems will control cold start and evaporative emissions, however, if this analysis is wrong or if the systems fail to deliver durable emissions performance, the conversion system failures could lead to significantly increased emissions compared to the unconverted vehicles. For this reason, staff recommends adoption of the proposed tiered certification procedures with the limited numbers of vehicles per tier and the 5,000 total systems cap for the industry. This would have worst case potential emission increase of 19.4 tons per year of excess oxides of nitrogen plus non methane organic gases. The economic impacts of this proposal are largely the same as the original staff proposal; however they are spread out over the manufacturer's first 100 vehicle conversions, providing conversion companies with a revenue stream to support certification costs.

Introduction

The most recent changes to the ZEV regulation, considered in March 2008 included provisions that strongly encourage commercialization of plug-in HEVs (pHEV) or off vehicle charge capable HEVs. However existing regulations governing emission test procedures applicable to PHEVs needed to be modified and certification procedures for conversions needed to be created to fully implement the incorporation of this vehicle technology. At its January 23,2009, public hearing, the Air Resources Board (ARB or Board) considered' staff's proposed regulations for the certification of PHEV conversion systems and emission test procedures applicable to PHEVs. These certification procedures are required because any emission related vehicle modification requires an exemption from California's anti-tampering statute, Vehicle Code section 27156. The anti-tampering exemption is needed to assure that vehicle modifications do not cause increase emissions.

During the Board Hearing several conversion system manufacturers expressed that the proposed certification procedures were too costly, would stifle innovation, would severely impact small businesses, and may eliminate the technology. At the conclusion of the hearing, the Board requested that staff continue to meet with PHEV conversion system manufacturers to determine if additional flexibility could be incorporated into the certification procedures. The vehicle code limits the amount of flexibility that can be given. Staff met with PHEV system manufacturers and held an additional public workshop on March 25, 2009 where additional flexibility could be provided without violating the vehicle code.

Staff is proposing modifications to the PHEV conversion system certification regulations to provide additional fleXibility to conversion system manufacturers! while staying within the guidelines of the vehicle code and limiting the potential emissions impacts of converted vehicles should tests show that application statements are not validated., This is accomplished through a tiered certification requirement system, which allows conversion manufacturers to sell a limited number of vehicles as they move through the certification process. This Supplemental Staff Report describes staff's revised proposal for the certification of PHEV conversion systems.

At the January 23,2009 hearing's conclusion, the Board also approved with modifications, staff's proposals for emission test procedures applicable to PHEVs. This Supplemental Staff Report does not review the emission test procedures because the Board's approved modifications will be available separately when staff releases a notice of availability of modified text. Additional information on the emission test procedures is available on ARB's internet website at:
http://www.arb.ca.gov/regact/2008/bhev09/phev09.htm.

Overview of Current Certification Processes

Currently, certification or installation procedures designed specifically for PHEV conversion systems do not exist. In the absence of certification procedures, PHEV conversion systems may be certified two ways: an exemption from the anti-tampering requirements or recertifying the entire vehicle. PHEV conversions systems may be granted an exemption from the anti-tampering requirements, using procedures for exemption add-on and modified parts, provided the converted vehicle can meet the emission certification standards and the onboard diagnostic system requirements of the original vehicle. This exemption procedure does not include warranty provisions and is not applicable to conversion of vehicles still operating under the OEM's warranty.

Date of Release of the Initial Statement of Reasons: December 5, 2008
Date of Initial Board Hearing: January 22-23, 2009 ,
Date of Release of Supplemental Staff Report: May 12,2009
Date of Second Board Hearing: May 28-29, 2009

Many PHEV conversion system manufacturers want to convert hybrid electric vehicles (HEV) that are still operating under the original equipment manufacturer's (OEM) warranty. For HEVs certified as partial zero emission allowance vehicles (PZEV), the OEM warranty is 15 years or 150,000 miles for all emission related components and 10 years or 150,000 miles for the zero emission energy storage device. An example of a zero emission energy storage device is a battery. .

Currently, a conversion system manufacturer modifying a vehicle still covered by the OEM warranty must certify the converted vehicle as a new vehicle, and be responsible for the entire vehicle as a small volume manufacturer. An application for certification must be submitted to and approved by ARB and the U.S. Environmental Protection Agency, concurrently. Uncertified conversions would violate California's anti-tampering statute.

Proposed Modifications

ARB staff proposes modifications to staffs originally proposed certification procedures to provide additional flexibility to conversion system manufacturers, while limiting the potential emissions impacts of converted vehicles and addressing the requirements of the anti-tampering regulation. The proposed modifications provide for a three-tiered certification process. The proposed tiered certification process grants a manufacturer certification based on conversion system production and sales numbers and allows the gradual increase in certification requirements to address increased emissions impact potentials. In addition, staff desires to keep these procedures aligned with the certification procequres for alternative fuel conversions.

The staffs revised proposed aftermarket certification procedure provides a streamlined process for PHEV conversion system manufacturers to certify their products, while balancing the economic concerns expressed at the January Board Hearing. The proposed certification procedure is less onerous than ARB's small volume manufacturer requirements or staffs original proposal for PHEV conversion system certification. Staffs revised proposal modifies the'certification and installation procedures by breaking the certification requirements into three tiers. Each tier contains additional certification requirements. Once the requirements of the next tier are met, conversion companies can increase their sales. Tier3 is similar to staffs original proposal. The revised certification procedure assures, however, that a conversion system does not increase the original vehicle's emissions. With this assurance, the revised certification procedures fulfill the criteria for exemption from California's anti-tampering statute, while allowing the additional flexibility needed to address the cost to comply.

Tier 1 allows the sale of up to 10 vehicle conversion systems. In the first tier, the conversion system manufacturer's application must address five main criteria: initial durability component data, a durability test plan for the converted vehicle, a consumer manual that shows at least a 3-year or 50,000 mile warranty on the conversion system, a discussion on the process to maintain records of sales and installations, and an engineering analysis showing that conversion does not impact the emissions of the original vehicle.

Tier 2 allows the sale of up to 100 vehicle conversions. In the second tier, manufacturers must meet the first tier requirements along with three additional criteria: provide an onboard diagnostic compliance plan, submit a consumer manual which shows at least a warranty of 5 years or 75,000 miles, and submit emission test data which shows that the vehicle meets applicable emission standards, and does not trigger the onboard diagnostics malfunction indicator light (MIL) or diagnostic trouble code (DTC). During the second tier, ARB may perform confirmatory testing to verify the emission test data.

In the third tier, conversion system manufacturers must fully comply with the emission test procedures, among other requirements, to achieve certification. The requirements must be met when a manufacturer has sold 100 vehicle conversions. For this tier, all of the requirements of the previous two tiers must be met along with proof that the following requirements are met:

- The battery durability requirement is completed;
- The durability of the conversion is proven to last through the vehicle's useful life;
- The converted vehicle must fully comply with onboard diagnostics;
- The warranty must go through the remaining OEM warranty or the requirements in the second tier, whichever is longer; and
- The exhaust-, evaporative-, and on-board-vapor-recovery-refueling emission standards testing for hybrid electric vehicles are satisfactorily completed.

The proposed regulatory language is shown in Appendices, A and B.

For the third tier, the conversion system certification requirements are similar to what staff proposed at the January Board Hearing with the exception of the warranty. The conversion system warranty originally proposed in the December 5, 2008 Staff Report was equivalent to the OEM warranty: 15 years or 150,000 miles, and 1 years or 150,000 miles for the zero-emission energy-storage device. In the new proposal the third tier requires a 5 year or 75,000 mile warranty or the remaining OEM warranty whichever is greater, and thus reduces the warranty requirements.

The compliance flexibility of the tiered certification procedure applies to the manufacturer and not to individual conversion system designs. Therefore a manufaCturer may choose to submit multiple applications for different conversion system designs; however, only ten total conversions per manufacturer can be certified under Tier 1. This allows each company to make a decision on how many systems to develop and what will best serve the company's goals. After 5000 vehicles are converted industry-wide, Tier 1 and Tier 2 options are no longer available. This limits and controls the overall potential em'issions and economic impacts for the tiers as will be discussed in the next section.

The proposed tiered certification process provides additional flexibility that is balanced with the potential impacts to air quality and the economy. The flexibility is provided to encourage the conversion system industry to certify vehicles and, therefore, operate legally in California. As product sales increase, staff anticipates conversion system manufacturers will have the resources to meet each tier of certification requirements.

Table 1 on the following page summarizes staff's proposal for tiered certification of PHEV conversions.

Date of Release of the Initial Statement of Reasons: December 5, 2008
Date of Initial Board Hearing: January 22-23, 2009
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Table 1: Proposed Tier Requirements

Tier[†]	Number of systems that can be sold in the tier[1]	Requirements prior to sale in the tier	Action items to proceed to next tier
1	0-10	1. Application (see below for items to be included) 2. Engineering analysis showing no impact on emissions (specifically canister purge and cold starts) 3. Submit durability test plan[2] and initial durability data (component and in-use)3 4. System Warranty 3yr/50K mi 5. Installation Warranty 3yr/50K mi 6. ARB approval of engineering analysis & submittal prior to exemption/sale	1. Conduct emission tests. 2. Oevelop process for compliance with OBO. 3. Maintain record of sales/installations. 4. Ourability test plan begins for their vehicle[3]
2	11-100	1. Application for Tier 2 2. Emission test data 3. Show that durability testing has beg'un[3] 4. Show of readiness indicators set and no OBO MIU OTC during emission tests 5. OBO compliance plan 6. System warranty: 5yrf75K mi 7. ARB may perform confirmatory testing to verify emission test data. If requested, provide test vehicle. 8. ARB approval of submittal prior to exemption/sale	1. Start OBO compliance process. 2. Maintain record of sales/installations. 3. Continue durability testing
3	101+	1. Application for Tier 3 2. Ourability test data to vehicle useful life[3] 3. Battery durability/test data 4. OBO approval 5. System warranty: 5yr/75K mi or . remaining OEM warranty, whichever is longer 6. ARB approval of submittal prior to exemption/sale	1. ARB will begin in-use testing. If requested, conversion. manufacturers provide converted vehicles[3]. 2. Maintain record of sales/installations.

t The tiered system ends and is no longer available for any manufacturer after a cumulative total from all manufacturers reaches 5000 vehicle conversion kits. For the 5001[s1] vehicle conversion and all conversions thereafter, all manufacturers must meet the full certification requirements in the regulation. OBO compliance fleXibility is still available under the OBO regulations.

1 The experimental permit process allows manufacturers to produce a prototype system and test up to 5 vehicles. Manufacturers must apply for the permits and the vehicles cannot be sold.
2 Plan must be for useful life of vehicle.
3 Up to 5 vehicles temporarily needed for in-use testing.

Potential Impacts of the Prop,osed Modifications

Warranty Impacts

Most hybrid electric vehicles (HEV) that conversion manufacturers are interested in providing systems for are certified to partial zero emission vehicle (PZEV) emission .standards. These vehicles come with a 15-year or 150,000 mile warranty on the emissions system and a 1O-year or 150,000 mile warranty on the zero-emission energy-storage device. In the case of HEVs, the zero-emission energy-storage device would most likely be a battery. Warranties on the emissions system are a valuable tool to . encourage consumers to repair their vehicle and guarantee the emission benefits of those cars operating in California. Staff has determined that consumers typically fix emission related problemswith their vehicles only if required through SmogCheck, recalls or if covered by warranty. Converting a vehicle could impact the OEM warranty, if defect in the conversion is determined to cause the damage to tfte OEM's system.

Emission Impacts

While staff believes a PHEV conversion can be done without increasing the vehicle's emissions, installations or configurations must be made carefully to prevent significant increases to the original vehicle's emissions. Staff has evaluated the potential emission impact of PHEV conversions. Based on emissions testing performed on several . converted PHEVs, a PHEVconversion system can easily increase the original vehicle's exhaust emissions up to 5 times the amount its original certification value. In addition, the evaporative emissions can increase to up to 16 times the amount of its original certification value. Table 2 shows a comparison of PZEVs (the .certification standard for the original vehicle) and the potential emissions of PHEV conversions without careful consideration of cold start and evaporative emissions.

Table 2: Potential Increase in Emissions from 5000 PHEV Conversions in TPY*

	NOx	Hwy NOx	NMOG	CO	PM
PZEV	1.2	1.7	1.3	57	0.6
Potential PHEV.conversion	5.8	8.6	13.8	287	2.9
Incremental Increase	**4.6**	**6.9**	**12.5**	**230**	**2.3**

* Assumes 11,500 mile.s per year

. A vehicle's emissions come predominantly from internal combustion engine starts. Catalytic converters are designed to reduce these emissions, but must be adequately warmed for the emissions system to work properly. Hybrid systems operate on an electric motor, an internal combustion engine, or a combination of both. Emission

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increases can occur with multiple engine starts during a single vehicle trip, and inadequate warming of the catalytic converter. In an HEV, the internal combustion engine starts and stops depending on user demand and the amount of energy stored in the energy storage device. If user demand exceeds the amount of energy stored, the vehicle's computer will trigger the internal combustion engine start. Examples of this would include high acceleration rates, streets with high grades, or even simple driving habits if the battery is depleted. If this consumer demand occurs when the catalytic converter is not adequately warmed the emissions will be higher as well.

Converting hybrids to add plug in capability can increase evaporative emissions, as well. Careful consideration of the canister limitations must be evaluated. If the conversion prevents the internal combustion engine from purging"the canister or the control system,from recognizing when the internal combustion engine should purge the canister, emission breakthrough will' occur.

Verification of *Emissions Performance*

To ensure that the emissions do not increase, maintenance and periodic checks are necessary to ensure that the emissions do not increase over the life of the vehicle. In addition, three programs determine if emission related issues exist: certification, SmogCheck and in-use testing.

The certification requirements include provisions which require the conversion system manufacturer to demonstrate that the conversion does not Increase the original vehicle's emissions throughout the useful life of the vehicle. Generally, for aftermarket conversions, the demonstration is made through emission and durability testing. Through aftermarket certification, these two demonstrations are used to determine if the vehicle meets the anti-tampering requirements prior to public sale.

For most vehicles, SmogCheck is the main tool that is used after certification to determine if vehicles have emission related problems and need emission systems repair. Smog Check does not determine if a vehicle meets its ARB certification values. At best, the SmogCheck tai.lpipe test identifies vehicles meeting in-use exhaust emission levels that were more than two or three times the vehicle exhaust emission standards. All 1993 and newer model year vehicles are held to the same SmogCheck tailpipe in-use levels even though certification standards have dropped by at least an order of magnitude. In addition, conversion installations are usually verified for correct installation and checked for ARB certification at SmogCheck stations. However, HEV testing is not available under the existing SmogCheck process and these vehicles are exempt from Smog Check through January 2010 for purposes of vehicle registratiqn renewal.

HEVs are currently excluded from SmogCheck because the current SmogCheck test has a mandatory tailpipe test and these results must be electronically recorded in order for the vehicle to pass. Since HEVs have two modes of motive power and, therefore, do not always utilize the internal combustion engine, an HEV will not reliably run the internal combustion engine during the tailpipe test. This will cause a SmogCheck failure, s.ince the analyzer thinks the technician has not run the test correctly (failed to turn the engine on, is diluting the tailpipe exhaust, etc.). The Bureau of Automotive Repair (BAR) plans to modify the test to allow HEVs to receive all the other elements of the SmogChe,ck test (On Board Diagnostics (aBO), visual inspection, gas cap test) without conducting the tailpipe test. .

Uncertified and illegal conversions would normally be identified during SmogCheck's visual inspection. Since HEVs are excluded from SmogCheck, uncertified and illegal aftermarket PHEV conversions are going unnoticed, and consumers owning these converted vehicles are able to renew the vehicle's registration without knowing their vehicle may have increased emissions. Once modified, SmogCheck will identify emission related problems in HEVs through the aBO and the visual inspections. Visual inspections will identify conversions and then verify certification of the conversion system. Therefore, a complying aBO system is a necessary component for the PHEV certification requirements.

To determine if vehicles meet the certification standards and requirements, the vehicles are also tested in ARB's in-use testing program. ARB's in-use testing is currently the only enforcement mechanism that can determine if an HEV is not meeting the certification requirements and thus having emission related problems. ARB's in-use te,sting program allows ARB staff to randomly select vehicles and check them for compliance with certification standards. ARB has the authority to require OEMs and conversion system manufacturers to recall vehicles that fail to meet certification emission standards under ARB's in-use testing program. In addition, ARB may choose to rescind a conversion system manufacturer's certification executive order.

Economic Impacts

Staff evaluated the economic impacts' of the proposed modifications and determined that the costs will. not be more than what was discussed in Staff's December 5, 2008 Initial Statement of Reasons. Most economic costs to the conversion system manufacturer are reduced or shifted. Since under the modified proposal for Tiers 1 and 2 emissions testing, durability testing, and aBO cbmpliance are based on submitted data rather than testing, the costs associated with these items are reduced. In addition, the modified proposal's reduced warranty periods shift most of the warranty costs and risk from the conversion system manufacturer to the consumer. This is true of all three tiers, butwill most significant impact in the first two tiers. In the third tier, costs, with the exception of the reduced potential economic impact of the warranty, will be the same as staffs original proposal.

Issues

After meetings with conversion system manufacturers and our March 25, 2009 workshop the following issues remain for conversion system manufacturers:

- Conversion system manufacturers have requested higher vehicle thresholds for Tier 1 and Tier 2

Staff does not believe increases in the thresholds are ·appropriate. Vehicle Code section 27156 allows the anti-tampering exemption only if emissions are not increased. Under the tiered process, aftermarket certification requirements are less onerous for Tiers 1 and 2 and take into account the size of the businesses. By tiering aftermarket certification requirements, the modified proposed procedure would set a new precedent and would be the least stringent of all ARB's conversion system certification procedures.

- Conversion system manufacturers believe the warranty for the battery is too onerous

Conversion system manufacturers want to reduce the warranty on the battery from 10 years to 3 years. The modified proposal requires a minimum of 5 years or 75,000 miles or the remainder of the OEM warranty. Staff believ.es the Warranty is needed for assure emissions control systems performance and consumer protection. Supplemental batteries can cause additional load on the OEM battery' and thus an early failure. The overall effects of the conversion on the existing emissions control systems are unknown. More studies need to be done before reversing the precedent set for warranties in other ARB aftermarket procedures.

- Conversion manufacturers want to "grandfather" existing converted vehicles. into PHEV certification

Vehicle Code section 27156 prevents the ARB from certifying vehicles that do not meet the requirements. These conversions can be certified as long as they meet the proposed requirements. If certified, staff proposes that these vehicles count in the manufacturer's tier requirements. If not certified, the vehicles will be operating illegally.

- Conversion manufacturers want to be able to make running changes to controls and are concerned that these changes may trigger additional emissions testing

As with all certifications, production vehicles and conversions must be identical in all material respects to those of the certification vehicles for which the certification was granted and all emissions-related production running changes and field fixes must be approved prior to sale. Some running changes may have the potential to impact emissions and therefore may require additional emissions testing.

The experimental permit process will remain available to manufacturers still perfecting their aftermarket conversion systems. Due to the research purposes and experimental nature of vehicle conversion systems operating under the experimental permit process, however, vehicles converted under experimental permits are not eligible for sale. Aftermarket companies should seek certification of their conversion systems when their conversion systems are able to meet the applicable certification requirements and are ready for sale to the public.

Conclusion

Staff recommends the Board adopt the modified proposal as described.

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APPENDICIES

APPENDIX A: **PROPOSED REGULATION ORDER (no additional modifications from December 5, 2009)**

APPENDIX B: **MODIFIED PROPOSED LANGUAGE FOR AFTERMARKET PARTS CERTIFICATION OF OFF-VEHICLE CHARGE CAPABLE HYBRID-ELECTRIC VEHICLES**

Date of Release of the Initial Statement of Reasons:	December 5, 2008
Date of Initial Board Hearing:	January 22-23, 2009
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APPENDIX A

PROPOSED REGULATION ORDER: (no modifications to December 5, 2009 version)

Note: The regulation text is shown in underline to indicate additions to and strikeout to indicate deletions from the current regulations. For ease of review, the text of section 2032, which is proposed for adoption as a new regulation, is shown without underline as permitted by section 8, title 2, California Code of Regulations.

Date of Release of the Initial Statement of Reasons: December 5, 2008
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Amend the title of article 5, chapter 1, division 3, title 13, California Code of Regulations and adopt section 2032, title 13, California Code of Regulations to read:

Article 5. Approval of Systems Designed to Convert Motor Vehicles to Use Fuels Other Than the Original Certification Fuel or to Convert Motor Vehicles for Emission Reduction Credit or to Convert Hybrid Electric Vehicles to Off-Vehicle Charge Capable Hybrid. Electric Vehicles

§ 2032. Off-Vehicle Charge Capable Hybrid Electric Vehicle Conversion Systems

(a) Applicable Standards.

Hybrid electric vehicles for the 2000 and later model years in the passenger car, light-duty truck, and medium-duty vehicle classes, converted to incorporate off-vehicle charging capability shall meet the California emission standards for the model year of original manufacture and certification.

(b) Applicable Test Procedures.

The certification and installation procedures that shall apply for approval of systems that convert 2000 and later model-year hybrid electric vehicles in the passenger car, light-duty truck, and medium-duty vehicle classes to use off-vehicle charging are contained in the "California Certification and Installation Procedures for Off-Vehicle Charge Capable Conversion Systems for 2000 and Subsequent Model Year Hybrid Electric Vehicles," adopted by the state board on {INSERT DATE OF ADOPTION], which are incorporated herein by reference.

(c) Definitions.

The definitions that apply to section 2032, title 13, CCR, are contained in sections 1900, 1962, and 1962.1, title 13, CCR, and the test procedures incorporated by reference in paragraph (b); section 2032, title 13, CCR.

NOTE: Authority cited: Sections 39515, 39600, 39601, 43000, 43006, and 43013, Health and Safety Code. Reference: Sections 43000,43004,43006,43008.6, and 43013, Health and Safety Code; and Sections 27156 and 38391, Vehicle Code.

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APPENDIXB

State of California
AIR RESOURCES BOARD

CALIFORNIA CERTIFICATION AND INSTALLLATION PROCEDURES FOR OFF-VEHICLE CHARGE CAPABLE CONVERSION SYSTEMS FOR 2000 AND SUBSEQUENT MODEL YEAR HYBRID ELECTRIC VEHICLES

[Note: All text is proposed for' adoption. As permitted by section 8, title 2, California Code of Regulations, the proposed text from December 5, 2008 is not underlined for ease of review., Proposed text modifications marked with underline are additions to the December 5, 2008 text, and text marked for deletion is indicated with strikeout.]

Adopted: [INSERT DATE OF ADOPTION]

Note: These procedures are incorporated by reference into section 2032,'title 13, California Code of Regulations (CCR).

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California Certification and Installation Procedures for Off-Vehicle Charge Capable Conversion Systems for 2000 and Subsequent Model Year Hybrid Electric Vehicles.

1. APPLICABILITY

(a) "California Certification and Installation Procedures for Off-Vehicle Charge Capable Conversion Systems for 2000 and Subsequent Model Year Hybrid Electric Vehicles" (these Procedures) apply to off-vehicle charge capable . conversion systems designed for installation on 2000 and subsequent model year hybrid electric vehicles in the passenger car, light-duty truck, and medium-duty vehicle classes.

(b) Hybrid electric vehicles converted to incorporate off-vehicle charging are not eligible for zero emission vehicle credits under sections 1962 and 1962.1,' title 13" CCR.

(c) Certification of off-vehicle charge capable conversion systems issued pursuant to these Procedures shall have the effect of an exemption issued pursuant to . Vehicle Code Sections 27156 and 38391.

2. DEFINITIONS

"Advanced technology partial zero emission vehicle" means any partial zero emission vehicle with an allowance greater than 0.2 before application of the partial zero emission vehicle early introduction phase-in multiplier under section 1962 or 1962.1, CCR.

"Driveability" of a vehicle means the smooth delivery of power, as demanded by the driver. Typical causes of driveability degradation are rough idling, misfiring, surging, hesitation, or insufficient power.

"Hybrid electric vehicle"· means any vehicle that can draw propulsion energy from both of the following on-vehicle sources of st9red energy: 1) a consumable fuel and 2) an energy storage device such as a battery, capacitor, or flywheel.

"Installer" means a person authorized.by the manufacturer to install the manufacturer's off-vehicle charge capable conversion system on a motor vehicle.

"Off-vehicle charge capable" or "OVCC" means having the capability to charge a battery from an off-vehicle electric energy 'source that cannot be connected or coupled to the vehicle in any manner while the vehicle is being driven.

"Off-vehicle charge capable conversion system" or "conversion system" means a package of zero emission vehicle energy storage device and charger, control

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modules, and any other vehicle/engine components that are modified, removed, or added during the process of modifying a hybrid electric vehicle to an off-vehicle charge capable hybrid electric vehicle.

"Off-vehicle charge capable conversion system manufacturer" or "manufacturer" means a person who manufactures, assembles, imports, packages, or repackages an off-vehicle charge capable conversion system for sale in California and requests or is granted the Executive Order. certifying the off-vehicle charge capable conversion system.

"Partial zero emission vehicle" or "PZEV" means any vehicle that is delivered for sale in California and that qualifies for a partial zero emission vehicle allowance of at least 0.2 under sections 1962 or 1962.1; title 13, CCR.

"Small volume off-vehicle charge capable conversion system manufacturer" or "small volume manufacturer" means any manufacturer whose projected and realized California sales of conversion systems in its entire product line are 100 or fewer units. A small volume manufacturer's California realized sales shall consist of all conversion systems produced by the small volume manufacturer and delivered for sale in California. All provisions allowed under these Procedures for small volume manufacturers will terminate upon Air Resources Board's determination that a total of 5,000 conversion systems have been sold and installed in California.

Tier 1 small volume manufacturer means any small volume manufacturer whose projected and realized California sales of conversion systems in its entire product line are 10 or fewer units.

Tier 2 small volume manufacturer means any small volume manufacturer whose projected and realized California sales of conversion systems in its entire product line are 11 to 100 units.

"Useful life" for purposes of these Procedures, means the duration, expressed in miles, of the longest durability period for the new vehicle emission standards to which the hybrid electric vehicle was certified.

"Zero emission vehicle" means any vehicle certified to zero emission standards under sections 1962 or 1962.1, title 13, CCR.

"Zero emission vehicle energy storage device" means batteries and other electric energy storage devices.

3. GENERAL REQUIREMENTS

In addition to all other standards or requirements imposed, the following general requirements shall apply to all conversion systems to be certified for installation on hybrid electric vehicles:

(a) *On-Board Diagnostic (aBO) System Compatibility.*
If the vehicle to be converted was certified with an OBD system pursuant to section 1968.1, or 1968.2, title 13, CeR, the converted vehicle shall also be required to comply with and be certified to the same applicable aBO regulation. This includes, but is not limited to, ensuring the converted vehicle robustly detects malfunctions at the required emission thresholds, meets the required minimum monitoring frequency, implements required monitors for applicable added electronic hardware or emission controls, complies with standardization requirements, and conducts required demonstration and production vehicle testing. This requirement may necessitate modification of the original vehicle aBO system and/or addition of more diagnostics to supplement the original vehicle aBO system. All modifications affecting aBO compliance including added, modified, or original vehicle hardware (e.g., components, wiring) or software (e.g., programming, calibration) must be fully documented as part of the conversion system application for certification.

(b) *Driveability* :
The driveability of a vehicle equipped with a conversion system shall not be degraded in such a way as to encourage consumer tampering. To verify that. the driveability of a converted vehicle is acceptable, the Executive Officer may require that an independent laboratory evaluate driveability. The Executive Officer's determination that driveability must be evaluated shall be based on an engineering evaluation of the conversion system described in the application for certification or on reports or observations that conversion systems similar in design to the system for which certification is sought have caused driveability degradation. The cost of this evaluation shall be borne by the manufacturer.

(c) *Emission Control Label:* .
California motor vehicle emission control label specifications, incorporated by reference in section 1965, title 13, CCR, shall apply to installations of conversion systems, with the following additions: .

(i) The manufacturer shall provide a supplemental emission control information label, which shall be affixed in a permanent manner to each converted vehicle, in a location adjacent to the original Vehicle Emission ControlInfQrmation label. If the supplemental label cannot be placed. adjacent to the original label, it shall be placed in a location where it can be seen by a person viewing the original label.

(ii) The supplemental label shall show the vehicle model year; the Executive Order number certifying the conversion system; and the conversion system manufacturer's name, address, and telephone number. The label shall also list any original parts that were removed during installation of the conversion system, as well as any changes in tune-up specifications required by the conversion system. In addition, the label shall show the installer's name, address, and telephone number; the date on which the conversion system was installed; and the mileage (vehicle odometer reading) at time of conversion; and date on which the conversion system's warranty expires. The label shall clearly state that the vehicle has been equipped with an off-vehicle charge capable conversion system and that the converted vehicle complies with California emission requirements. If the conversion system was certified under provisions allowed for small volume manufacturers, the label shall display the notation "Tier 1" or "Tier 2," as appropriate. It is not necessary for supplemental emission control information labels installed with conversion systems to be machine readable.

(d) *Owner's Manual:*
Each conversion system installed shall include an owner's manual containing at least the following information:

(i) Description of the conversion system, including wiring diagrams and descriptions of major components and their theory of operation;

(ii) Charging procedure;

(iii) Listing of necessary service and service intervals, as well as tune-up data, which differ from the service requirements specified by the vehicle's original manufacturer;

(iv) Name, address, and phone number of the installer, as well as a list of the names, addresses, and phone numbers of the major dealers in California who supply parts for or service the conversion system; and

(v) Warranty information.

(e) *Manufacturer Recordkeeping Requirement*
The manufacturer of a conversion system shall maintain a record of the vehicle identification numbers and California license plate numbers of those vehicles on which the conversion system has been installed. As part of this *record,* the manufacturer shall identify the installation date and the certification Executive Order number of the conversion system installed on each vehicle and shall identify the vehicles' owners at the time of installation, including the owners'

current addresses and phone numbers. The manufacturer shall supply a copy of all installation information to the Executive Officer upon request. Small volume manufacturers shall submit this installation information on a quarterly basis to the Zero-Emission Vehicle Implementation Section of the Air Resources Board.

(f) *Installer Rec ordkeeping Requirement*
The installer of a conversion system shall maintain a, record as specified in paragraph 3(e) of these Procedures and shall provide this information to manufacturers upon request.

4. REQUEST FOR CERTIFICATION

(a) Request for certification of a conversion system shall be submitted in writing by the manufacturer, or its authorized representative, intending to offer the conversion system for sale in California.

(b) ,The request shall include all the information required pursuant to these Procedures, including:

(i) Identification and description of the test groups for which the conversion system to be certified is designed;

(ii) Complete description of the conversion system, including detailed wiring diagrams and parts list; explanation on how the ,conversion system interacts with or integrates into the original vehicle; all the necessary modifications to the vehicle and its OBO system; sample of the supplemental emission control information label; owner's manual; warranted parts listj and samples of warranty statements;

(iii) Procedures for installing and maintaining the conversion system, including tune-up specifications and discussion of any special tools or techniques required for proper installation, maintenance,or operation;

(iv) Agreement to supply the Air Resources Board, within 45 calendar days of the Executive Officer's request, with anyone or more of the vehicles used for certification testing or to provide Air Resources Board personnel with the equipment to inspect and test such vehicles at the manufacturer's facility, if requested by the Executive Officer;

(v) Names and addresses of the fabrication, assembly line, and test facilities where the conversion system and its major components are manufactl:Ired and tested; and

(vi) Test data.

5. TEST PROCEDURES

(a) *Test Procedures for OVCC Converted Vehicles:*
Test procedures set forth in the "California Exhaust Emission Standards and. Test Procedures for 2005 Through 2008 Model Zero-Emission Vehicles and· 2001 Through 2010 Hybrid Electric Vehicles in the Passenger Car, Light-Duty Truck, and Medium-Duty Vehicle Classes," as incorporated by reference in section 1962, title 13, CCR; the "California Exhaust Emission Standards and Test Procedures for 2009 and Subsequent Model Zero-Emission Vehicles and Hybrid Electric Vehicles in the Passenger Car, Light-Duty Truck, and Medium-Duty Vehicle Classes," as incorporated by reference in section 1962.1, title 13, CCR; the "California Evaporative Emission Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles," as incorporated by reference in section 1976, title 13, CCR, and the "California Refueling Emission Standards and Test Procedures for 2001 and Subsequent Model Motor Vehicles," as incorporated by reference in section 1978, title 13, CCR, shall be used to determine the emission levels of OVCC converted vehicles.

(b) *Applicable Standards:*
The conversion system shall meet the emission standards for the model year of original manufacture and certification. The converSion system must also be durable for the useful life of the vehicle. The manufacturer shall demonstrate' compliance with these requirements through durability and emission testing.

(c) *Demonstration* of *Durability.*
The manufacturer shall propose a durability program 'for advance approval by the Executive Officer. The durability program shall consist of:

(i) Whole vehicle full mileage accumulation or whole vehicle accelerated mileage accumulation over the useful life or equivalent useful life of the vehicle; bench aging of individual components or systems over the useful life of the vehicle; or alternative methods that would effectively predict the deterioration of the converted vehicle over its useful life.

(ii) A maximum of one durability data vehicle per test group for which certification is sought shall be required.

(iii) The vehicle is assumed to have zero miles at the time of conversion. Vehicle mileage accumulation shall be conducted using vehicle drive patterns found in actual use.

(iv) Bench aging shall simulate component or system aging under vehicle drive patterns and operational conditions found in actual use. The list of components or systems to be aged and their aging techniques must be approved in advance by the Executive Officer. Approval of bench aging and alternative methods shall be contingent upon a demonstration by the manufacturer that they result in deterioration at least as great as the deterioration from vehicle mileage accumulation.

(d) *Demonstrat(on* of *Emission Compliance:* .
The'manufacturer shall propose the procedures for determining compliance with the emission standards for advance approval by the Executive Officer. Emission compliance shall be determined by:.

(i) Testing a vehicle aged with the conversion system; installing aged components or systems on an .emission data vehicle prior to testing; or using alternative methods that would effectively predict the useful life emissions of the converted vehicle.

(ii) Amaximum of one emission data vehicle per test group for which certification is sought shall be required.

(iii) Alternative methods must be approved in advance by the Executive Officer..

(e) *Small Volume Manufacturers:*
Special certification procedures are available for small volume manufacturers.

(i) For Tier 1 small volume manufacturers, the following are required in lieu of requirements in sections 5(a), 5(c). and 5(d):

(1) Engineering analysis demonstrating no adverse impact on emissions.
(2) Conversion system component durability data and any available in-use data.
(3) Durability test plan designed to demonstrate conversion system durability for useful life of the vehicle.

(ii) For Tier 2 small volume manufacturers. the following are required in lieu of requirements in sections 5(c) and 5(d):

(1) Conversion system component durability data and any available in-use data.
(2) Durability test plan designed to demonstrate conversion system ' durability for useful life of the vehicle.
(3) Report on the progress of durability testing.

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(4) Demonstrate that the OBD system readiness indicators are set and no diagnostic trouble codes or malfunction indicators are set during emission tests.

(5) Emission test data following a minimum of 4.000 miles of vehicle operation with the conversion system installed.

(fa) Prior to the commencement of testing, the choice of durability data vehicle and emission data vehicle must be approved by the Executive Officer as being representative of the range of test groups for which certification is sought.

6. APPROVAL

(a) *Issuance of Executive Orders:*
If, after reviewing the test data and other information submitted by the manufacturer, the Executive Officer determines that the conversion system meets the applicable emission standards demonstrated under an approved test plan, an Executive Order shall be issued certifying the conversion- system for sale and installation on the vehicles with the test groups specified in the certification request.

(b) *Carry-Over and Carry-Across:*

(i) Carry-over and carry-across of durability and emission test data from the previous model year to the following model year and from one test group to similar test groups will be-allowed if the Executive Officer determines that the carry-over/carry-across data will adequately represent the durability and emission performance of the conversion system to be certified.

(ii) Requests for carry-over and carry-across must be accompanied by an engineering analysis demonstrating that the durability and emission performance of the conversion system and the test group for which certification is sought will be adequately represented by a certified conversion system/test group.

7. WARRANTY REQUIREMENTS

(a) *Requirements of Manufacturers:*
Each manufacturer of a conversion system shall warrant to the person having the vehicle converted and to each subsequent purchaser of the vehicle that the conversion system is designed-and manufactured to conform with the applicable requirements of these Procedures without causing damage to any part on the converted vehicle. and is free from defects in materials and workmanship which cause the conversion system to fail to conform with the applicable requirements of these Procedures or cause damage to any part on

the converted vehicle. This warranty shall cover customer service and the full repair or replacement costs including the costs of diagnosis. labor. and parts. including any part on the converted vehicle that is damaged due to a defect in the conversion system. This warranty requirement will be effective for longer of the following from the date of installation:

(i) 5 years or 75.000 miles, whichever first occurs.
(ii) Remaining original equipment manufacturer warranty period.

the applicable warranty period specified in section 2037(b), title 13, GGR, from the date of installation if the conversion system is installed on the vehicle within four years of the date the vehicle, is first acquired by an ultimate purchaser. If the conversion system is installed on the vehicle after four years of the date the vehicle is first acquired by an ultimate purchaser, the warranty period will be three years or half the 'applicable warranty period mileage specified in section, 2()37(b), title 13, GGR, whichever occurs first from the date- of installation. 'For PZEVs, this warranty requirement will be effective for the applicable warranty peri'od specified in section 1962(c) or section 1962.1(c), title 13, GGR, from the date of instqllation if the conversion system is installed on the vehicle within six years of the date the vehicle is first acquired by an ultimate purchaser. If the conversion system is installed on the PZEV after six years of the date the vehicle is first acquired by an ultimate purchaser, the warranty period will be five years or half the applicable warrant)' period mileage specified in section 1962(c) or section 1962.1(c), title 13, GeR, whichever occurs first from the date of installation. This warranty shall cover customer service and the full repair or replacement costs including the costs of diagnosis, labor, and parts, including any part on the converted vehicle that is damaged due to a defect in the conversion system.

(b) *Requirements* of *Small Volume Manufacturers:*
For small volume manufacturers. requirements in section 7(a) apply with the exception of the warranty periods.

(i) For Tier 1 small volume manufacturers. the warranty requirements will be effective for 3 years or 50.000 miles. whichever first occurs. from the date of installation.
(ii) For Tier 2 small volume manufacturers. the warranty requirements will be effective for 5 years or 75,000 miles. whichever first occurs, from the date of installation.

(cb) *Requirements* of *Installers:*
Each installer of a conversion system shall warrant to the person having the vehicle converted and to each subsequent purchaser of the vehicle that the , conversion system will not fail to conform with the applicable requirements of

these Procedures due to incorrect installation and that no part on the converted vehicle will be damaged due to incorrect installation. Installers of conversion systems shall install only those systems of a certified configuration and shall agree to indemnify the person having the vehicle converted and to each subsequent purchaser of the vehicle for the cost of repair of any vehicle upon which a noncertified configuration was installed. In addition, the installer shall agree to indemnify the person having the vehicle converted and to each subsequent purchaser of the vehicle for any tampering fines that may be , imposed as a result of improper installation of the conversion system. The warranties and agreements to indemnify shall be effective for 3 years or 50,000 miles, whichever first occurs. the applioable warranty period speoified in section 2037(b)(2), title 13, CCR. This warranty shall cover customer service and the full repair or replacement costs including the cost of diagnosis, labor, and parts, including any part on the converted vehicle that is damaged due to incorrect installation of the conversion system._Before an. tnstaller installs a conversion system, the installer shall submit to ARB a sample of the warranty .statement to be provided by the installer as specified above.

8. CONFIRMATORY TESTING REQUIREMENTS

The Air Resources Board may conduct confirmatory tests to verify the emission test results submitted by the manufacturer. Confirmatory tests, if required, shall be performed by the Air Resources Board within 45 days of receipt from the manufacturer all data, materials, and vehicles necessary to conduct the test. Confirmatory testing conducted by the Air Resources Board shall utilize the same test vehicle and procedures as those used by the manufacturer. In the event of discrepancies between the Air Resources Board's confirmatory test results and the manufacturer's test results, the Air Resources Board's evaluation for certification may be based solely on the Air Resources Board's test results. Tier 1 small volume manufacturers are not subject to confirmatory'testing requirements.

, 98. IN-USE TESTING REQUIREMENTS

The Air Resources Board may select up to five conversion systems per manufacturer per year for in-use testing. The manufacturer must provide the in-use OVCC converted vehicle(s) selected by the Air Resources Board to be sent to the Air Resources Board facility or a designated independent laboratory for testing in accordance with the test procedures in paragraph (5)(a) of these Procedures. Testing costs will be borne by the Air Resources Board, except for those conversion systems that do not comply with the applicable emission standards. If one or more of the conversion system fails to meet the applicable emission standards in an .' applicable test vehicle, the Air Resources Board may rescind a previously granted Executive Order, request further analysis and data from the manufacturer, or require, at the manufacturer's expense, additional vehicles to be tested. Additional vehicles to be tested shall be limited to no more than five for each failed conversion system. Small volume manufacturers are not subject to in-use testing requirements.

CALIFORNIA AIR RESOURCES BOARD

NOTICE OF PUBLIC MEETING TO CONSIDER AN UPDATE ON "EXISTING GRANT AGREEMENTS FOR THE PROPOSITION 1B: GOODS MOVEMENT EMISSION REDUCTION PROGRAM AND THE LOWER-EMISSION SCHOOL BUS PROGRAM

The Air Resources Board (ARB or the Board) will conduct a public meeting at the time and place noted below to consider a staff update on existing grant agreements for the Proposition 1B Goods Movement Emission Reduction Program (Goods Movement Program) and the Lower-Emission School Bus Program (School Bus Program), including delegation to the Executive Officer to amend those agreements to reflect funding delays and other implementation issues.

DATE: May 28, 2009

TIME: 9:00 a.m.

PLACE: California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

This item may be considered at a two-day meeting of the Board, which will commence at 9:00 a.m., May 28, 2009, and rnay continue at 8:30 a.m., on May 29,2009. Please consult the agenda for the meeting, which will be available at least 10 days before May 28,2009, to determine the day on which this item will be considered.

If you require special accommodations or language needs, please contact the Clerk of the Board at (916) 322-5594 or by facsimile at (916) 322-3928 as soon as possible, but no later than 10 business days before the scheduled board hearing. *TTYITDD/Speech* to Speech users may dial 711 for. the California Relay Service.

Under the Goods Movement Program, ARB awards bond funds to local agencies that then offer competitive grants to owners of diesel freight equipment to clean up that equipment ahead of, or in excess of, .regulatory or enforceable requirements. These incentives are targeted to reduce emissions from trucks, locomotives, ships at dock, harbor craft, and cargo equipment used to move goods. Under the School Bus Program, ARB awards funds to local air districts that work with school districts to retrofit or replace existing diesel school buses.

ARB staff will provide an oral presentation at the meeting, focused on the Goods Movement Program. Following an update on available funding, staff will describe the changes needed to existing grant agreements to reflect delays in State bond funding, as well as to incorporate other amendments requested by local agencies or proposed by ARB staff to resolve implementation issues.

The majority of the grant agreement amendments are within the Executive Officer's authority to implement under the Goods Movement Program Guidelines adopted by the Board in February 2008. The presentation will summarize those changes and highlight the areas where staff is seeking Board support to change limited provisions of the existing Guidelines to resolve implementation issues. Attachment A to this notice describes the changes being considered for goods movement grant agreements. The attachment identifies the three conforming changes that would also be applied to the school bus grant agreements.

Additional information on the Goods Movement Program is available on ARB's website at http://www.arb.ca.gov/gmbond. Additional information on the School Bus Program is available at http://www.arb.ca.gov//bonds/schoolbus/schoolbus.htm.

Interested members of the public may also present comments orally or in writing at the meeting, and in writing or bye-mail before the meeting. To be considered by the Board, written comments submissions not physically submitted at the meeting must be received no later than 12:00 noon, May 27,2009, and addressed to the following:

Postal mail: Clerk of the Board, Air Resources Board
1001 I Street, Sacramento, California 95814

Electronic submittal: http://www.arb.ca.gov/lispub/comm/bclist.php

Facsimile submittal: (916) 322-3928

Please note that under the California Public Records Act (Gov. Code, § 625.0 et seq.), your written and oral comments, attachments, and associated contact information (e.g., your address, phone, email, etc.) become part of the public record and can be released to the public upon request. Additionally, this information may become available via Google, Yahoo, and any other search engines.

The Board requests, but does not require 30 copies of any written submission. Also, ARB requests that written and e-mail statements be filed at least 10 days prior to the meeting so that ARB staff and Board members have time to fully consider each comment. Further inquiries regarding this matter should be directed to Mr. Matthew Botill, Air Pollution Specialist, at (916) 445-6243, or Ms. Judith Friedman, Manager, Goods Movement Programs Section, at (916) 324-9949.

CALIFORNIA AIR RESOURCES BOARD

James N. Goldstene
Executive Officer

Date: May 14, 2009

The energy challenge facing California is real. Every Californian needs to take immediate action to reduce energy consumption. For a list of simple ways you can reduce demand and cut your energy costs, see our website at www.arb.ca.qov.

ATIACHMENTA

Proposition 1B Goods Movement Emission Reduction Program
and Lower-Emission School Bus Program

Description of Changes to Existing Grant Agreements with Local Agencies
May 2009 Board Action

Program Background for Goods Movement

The Good,s Movement Emission Reduction Program (Program) is a partnership between the Air Resources Board (ARB or Board) and local agencies (like air districts, ports, and transportation agencies) to quickly reduce air pollution emissions and health risk from freight movement along California's priority trade corridors. Proposition 1B authorizes $1 billion in bond funding for incentives to equipment owners to achieve early or extra emission reductions by cleaning up the diesel equipment used to transport goods.

The Board adopted the Program Guidelines in February 2008. At that meeting, and a subsequent hearing in May 2008, the Board awarded a total of over $246 million in first year funds to nine local agencies to administer 21 grants. These grants cover cleaner trucks, locomotives, ships at berth, and harbor craft. In June 2008, ARB staff then signed grant agreements with local agencie.s to administer the funding awarded by the Board. Consistent with the Guidelines, these agreements established milestones and deadlines for local agencies to meet in implementing the projects - based on the expectation that bond funding would be available without delay.

Local agencies actively implemented the Program in the second half of 2008. By December 2008, equipment owners had submitted over 9,500 applications to the local agencies for all project types, requesting over $385 million in project funds. The agencies have signed roughly 380 contracts with equipment owners in this process. Local agencies requested and ARB disbursed $20 million in payments for three early grant truck projects, plus some initial local administrative costs.

On December 18, 2008, the State Department of Finance issued BUdget Letter 08-33 requiring agencies slated to receive general obligation bond funding (including ARB) to suspend action on these programs. As directed, ARB then instructed local agencies to stop entering into new equipment project contracts or expending funds for signed contracts until ARB is able to secure the bond monies needed to fund those projects.

In April 2009, we received a first installment of bond funding to reimburse ARB for the $20 million in prior expenditures to local agencies for this Goods Movement Program. In late April 2009, ARB was notified that a second installment would be forthcoming. We expect this .latest bond funding to add approximately $90 million for the Goods Movement Program.

ARB staff identified the subset of grants to be restarted with the $90 million, consistent with priorities previously established by the Board. The priorities include early grant projects for trucks and shore power, main grant projects for trucks serving ports and intermodal rail yards, and partial funding for a limited number of main grant projects for other trucks. ARB staff expects to notify the affected local agencies in writing later this month and will post those notices on the Program website.

Need to Amend Existing Grant Agreements for Goods Movement

The suspension of bond funding means that local agencies will require additional time to complete projects under the existing grant agreements. We need to amend the agreements to tie the timeframes for completion to the date when ARB notifies a local agency that it can move forward, as bond funds become available. Local agencies have also requested changes to their existing funding awards or conditions, consistent with the adopted Program Guidelines. We support the requests discussed here. ARB staff has also identified a few areas where changes to those Guidelines are necessary to reflect the current uncertainty in the timing for full funding of the existing grant agreements or to support effective implementation.

Changes fhat require authorization by the Board under the current Program Guidelines are marked with an asterisk (*). ARB staff recommends approval of a Board resolution authorizing those changes to the Guidelines and supporting the Executive Officer's action on the other changes. All of the changes described here would be implemented through amendments to the existing grant agreements.

Broad Changes to Grant Agreements for Goods Movement

1. Tie ARB's Funding Obligation to the Availability of Bond Monies. The existing grant agreements provide that local agencies can request and receive funding from ARB when they demonstrate they have met the performance milestones in the Guidelines. We are adding a provision to each agreement that ARB's obligation to disburse funding is dependent on securing State bond funds. Since the timing and amount of funding for this Program in each bond sale are uncertain, ARB will notify local agencies in writing with authorization to restart projects up to specified funding amounts (grants may be fully or partially funded with each installment of bond monies that ARB receives).

   Although the State budget appropriated funds for this Program, ARB is not authorized to disburse money to local agencies until we have secured those funds through approval by the Department of Finance and release of funding by the State Treasurer's Office followi'ng bond sales. Local agencies may not proceed with the signing of new contracts or implementation of existing contracts without ARB's written authorization to restart the grant.

2. * Extend the Timelines for Local Agency Action. The existing grant agreements establish the·timeframes for local agencies to sign contracts with equipment-owners, and additional time to liquidate funds for completed projects. The early grant

projects required contracts by mid-2008 and liquidation by the end of 2008 (except for shore power). The main grants now provide local agencies with 18 months (through December 2009) to sign contracts,followed by 1-4 years to complete the' project.

With the delay in bond funding, and uncertainty about the next installments, ARB staff proposes to extend the deadlines to provide time for local agencies to do project solicitation, evaluation, ranking, contracting and funding. The extension will typically cover the amount of time that bond funding for that grant was suspended, plus a short restart period. This general concept will enable ARB staff to look at the individual situation, including when bond funds are made available, to determine the appropriate deadlines in consultation with the local agency. Since the implementing statute defines an absolute maximum time to contract and liquidate funds, the extension must fit within that period or the funds revert to the legislatively-controlled Program account.

3. * Expand the Executive Officer's Authority. The Program GuiClelines and Board Resolution 08-12 delegate to the Executive Officer or his designee, the ability to make limited, interim changes to the Guidelines and to bring those changes back to the Board with the next comprehensive update to the Guidelines. To allow the Program to be more responsive to issues and new developments, we propose that the Executive Officer's authority be expanded to include making changes to the Program Guidelines and grant agreements that are consistent with the statute and the goals established by the Board, if needed to enable effective implementation. This provision would offer more flexibility for dealing with unanticipated circumstances, eliminate unnecessary delays, and improve the timely distribution of bond funds in the future.

4. * Reduce the Early Period for Port Truck Retrofits. The Program Guidelines currently require that bond-funded truck retrofits with particulate matter (PM) filters be completed early (at least 6 months prior to a regulatory requirement). With the January 1, 2010, compliance deadline in ARB's drayage truck rule, bond-funded retrofits for trucks serving ports and intermodal rail yards must be completed by June 30,2009. Due to the delay in availability of bond funds, it is no longer possible to meet that deadline. However, when the Board adopted the drayage rule, we expected that substantial bond funds would be available for early compliance, with -retrofits as the top funding priority.

   In light of the extraordinary circumstances, we recommend that the Board reduce the early period for installation of PM retrofits on trucks serving ports and intermodal rail yards such that projects completed by December 31, 2009, are eligible for bond funding. Staff believes that this represents the earliest feasible deadline. After ARB notifies the local agencies that there is bond funding to re-start the port truck grants, local agencies must complete the evaluation process, rank and select projects for funding, and sign contracts with truck Qwners. Once a truck owner has a contract, the filter must be ordered, manufactured (in many cases), delivered and installed. With fast action by local agencies, we expect that all of these steps will take about 6 months.

5. * Reduce the Early Period for Model Year 1998 and 1999 Other Truck Replacements. The Program Guidelines require that replacements be operational at least 3 years prior to the best available technology provisions of applicable rules (1997 and older trucks are already permitted a 2-year early period). Under the statewide truck and bus rule, the relevant deadline is January 1, 2013, which would require the new trucks to be funded and operational this year. Because of the funding delay, we recommend that the Board reduce the early period for MY1998-1999 other trucks from 3 to 2 years so they can be funded through 2010.

6. Streamline Process to Transfer Funds from Truck Retrofits to Replacements. The grant agreements allow local agencies with truck grants to shift funds allocated for truck retrofits to truck replacements if there is a lack of demand for retrofit funding. To do so, the agencies must submit a formal request and receive written approval from ARB. Since the demand for retrofit projects is significantly less than anticipated, all of the agencies administering retrofit projects are in the same situation. We are proposing to eliminate the exchange of letters. Consistent with the grant agreements, eligible retrofits would still need to be funded first; any remaining funds could then be quickly applied to replacement projects.

7. * Shorten Contract Term for Truck Projects. The current Guidelines require that truck owners be under contract for a specified project life and subject to Program operating conditions (like 100 percent operation in California). With the Board's subsequent adoption of the statewide truck and bus rule, there is now additional certainty that clean trucks will stay in operation in California. With this rule, we believe it is appropriate to shorten the length of time that each truck would need to remain under contract. Specifically, shorten the project life from 8 years to 5 years for truck,replacements and repowers, and decrease the life from 4 years to 2 years for retrofits. These changes would apply to all truck contracts funded under the existing grant agreements.

   These changes are necessary to harmonize the Program requirements with the statewide truck and bus rule. For example, the timing of the bond funding and the rule deadlines mean that a truck retrofit with a PM filter may not be able to operate for 4 years before the next rule milestone requires replacement of that truck. With these changes, the resulting projects would still achieve cost-effective emission reductions.

Region-Specific Changes to Grant Agreements for Goods Movement

8. Administration of Funding for Trucks Serving the Ports of Los Angeles and Long Beach. ARB awarded a $98 million grant jointly to the Port of Los Angeles and the Port of Long Beach to replace nearly 2,000 old trucks with the owner's choice of a new diesel or alternative fuel model. Despite the impending ARB and port requirements for cleaner trucks, there has been a lack of applications for bond-related funding because of the structure of the gate fees established by the ports. Truck owners who receive a $50,000 grant from port-administered bond funds for a new diesel truck are subject to gate fees that can exceed $100,000 over the first five years (alternative fuel trucks receiving the same bond funding are exempt from the gate fees).

Unless the ports choose to amend the existing gate fee structure, ARB staff believes that the unused grant funds should be transferred to the South Coast Air Quality Management District for administration as permitted under the existing grant. The South Coast District would follow Program Guidelines to solicit and competitively rank applications based on the emission reductions to be achieved and bond-cost effectiveness. Regardless of fuel type, new trucks receiving bond funding outside of the port-administered program are exempt from gate fees. Altering the existing situation to allow truck owners to obtain bond funding for scrapping an old truck and replacing' it with a new model (diesel, natural gas, or other) without gate fees would significantly increase the number of truck replacements accomplished this year.

The existing grant agreement provides two mechanisms to activate the defined backup project administered by the South Coast District for trucks serving the two ports: (a) the ports can request this change, or (b) ARB can exercise its option to transfer administrative responsibility because the ports are"...constrained from implementing the Project due to a court order or other legal proceedings that renders the Local Agency unlikely to be able to fully expend the Program funds according to the Project Schedule." Constraint was created by the ports 'when they adopted the gate fees. The South Coast District has confirmed its ability to take over administration of this grantand we are in discussions with the ports about the next steps.

9. * Re-Allocate Bay Area HarborCratt Funds to Port Trucks. The Bay Area Air Quality Management District has requested that ARB reallocate the $4,263,844 grant for harbor craft projects to the District's existing port truck grant. This request is based on a lack of demand fo'r harbor craft funding and the need for additional port truck funding prior to the upcoming January 2010 compliance deadline in ARB's drayage truck rule. ARB staff supports this request.

10. * Ability to Re-Allocate San Diego Shore 'Power Funds to Truck Projects. The Port of San Diego applied for and received a $2.5 million grant award to install grid-based shore power at a cargo berth for ships carrying refrigerated products with high power demands at dock. The shipping line expected to participate has indicated a lack of interest in the proposed grant project. If the Port cannot secure a participant shipper in summer 2009, staff proposes to reallocate the $2.5 million to truck projects in the San Diego/Border Corridor. This option to transfer funds from shore power to trucks may be necessary to ensure that funds can be used and do not revert back to the legislatively-controlled Program account.

The first priority would be to provide additional funding to the San Diego Air Pollution Control District under its existing grant for port trucks, if there is a demonstrated demand and the funds could be quickly utilized. The next,priority would be to provide additional funding to the San Diego District and/or the Imperial County Air Pollution Control District under their existing grants for other trucks in that corridor. Demand and the ability to act quickly must remain a consideration. If the funds could not be utilized in the San Diego/Border corridor within the statutory deadlines, ARB would make those monies available for truck projects in other regions.

11. Truck Travel in the San Diego/Border Corridor. Following signature of the grant agreement, the San Diego District requested the ability to implement one of the defined project alternatives that would allow the District to require that trucks receiving funding travel at least 10 percent of their annual miles in the San Diego/ Border corridor. We support this request.

Lower-Emission School Bus Program

Please see the website at http://www.arb.ca.gov/lbonds/schoolbus/schoolbus.htm for a complete description and the current status of the Proposition 1BLower-Emission School Bus Program. For school buses, ARB also adopted implementing guidelines and awarded Proposition 1B grants totaling over $191 million to air districts. We received a first installment of $11 million in bond funds to reimburse ARB for prior expenditures on the School Bus Program and expect that the second installment will add approximately $71 million for the School Bus Program.

Similar to the Goods Movement Program, the suspension of bond funding for the School Bus Program also means that local districts will require additional time to complete projects under the existing grant agreements. With the uncertainty in the timing for full bond funding for the School Bus Program, we are asking the Board to provide the ARB Executive Officer with the authority and flexibility to make future changes to the Lower-Emission School Bus Program Guidelines, if needed to support effective implementation.

ARB staff recommends that the Board authorize conforming changes for the School Bus-Program based on the following items:

1. Tie ARB's Funding Obligation to the Availability of Bond Monies. The existing grant agreements provide that local air districts can request and receive funding from ARB when they demonstrate they have met the performance milestones in the Guidelines. We are adding a provision to each agreement that ARB's obligation to disburse funding is dependent on securing State bond funds. Since the timing and amount of funding for this Program in each bond sale are uncertain, ARB will notify local air districts in writing with authorization to restart projects up to specified funding amounts (grants may be fully or partially funded with each installment of bond monies that ARB receives).

   Although the State budget appropriated funds for this Program, ARB is not authorized to disburse money to local air districts until we have secured those funds through approval by the Department of Finance and release of funding by the State Treasurer's Office following bond sales. Local air districts may not proceed with the signing of new contracts or implementation of existing contracts without ARB's written authorization to restart the grant.

2. Extend the Timelines for Local Air District Action. With the delay in bond funding, and uncertainty about the next installments, ARB staff proposes to extend the deadlines to provide time for local-air districts to do project solicitation, evaluation, ranking, contracting and funding. The extension will typically cover the amount of time that bond funding for that grant was suspended, plus a short restart period.

This general concept will enable ARB staff to look at the individual situation, including when bond funds are made available, to determine the appropriate deadlines in consultation with the local air district.

3. Expand the Executive Officer's Authority. The Program Guidelines and Board Resolution 08-23 delegate to the Executive Officer or his designee, the ability to change the match requirement and school bus cost cap of the Guidelines only., To allow the Program to be more responsive to issues and new developments, we propose that the Executive Officer's 'authority be expanded to include making changes to the Program Guidelines and grant agreements that are consistent with the statute and the goals established by the Board, if needed to enable effective implementation. This provision would offer more flexibility for dealing with unanticipated circumstances, eliminate unnecessary delays, and improve the timely distribution of bond funds in the future'.