Appendix A-2-1

Proposed Regulation Order:

Emergency Vehicle Emissions Regulations

Part I

[Note: The entire text of sections below is new language in "normal type" proposed to be added to title 13, California Code of Regulations]

The Chapters and Sections of title 13, California Code of Regulations that are being proposed for adoption per this regulatory proposal are as follows.

Chapter 1. Motor Vehicle Pollution Control Devices

Section 1956.8.1.	Exhaust Emissions Standards and Test Procedures -- 1985 and Subsequent Model Heavy-Duty Engines and Vehicles. (Alternative)
Section 1968.2.1.	Malfunction and Diagnostic System Requirements 2004 and Subsequent Model Year Passenger Cars, Light Duty Trucks, and Medium Duty Vehicles and Engines. (Alternative)
Section 1968.5.1.	Enforcement of Malfunction and Diagnostic System Requirements for 2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines. (Alternative)
Section 1971.1.1.	On-Board Diagnostic System Requirements--2010 and Subsequent Model-Year Heavy-Duty Engines. (Alternative)
Section 1971.5.1.	Enforcement of Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines. (Alternative)
Section 2035.0.1.	Purpose, Applicability, and Definitions (Alternative)
Section 2036.0.1.	Defects Warranty Requirements for 1979 Through 1989 Model Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles; 1979 and Subsequent Model Motorcycles and Heavy-Duty Vehicles; and Motor Vehicle Engines Used in Such Vehicles. (Alternative)
Section 2040.0.1.	Vehicle Owner Obligations. (Alternative)

Chapter 2. Enforcement of Vehicle Emission Standards and Surveillance Testing

Section 2111.0.1.	Applicability. (Alternative)
Section 2113.0.1.	Initiation and Approval of Voluntary and Influenced Emission-Related Recalls. (Alternative)
Section 2114.0.1.	Voluntary and Influenced Recall Plans. (Alternative)
Section 2115.0.1	Eligibility for Repair. (Alternative)
Section 2116.0.1.	Repair Label. (Alternative)

Section 2117.0.1.	Proof of Correction Certificate. (Alternative)
Section 2118.0.1.	Notification. (Alternative)
Section 2119.0.1.	Recordkeeping and Reporting Requirements. (Alternative)
Section 2121.0.1.	Penalties. (Alternative)
Section 2123.0.1.	Initiation and Notification of Ordered Emission-Related Recalls. (Alternative)
Section 2125.0.1.	Ordered Recall Plan. (Alternative)
Section 2126.0.1.	Approval and Implementation of Recall Plan. (Alternative)
Section 2127.0.1.	Notification of Owners. (Alternative)
Section 2128.0.1.	Repair Label. (Alternative)
Section 2129.0.1.	Proof of Correction Certificate. (Alternative)
Section 2130.0.1.	Capture Rates and Alternative Measures. (Alternative)
Section 2131.0.1.	Preliminary Tests. (Alternative)
Section 2133.0.1.	Recordkeeping and Reporting Requirements. (Alternative)
Section 2137.0.1.	Vehicle and Engine Selection. (Alternative)
Section 2141.0.1.	General Provisions. (Alternative)
Section 2142.0.1.	Alternative Procedures. (Alternative)
Section 2143.0.1.	Failure Levels Triggering Recall. (Alternative)
Section 2144.0.1.	Emission Warranty Information Report. (Alternative)
Section 2145.0.1.	Field Information Report. (Alternative)
Section 2146.0.1.	Emissions Information Report. (Alternative)
Section 2148.0.1.	Evaluation of Need for Recall. (Alternative)
Section 2149.0.1.	Notification and Subsequent Action. (Alternative)

Chapter 9. Off-Road Vehicles and Engines Pollution Control Devices

Section 2423.0.1.	Exhaust Emission Standards and Test Procedures — Off-Road Compression-Ignition Engines. (Alternative)

Chapter 10. Mobile Source Operational Controls

Section 2485.0.1.	Airborne Toxic Control Measure to Limit Diesel-Fueled Commercial Motor Vehicle Idling. (Alternative)

Proposed Regulation Order

Title 13, California Code of Regulations

Adopt New Sections 1956.8.1, 1968.2.1, 1968.5.1, 1971.1.1, 1971.5.1, 2035.0.1, 2036.0.1, 2040.0.1, 2111.0.1, 2113.0.1, 2114.0.1, 2115.0.1, 2116.0.1, 2117.0.1, 2118.0.1, 2119.0.1, 2121.0.1, 2123.0.1, 2125.0.1, 2126.0.1, 2127.0.1, 2128.0.1, 2129.0.1, 2130.0.1, 2131.0.1, 2133.0.1, 2137.0.1, 2141.0.1, 2142.0.1, 2143.0.1, 2144.0.1, 2145.0.1, 2146.0.1, 2148.0.1, 2149.0.1, 2423.0.1, and 2485.0.1.

§ 1956.8.1. Exhaust Emissions Standards and Test Procedures -- 1985 and Subsequent Model Heavy-Duty Engines and Vehicles. (Alternative)

For purposes of this section, any cross-referenced section in title 13 or title 17 of the California Code of Regulations shall refer to the section identified as the alternative version "(Alternative)" for the corresponding section, to the extent an alternative version of that section exists.

(a)(1) The exhaust emissions (i) from new 1985 through 2003 model heavy-duty diesel engines (except methanol-fueled engines), and heavy-duty natural-gas-fueled and liquefied-petroleum-gas-fueled engines derived from diesel-cycle engines, and (ii) from all new 1993 through 2003 model heavy-duty methanol-fueled, diesel engines, except in all cases engines used in medium-duty vehicles, shall not exceed:

Exhaust Emission Standards
For 1985-2003 Model Heavy-Duty Engines Other than Urban Bus Engines
(grams per brake horsepower-hour [g/bhp-hr])

Model Year	*Total Hydrocarbons or OMHCE*[A]	*Optional Non-methane Hydrocarbons*[A]	*Carbon Monoxide*	*Oxides of Nitrogen*	*Particulates*
1985-1986	1.3		15.5	5.1	—
1987[B]	1.3		15.5	5.1	—
1988-1989	1.3		15.5	6.0	0.60
1990	1.3	1.2	15.5	6.0	0.60
1991-1993[C]	1.3	1.2	15.5	5.0	0.25[D]
1994-1997	1.3	1.2	15.5	5.0	0.10[D]
1995-1997[E]	1.3	1.2	15.5	3.5 to 0.5	0.10
1998-2003[F]	1.3	1.2	15.5	4.0[G,H]	0.10[G]
1998-2003[E]	1.3	1.2	15.5	2.5 to 0.5[I]	0.10

[A] The total or optional non-methane hydrocarbon standards apply to petroleum-fueled, natural-gas-fueled and liquefied-petroleum-gas-fueled engines. The Organic Material Hydrocarbon Equivalent, or OMHCE, standards apply to methanol-fueled engines.

[B] As an option a manufacturer may elect to certify to the 1988 model-year emission standards one year early, for the 1987 model year.

[C] For methanol-fueled engines, these standards shall be applicable beginning with the 1993 model year.

[D] Emissions averaging may be used to meet this standard. Averaging is restricted to within each useful life subclass and is applicable only through the 1995 model year. Emissions from engines used in urban buses shall not be included in the averaging program.

[E] These are optional standards. A manufacturer may elect to certify to an optional NOx standard between the values, inclusive, by 0.5 grams per brake horsepower-hour increments. Engines certified to any of these optional NOx standards are not eligible for participation in any averaging, banking or trading programs described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" incorporated by reference in (b), below.

[F] These are mandatory standards.

[G] Engines of 1998 through 2003 model years may be eligible to generate banking credits based on these standards according to the requirements of the averaging, banking and trading programs described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" incorporated by reference in (b), below.

[H] May be used as the certification standard for the higher emitting fueling mode of an engine certified under the dual fueling mode certification process of (a)(3)(4), below.

[I] May be used as the certification standard for the lower emitting fueling mode of an engine certified under the dual fueling mode certification process of (a)(3)(4), below.

(2)(A) The exhaust emissions from new 2004 and subsequent model heavy-duty diesel engines, heavy-duty natural gas-fueled and liquefied-petroleum-gas-fueled engines derived from diesel-cycle engines, and heavy-duty methanol-fueled diesel engines, and the optional, reduced-emission standards for 2002 and subsequent model engines produced beginning October 1, 2002, except in all cases engines used in medium-duty vehicles, shall not exceed:

Exhaust Emission Standards for 2004 and Subsequent Model Heavy-Duty Engines, and Optional, Reduced Emission Standards for 2002 and Subsequent Model Heavy-Duty Engines Produced Beginning October 1, 2002, Other than Urban Bus Model-Year Engines Produced From October 1, 2002 Through 2006
(grams per brake horsepower-hour [g/bhp-hr])

Model Year	*Oxides of Nitrogen Plus Non-methane Hydrocarbons*	*Optional Oxides of Nitrogen Plus Non-methane Hydrocarbons*	*Oxides of Nitrogen*	*Optional Oxides of Nitrogen*	*Non-methane Hydrocarbons*	*Carbon Monoxide*	*Particulates*
2004-2006[H]	2.4[A,C,E,J]	2.5[B,C,E,J]	n/a		n/a	15.5	0.10[C]
October 1, 2002-2006	n/a	1. 8 to 0.3[A,D,F]	n/a		n/a	15.5	0.03 to 0.01[G]
2007 and subsequent[M]	n/a	n/a	0.20[I]		0.14	15.5	0.01[K]
2015 and Subsequent (Optional)[N,O]	n/a	n/a	n/a	0.10, 0.05, or 0.02	0.14	15.5	0.01

A This is the standard for the arithmetic sum of the oxides of nitrogen exhaust component certification value and the non-methane hydrocarbon exhaust component certification value, without individual restriction on the individual component values.

B This is the standard for the arithmetic sum of the oxides of nitrogen exhaust component certification value and the non-methane hydrocarbon exhaust component certification value, with the non-methane hydrocarbon individual component value not to exceed 0.5 g/bhp-hr.

C For 2004 through 2006 model years, emissions averaging may be used to meet this standard. Averaging must be based on the requirements of the averaging, banking and trading programs described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" incorporated by reference in section 1956.8(b), below.

D A manufacturer may elect to certify to an optional reduced-emission NOx+NMHC standard between the values, inclusive, by 0.3 grams per brake horsepower-hour increments. Engines certified to any of these optional reduced-emission NOx standards are not eligible for participation in any averaging, banking or trading programs described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" incorporated by reference in section 1956.8(b), below.

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[E] May be used as the certification standard for the higher emitting fueling mode of an engine certified under the dual fueling mode certification process of section 1956.8(a)(4), below.

[F] May be used as the certification standard for the lower emitting fueling mode of an engine certified under the dual fueling mode certification process of section 1956.8(a)(4), below.

[G] A manufacturer may elect to certify to an optional reduced-emission PM standard between the specified values, inclusive, by 0.01 grams per brake horsepower-hour increments. Engines certified to any of these optional reduced-emission PM standards are not eligible for participation in any averaging, banking or trading programs described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" incorporated by reference in section 1956.8(b), below.

[H] Engine manufacturers subject to the Heavy-Duty Diesel Engine Settlement Agreements (Settlement Agreements)[1] must produce engines in compliance with the requirements contained in their respective Settlement Agreement. Most engine manufacturers subject to the Settlement Agreements are required to manufacture engines meeting the exhaust emission standards for 2004 and subsequent model years engines beginning October 1, 2002.

[I] A manufacturer may elect to include any or all of its heavy-duty diesel engine families in any or all of the NOx emissions averaging, banking, or trading programs for heavy-duty diesel engines, within the restrictions described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" incorporated in section 1956.8 (b), below. If the manufacturer elects to include engine families in any of these programs, the NOx family emission limit (FEL) may not exceed the following FEL caps: 2.00 grams per brake horsepower-hour (0.75 grams per megajoule) for model years before 2010; 0.50 grams per brake horsepower-hour (0.19 grams per megajoule) for model years 2010 and later. The FEL cap applies whether credits for the engine family are derived from averaging, banking, or trading programs.

[J] For 2007 through 2009 model years, a manufacturer may use these emission standards in accordance with section 1956.8 (a)(2)(B). A manufacturer may elect to include any or all of its heavy-duty diesel engine families in any or all of the NOx plus NMHC emissions averaging, banking, or trading programs for heavy-duty diesel engines, within the restrictions described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" incorporated in section 1956.8 (b), below. If the manufacturer elects to include engine families in any of these programs, the NOx family emission limit (FEL) may not exceed the following FEL caps: 2.00 grams per brake horsepower-hour (0.75 grams per megajoule) for model years. The FEL cap applies whether credits for the engine family are derived from averaging, banking, or trading programs.

[K] A manufacturer may elect to include any or all of its heavy-duty diesel engine families in any or all of the particulate averaging, banking, or trading programs for heavy-duty diesel engines, within the restrictions described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" incorporated by reference in section 1956.8 (b), below. The particulate FEL for each engine family a manufacturer elects to include in any of these programs may not exceed an FEL cap of 0.02 grams per brake horsepower-hour (0.0075 grams per megajoule). The FEL cap applies whether credits for the engine family are derived from averaging, banking, or trading programs.

[L] For 2007 and subsequent model-year urban bus engines, this section applies. For urban bus model-year engines produced from October 1, 2002 through 2006, refer to section 1956.1.

[M] For model years between 2007 and 2009, transit agencies purchasing urban buses and/or urban bus engines shall meet the requirements set forth in section 2023.1.

[N] Optional Low NOx emission standards. A manufacturer may choose to offer an engine that is 50%, 75%, or 90% below the current 0.20 g/bhp-hr NOx emission standards for heavy duty engines. A manufacturer may not include an engine family certified to the optional NOx emission standards in the ABT programs for NOx but may include it for particulates.

- On-Board Diagnostic (OBD) requirements are to be followed per Title 13, CCR, section 1971.1 with the exception of the NOx emission threshold malfunction criteria for all applicable monitors, in which case a malfunction criterion of 0.4 g/bhp-hr NOx shall be used (i.e., the OBD system is required to detect a malfunction before NOx emissions exceed 0.4 g/bhp-hr).

[1] Seven of the largest heavy-duty diesel engine manufacturers will be implementing measures to reduce emissions beginning October 1, 2002, to meet the requirements of the Heavy-Duty Diesel Engine Settlement Agreements reached with the ARB. The Heavy-Duty Diesel Engine Settlements were agreements reached in response to lawsuits brought by the United States Environmental Protection Agency and violations alleged by the ARB pertaining to excess in-use emissions caused by the use of defeat devices and unacceptable algorithms. Navistar signed its Settlement Agreement on October 22, 1998. Cummins, Detroit Diesel Corporation, Caterpillar, Volvo, Mack and Renault signed their Settlement Agreements on December 15, 1998.

(B) Phase-in Options.

1.Early NOx compliant engines. For model years 2007, 2008, and 2009, a manufacturer may, at their option, certify one or more of their engine families to the combined NOx plus NMHC standard or FEL applicable to model year 2006 engines under section 1956.8 (a)(2)(A), in lieu of the separate NOx and NMHC standards or FELs applicable to the 2007 and subsequent model years, specified in section 1956.8 (a)(2)(A). Each engine certified under this phase-in option must comply with all other emission requirements applicable to model year 2007 engines. To qualify for this option, a manufacturer must satisfy the U.S.-directed production requirement of certifying no more than 50 percent of engines to the NOx plus NMHC standards or FELs applicable to 2006 engines, as specified in 40 Code of Federal Regulations, part 86, section 86.007-11(g)(1), as adopted January 18, 2001. In addition, a manufacturer may reduce the quantity of engines that are required to be phased-in using the early certification credit program specified in 40 Code of Federal Regulations, part 86, section 86.007-11(g)(2), as adopted January 18, 2001, and the "Blue Sky" engine program specified in 40 Code of Federal Regulations, part 86, section 86.007-11(g)(4), as adopted January 18, 2001.

2. Early PM compliant engines. A manufacturer certifying engines to the 2007 and subsequent model year PM standard listed in section 1956.8(a)(2)(A) (without using credits, as determined in any averaging, banking, or trading program described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles," to comply with the standards) before model year 2007 may reduce the number of engines that are required to meet the 2007 and subsequent model year PM standard listed in section 1956.8(a)(2)(A) in model year 2007, 2008 and/or 2009. To qualify for this option, a manufacturer must satisfy the PM emission requirements pursuant to the methods detailed in 40 Code of Federal Regulations, part 86, section 86.007-11 (g)(2)(ii), as adopted January 18, 2001.

(3) Formaldehyde exhaust emissions from new 1993 and subsequent model methanol-fueled diesel engines, shall not exceed:

Model Year	*Formaldehyde (g/bhp-hr)*
1993-1995	0.10
1996 and subsequent	0.05

(4) An engine family whose design allows engine operation in either of two distinct alternative fueling modes, where each fueling mode is characterized by use of one fuel or a combination of two fuels and by significantly different emission levels under each mode, may certify to a different NOx or NOx plus NMHC (as applicable depending on model year) standard for each fueling mode, provided it meets the following requirements:

(A) The NOx or NOx plus NMHC certification standard used for operation under the higher emitting fueling mode must be one of the standards denoted by footnote H in paragraph (a)(1) and footnote E in paragraph (a)(2).

(B) The NOx or NOx plus NMHC certification standard used for operation under the lower emitting fueling mode must be one of the reduced-emission standards denoted by footnote I in paragraph (a)(1) and footnote F in paragraph (a)(2).

(C) The engine family is not used to participate in any manufacturer's averaging, banking or trading program.

(D) The engine family meets all other emission requirements contained in this section.

(E) The higher emitting fueling mode must be intended only for fail-safe vehicle operation when a malfunction or inadvertent fuel depletion precludes operation in the lower emitting fueling mode, as evidenced by a significantly reduced horsepower versus engine speed curve when operating in the higher emitting fueling mode when compared to the similar curve for the lower emitting fueling mode.

(5) No crankcase emissions shall be discharged directly into the ambient atmosphere from any new 2007 or later model year diesel heavy-duty diesel engine, with the following exception: heavy-duty diesel engines equipped with turbochargers, pumps, blowers, or superchargers for air induction may discharge crankcase emissions to the ambient atmosphere if the emissions are added to the exhaust emissions (either physically or mathematically) during all emission testing. Manufacturers using this exception must manufacture the engines so that all crankcase emissions can be routed into a dilution tunnel (or other sampling system approved in advance by the

Executive Officer), and must account for deterioration in crankcase emissions when determining exhaust deterioration factors. For the purpose of section 1956.8(a)(2), crankcase emissions that are routed to the exhaust upstream of exhaust aftertreatment during all operation are not considered to be "discharged directly into the ambient atmosphere."

(6) Heavy-Duty Diesel Engine Idling Requirements.

(A) *Engine Shutdown System*. The requirements in this subsection apply to engine manufacturers and original equipment manufacturers, as applicable, that are responsible for the design and control of engine and/or vehicle idle controls.
1. Requirements. Except as provided in subsections (a)(6)(B) and (a)(6)(C), all new 2008 and subsequent model-year heavy-duty diesel engines shall be equipped with an engine shutdown system that automatically shuts down the engine after 300 seconds of continuous idling operation once the vehicle is stopped, the transmission is set to "neutral" or "park", and the parking brake is engaged. If the parking brake is not engaged, then the engine shutdown system shall shut down the engine after 900 seconds of continuous idling operation once the vehicle is stopped and the transmission is set to "neutral" or "park." The engine shutdown system must be tamper-resistant and non-programmable. A warning signal, such as a light or sound indicator inside the vehicle cabin, may be used to alert the driver 30 seconds prior to engine shutdown. The engine shutdown system must be capable of allowing the driver to reset the engine shutdown system timer by momentarily changing the position of the accelerator, brake, or clutch pedal, or other mechanism within 30 seconds prior to engine shutdown. Once reset, the engine shutdown system shall restart the engine shutdown sequence described in this paragraph above, and shall continue to do so until the engine shuts down or the vehicle is driven.

2. *Engine Shutdown System Override*: The engine shutdown system may be overridden, to allow the engine to run continuously at idle, only under the following conditions:

a. *If the engine is operating in power take-off (PTO) mode.*
The PTO system shall have a switch or a setting that can be switched "on" to override the engine shutdown system and will reset to the "off" position when the vehicle's engine is turned off or when the PTO equipment is turned off. Subject to advance Executive Officer approval, other methods for detecting or activating PTO operation may be allowed; or,

b. *If the vehicle's engine coolant temperature is below 60°F.*
The engine shutdown system shall automatically be activated once the coolant temperature reaches 60°F or above. The engine coolant temperature shall be measured with the engine's existing engine coolant temperature sensor used for engine protection, if so equipped. Other

methods of measuring engine coolant temperature may be allowed, subject to advance Executive Officer approval.

c. If an exhaust emission control device is regenerating, and keeping the engine running is necessary to prevent aftertreatment or engine damage, the engine shutdown system may be overridden for the duration necessary to complete the regeneration process up to a maximum of 30 minutes. Determination of what constitutes the need for regeneration will be based on data provided by the manufacturer at time of certification. Regeneration events that may require longer than 30 minutes of engine idling to complete shall require advance Executive Officer approval. At the end of the regeneration process, the engine shutdown system shall automatically be enabled to restart the engine shutdown sequence described in subparagraph (a)(6)(A)1. above. A vehicle that uses a regeneration strategy under engine idling operating conditions shall be equipped with a dashboard indicator light that, when illuminated, indicates that the exhaust emission control device is regenerating. Other methods of indicating that the exhaust emission control device is regenerating may be used with advance Executive Officer approval.

d. if servicing or maintenance of the engine requires extended idling operation. The engine's electronic control module may be set to temporarily deactivate the engine shutdown system for up to a maximum of 60 minutes. The deactivation of the engine shutdown system shall only be performed with the use of a diagnostic scan tool. At the end of the set deactivation period, the engine's electronic control module shall reset to restart the engine shutdown system sequence described in subparagraph (a)(6)(A)1. above.

(B) *Exempt Vehicles*. Heavy-duty diesel engines to be used in buses as defined in California Vehicle Code sections 233, 612 and 642, school buses as defined in California Vehicle Code section 545, recreational vehicles as defined in Health and Safety Code 18010, medium duty vehicles as defined in section 1900(b) of title 13, California Code of Regulations, military tactical vehicles as defined in section 1905 of title 13, California Code of Regulations, authorized emergency vehicles as defined in California Vehicle Code section 165, armored cars, as defined in California Vehicle Code sections 115, and workover rigs, as defined in section 2449 of title 13, California Code of Regulations are exempted from these requirements.

(C) *Optional NOx idling emission standard*. In lieu of the engine shutdown system requirements specified in subsection (a)(6)(A) above, an engine manufacturer may elect to certify its new 2008 and subsequent model-year heavy-duty diesel engines to an optional NOx idling emission standard of 30 grams per hour. Compliance with this optional standard will be determined based on testing conducted pursuant to the supplemental NOx idling test cycle and procedures

specified in section 86.1360-2007.B.4 of the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles," as incorporated by reference in subsection (b). The manufacturer may request an alternative test procedure if the technology used cannot be demonstrated using the procedures in section 86.1360-2007.B.4, subject to advance approval of the Executive Officer. A manufacturer certifying to the optional NOx idling standard must not increase emissions of CO, PM, or NMHC, determined by comparing results from the supplemental NOx idling test cycle and procedures specified in section 86.1360-2007.B.4 of the referenced "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles" to emission results from the idle mode of the supplemental steady state test cycle or emission results from idle portions of the transient test cycle for heavy duty diesel engines, respectively specified in sections 86-1360-2007 and 86.1327-98 of the referenced "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles." With advance Executive Officer approval, a manufacturer may use other methods of ensuring that emissions of CO, PM, and NMHC are not adversely affected in meeting the optional NOx requirement. Also, manufacturers shall state in their application for certification that meeting the optional NOx idling requirement will not adversely affect the associated emissions of CO, PM and NMHC.
An engine manufacturer certifying its engine to the optional NOx idling emission standard must also produce a vehicle label, as defined in subsection 35.B.4 of the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles," as incorporated by reference in subsection (b).

(D) *Optional Alternatives to Main Engine Idling.* All new 2008 and subsequent model year heavy duty diesel engines may also be equipped with idling emission reduction devices that comply with the compliance requirements specified in title 13, CCR, section 2485(c)(3).

(7) Greenhouse Gas Emission Standards for new 2014 and Subsequent Model Heavy-Duty Diesel Engines, Heavy-Duty Natural Gas-Fueled and Liquefied-Petroleum-Gas-Fueled Engines Derived from Diesel-Cycle Engines, and Heavy-Duty Methanol-Fueled Diesel Engines.

(A) The CO_2 emissions from new 2014 and subsequent model heavy-duty diesel engines, heavy-duty natural gas-fueled and liquefied-petroleum-gas-fueled engines derived from diesel-cycle engines, and heavy-duty methanol-fueled diesel engines, except in all cases engines used in medium-duty vehicles, shall not exceed:

CO_2 Emission Standards for 2014 and Subsequent Model Heavy-Duty Diesel Engines [A, B, C] (in g/hp-hr)

Model Years	*Light heavy-duty-- vocational*	*Medium heavy-duty-- vocational*	*Heavy heavy-duty-- vocational*	*Medium heavy-duty-- tractor*	*Heavy heavy-duty-- tractor*
2014-2016	600	600	567	502	475
2017 and later	576	576	555	487	460

[A] *Family Certification Levels.* A Family Certification Level (FCL) must be specified for each engine family, which may not be less than the certified emission level for the engine family. The Family Emission Limit (FEL) for the engine family is equal to the FCL multiplied by 1.03. The FCL serves as the CO_2 emission standard for the engine family with respect to certification and confirmatory testing instead of the standards specified in this subsection (a)(7)(A). The FEL serves as the emission standard for the engine family with respect to all other testing.

[B] *Averaging, Banking, and Trading Program and Credits.* The requirements for the optional averaging, banking, and trading program and for generating credits are described in the applicable test procedures incorporated by reference in subsection (b).

[C] *Alternate Phase-in Emission Standards.* Alternate phase-in emission standards may be used in lieu of the required CO_2 emission standards in the table above. To qualify for these alternate phase-in emission standards, the manufacturer must begin certifying all of its model year 2013 diesel engines within a given primary intended service class to the applicable alternate emission standards of this footnote (c) and continue through model year 2016. This means that once a manufacturer chooses to certify a primary intended service class to the alternate emission standards of this footnote (c), it is not allowed to opt out of these standards. Engines certified to these alternate emission standards are not eligible for early credits. Note that these alternate emission standards for 2016 and later are the same as the otherwise applicable required emission standards for model year 2017 and later.

Alternate Phase-in CO_2 Emission Standards (in g/hp-hr)					
Model Years	***Light heavy-duty – vocational***	***Medium heavy-duty – vocational***	***Heavy heavy-duty – vocational***	***Medium heavy-duty – tractor***	***Heavy heavy-duty – tractor***
2013-2015	**618**	**618**	**577**	**512**	**485**
2016	**576**	**576**	**555**	**487**	**460**

[D] *Alternate Emission Standards Based on 2011 Model Year Engines.* For model years 2014 through 2016, heavy-duty diesel engines may be certified to these alternate emission standards based on 2011 model year engines, if they are not part of an averaging set in which a balance of banked credits remain. These alternate standards are determined from the measured emission rate of the test engine of the applicable baseline 2011 engine family(ies) as described in the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel-Engines and Vehicles," as incorporated by reference in section (b). The alternate CO_2 standard for light and medium heavy-duty vocational-certified engines is equal to the baseline 2011 emission rate

multiplied by 0.975. The alternative CO_2 standard for tractor-certified engines and all other heavy heavy-duty engines is equal to the baseline 2011 emission rate multiplied by 0.970.

(B) The methane (CH_4) emissions from new 2014 and subsequent model heavy-duty diesel engines, heavy-duty natural gas-fueled and liquefied-petroleum-gas-fueled engines derived from diesel-cycle engines, and heavy-duty methanol-fueled diesel engines, except in all cases engines used in medium-duty vehicles, shall not exceed 0.10 g/hp-hr.

(C) The nitrous oxide (N_2O) emissions from new 2014 and subsequent model heavy-duty diesel engines, heavy-duty natural gas-fueled and liquefied-petroleum-gas-fueled engines derived from diesel-cycle engines, and heavy-duty methanol-fueled diesel engines, except in all cases engines used in medium-duty vehicles, shall not exceed 0.10 g/hp-hr.

(b) *Test Procedures*. The test procedures for determining compliance with standards applicable to 1985 and subsequent model heavy-duty diesel engines and vehicles and the requirements for participating in the averaging, banking and trading programs, are set forth in the "California Exhaust Emission Standards and Test Procedures for 1985 through 2003 Model Heavy-Duty Diesel-Engines and Vehicles," adopted April 8, 1985, as last amended December 12, 2002, the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel-Engines and Vehicles," adopted December 12, 2002, as last amended October 21, 2014, and the "California Interim Certification Procedures for 2004 and Subsequent Model Hybrid-Electric and Other Hybrid Vehicles in the Urban Bus and Heavy-Duty Vehicle Classes," adopted October 24, 2002, as last amended October 21, 2014, which are incorporated by reference herein.

(c)(1)(A) The exhaust emissions from (i) new 1987 through 2004 model heavy-duty Otto-cycle engines (except methanol-fueled engines and except heavy-duty Otto-cycle natural-gas-fueled and liquified-petroleum-gas-fueled Otto-cycle engines derived from diesel-cycle engines) and (ii) from new 1993 through 2004 model heavy-duty methanol-fueled Otto-cycle engines (except in all cases engines used in medium-duty vehicles) shall not exceed:

Exhaust Emission Standards for Heavy-Duty Otto-Cycle Engines
(grams per brake horsepower-hour or g/bhp-hr)

Model Year	*Total Hydrocarbons or OMHCE*[A]	*Optional Non-Methane Hydrocarbons*[A]	*Carbon Monoxide*[B]	*Oxides of Nitrogen*
1987[C]	1.1[D]		14.4[D]	10.6
	1.9[E]		37.1[E]	10.6
1988-1989	1.1[D]		14.4[D]	6.0
	1.9[E]		37.1[E]	6.0
1990	1.1	0.9[D]	14.4[D]	6.0
	1.9[E]	1.7[E]	37.1[E]	6.0
1991-1994	1.1[D]	0.9[D]	14.4[D]	5.0
	1.9[E]	1.7[E]	37.1[E]	5.0
1995-1997	1.9[E]	1.7[E]	37.1[E]	5.0
	1.9[E]	1.7[E]	37.1[E]	2.5 to 5.0[F]
1998-2003[G]	1.9[E]	1.7[E]	37.1[E]	4.0
	1.9[E]	1.7[E]	37.1[E]	1.5 to 0.5[F]

	Non-Methane Hydrocarbons plus Oxides of Nitrogen (NMHC + NOx)	*Carbon Monoxide*
2004[G]	2.4 g/bph-hr; or 2.5 with 0.5 g/bhp-hr cap on NMHC	37.1

[A]The total or optional non-methane hydrocarbon standards apply to petroleum-fueled, natural-gas-fueled and liquefied-petroleum-gas-fueled engines and methanol-fueled engines beginning in 2004. The Organic Material Hydrocarbon Equivalent, or OMHCE, standards apply to 1987 through 2003 methanol-fueled engines.

[B]Prior to the 2002 model year, carbon monoxide emissions from engines utilizing exhaust after treatment technology shall also not exceed 0.5 percent of the exhaust gas flow at curb idle.

[C]Manufacturers with existing heavy-duty Otto-cycle engines certified to the California 1986 steady-state emission standards and test procedures may as an option certify those engines, for the 1987 model year only, in accordance with the standards and test procedures for 1986 heavy-duty Otto-cycle engines established in Section 1956.7.

[D]These standards are applicable to Otto-cycle engines intended for use in all heavy-duty vehicles.

[E]Applicable to heavy-duty Otto-cycle engines intended for use only in vehicles with a gross vehicle weight rating greater than 14,000 pounds. Also, as an option, a manufacturer may certify one or more 1988 through 1994 model Otto-cycle heavy-duty engine configurations intended for use in all heavy-duty vehicles to these emission standards, provided that the total model-year sales of such configuration(s) being certified to these emission standards represent no more than 5 percent of total model-year sales of all Otto-cycle heavy-duty engines intended for use in vehicles with a Gross Vehicle Weight Rating of up to 14,000 pounds by the manufacturer.

[F]These are optional standards and apply to all heavy-duty engines intended for use only in vehicles with a gross vehicle weight rating greater than 14,000 pounds. A manufacturer may elect to certify to an optional standard between the values, inclusive, by 0.5 grams per brake horsepower-hour increments.

[G]A manufacturer may request to certify to Option 1 or Option 2 federal NMHC + NOx standards as set forth in 40 CFR § 86.005-10(f), as adopted October 6, 2000.

(c)(1)(B) The exhaust emissions from new 2005 and subsequent model heavy-duty Otto-cycle engines, except for Otto-cycle medium- and heavy-duty engines subject to the alternative standards in 40 CFR §86.005-10(f), shall not exceed:

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PER AGENCY
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LSM

California Emission Standards for 2005 and Subsequent Model Heavy-Duty Otto-Cycle Engines[A] (in g/bhp-hr)

Model Year	*Emission Category*	*NMHC + NOx*	*NMHC*	*NOx*	*CO[G]*	*HCHO*	*PM*
Standards for Heavy-Duty Otto-Cycle Engines Used In 2005 through 2019 Model Incomplete Medium-Duty Vehicles 8,501 to 10,000 pounds GVW[B] and 2005 and Subsequent Model Incomplete Medium-Duty Vehicles 10,001 to 14,000 pounds GVW[C]							
2005 through 2007	ULEV	1.0[D,F]	n/a	n/a	14.4	0.05	n/a
	SULEV	0.5	n/a	n/a	7.2	0.025	n/a
2008 and subsequent	ULEV	n/a	0.14[F]	0.20[F]	14.4	0.01	0.01
	SULEV	n/a	0.07[F]	0.10[F]	7.2	0.005	0.005
Standards for Heavy-Duty Otto-Cycle Engines Used In Heavy-Duty Vehicles Over 14,000 pounds GVW							
2005 through 2007	n/a	1.0[D,F]	n/a	n/a	37.1	0.05[E]	n/a
2008 and subsequent	n/a	n/a	0.14[F]	0.20[F]	14.4	0.01	0.01
2015 and subsequent[H,I]	Optional	n/a	0.14	0.10, 0.05 or 0.02	14.4	0.01	0.01

A These standards apply to petroleum-fueled, alcohol-fueled, liquefied petroleum gas-fueled and natural gas-fueled Otto-cycle engines.

B For the 2020 and subsequent model years, medium-duty vehicles 8,501 to 10,000 pounds GVW must certify to the primary emission standards and test procedures for complete vehicles specified in section 1961.2, title 13, CCR.

C A manufacturer of engines used in incomplete medium-duty vehicles may choose to comply with these standards as an alternative to the primary emission standards and test procedures for complete vehicles specified in section 1961 or 1961.2, title 13, CCR. A manufacturer that chooses to comply with these optional heavy-duty engine standards and test procedures shall specify, in the Part I application for certification, an in-use compliance test procedure, as provided in section 2139(c), title 13 CCR.

[D] A manufacturer may request to certify to the Option 1 or Option 2 federal NMHC + NOx standards as set forth in 40 CFR § 86.005-10(f). However, for engines used in medium-duty vehicles, the formaldehyde level must meet the standard specified above.

[E] This standard only applies to methanol-fueled Otto-cycle engines.

[F] A manufacturer may elect to include any or all of its medium- and heavy-duty Otto-cycle engine families in any or all of the emissions ABT programs for HDEs, within the restrictions described in section I.15 of the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines," incorporated by reference in section 1956.8(d). For engine families certified to the Option 1 or 2 federal standards, the FEL must not exceed 1.5 g/bhp-hr. If a manufacturer elects to include engine families certified to the 2005 and subsequent model year standards, the NOx plus NMHC FEL must not exceed 1.0 g/bhp-hr. For engine families certified to the 2008 and subsequent model year standards, the FEL is the same as set forth in 40 CFR 86.008-10(a)(1).

[G] Idle carbon monoxide: For all Otto-cycle heavy-duty engines utilizing aftertreatment technology, and not certified to the on-board diagnostics requirements of section 1968, et seq, as applicable, the CO emissions shall not exceed 0.50 percent of exhaust gas flow at curb idle.

[H] Optional Low NOx emission standards. A manufacturer may choose to offer an engine that is 50%, 75%, or 90% below the current 0.20 g/bhp-hr NOx emission standards for heavy duty engines. A manufacturer may not include an engine family certified to the optional NOx emission standards in the ABT programs for NOx but may include it for NMHC.

[I] On Board Diagnostic (OBD) requirements are to be followed using Title 13, CCR, section 1971.1 with the exception of the NOx emission threshold malfunction criteria for all applicable monitors, in which case the malfunction criteria shall be as follows:

(A) for monitors that require detection of a malfunction before emissions exceed 1.5 times the applicable NOx standard, a malfunction criterion of 0.3 g/bhp-hr NOx shall be used (i.e., the OBD system is required to detect a malfunction before NOx emissions exceed 0.3 g/bhp-hr).

(B) for monitors that require detection of a malfunction before emissions exceed 1.75 times the applicable NOx standard, a malfunction criterion of 0.35 g/bhp-hr NOx shall be used (i.e., the OBD system is required to detect a malfunction before NOx emissions exceed 0.35 g/bhp-hr).

(C) for monitors that require detection of a malfunction before emissions exceed 3.0 times the applicable NOx standard, a malfunction criterion of 0.6 g/bhp-hr NOx shall be used (i.e., the OBD system is required to detect a malfunction before NOx emissions exceed 0.6 g/bhp-hr).

(2) Formaldehyde exhaust emissions from new 1993 and subsequent model methanol-fueled otto cycle engines shall not exceed:

Model Year	***Formaldehyde (g/bhp-hr)***
1993-1995	0.10
1996 and Subsequent	0.05

(3) *Optional Standards for Complete and Incomplete Heavy-Duty Vehicles that Use Heavy-Duty Otto-Cycle Engines.* Manufacturers may request to group complete and incomplete heavy-duty Otto-cycle vehicles into the same test group as Otto-cycle vehicles certifying to the LEV III exhaust emission standards and test procedures specified in title 13, CCR, §1961.2, so long as those complete and incomplete heavy-duty Otto-cycle vehicles meet the most stringent LEV III standards to which any vehicle within that test group certifies.

(4) Greenhouse Gas Emission Standards for New 2016 and Subsequent Model Heavy-Duty Otto-Cycle Engines.

(A) The CO_2 emissions from new 2016 and subsequent model heavy-duty Otto-cycle engines, except in all cases engines used in medium-duty vehicles, shall not exceed 627 g/hp-hr. An FCL must be specified for each engine family, which may not be less than the certified emission level for the engine family. The FEL for the engine family is equal to the FCL multiplied by 1.03. The FCL serves as the CO_2 emission standard for the engine family with respect to certification and confirmatory testing instead of the standard specified in this subsection (c)(4)(A). The FEL serves as the emission standard for the engine family with respect to all other testing. The requirements for the optional averaging, banking, and trading program and for generating credits are described in the applicable test procedures incorporated by reference in subsection (d).

(B) The CH_4 emissions from new 2016 and subsequent model heavy-duty Otto-cycle engines, except in all cases engines used in medium-duty vehicles, shall not exceed 0.10 g/hp-hr.

(C) The N_2O emissions from new 2016 and subsequent model heavy-duty Otto-cycle engines, except in all cases engines used in medium-duty vehicles, shall not exceed 0.10 g/hp-hr.

(d) *Test Procedures.* The test procedures for determining compliance with standards applicable to 1987 and subsequent model heavy-duty Otto-cycle engines and vehicles

are set forth in the "California Exhaust Emission Standards and Test Procedures for 1987 through 2003 Model Heavy-Duty Otto-Cycle Engines and Vehicles," adopted April 25, 1986, as last amended December 27, 2000, the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines and Vehicles," adopted December 27, 2000, as last amended October 21, 2014, and the "California Interim Certification Procedures for 2004 and Subsequent Model Hybrid-Electric and Other Hybrid Vehicles, in the Urban Bus and Heavy-Duty Vehicle Classes," adopted October 24, 2002, as last amended October 21, 2014, which are incorporated by reference herein; and the "California Non-Methane Organic Gas Test Procedures for 1993 through 2016 Model Year Vehicles" and the "California Non-Methane Organic Gas Test Procedures for 2017 and Subsequent Model Year Vehicles," which are incorporated by reference in section 1961.2.

(e) A manufacturer may elect to certify complete heavy-duty vehicles of 14,000 pounds or less maximum gross vehicle weight rating as medium-duty vehicles under section 1960.1 or section 1961 of this chapter, in which event the heavy-duty emission standards and test procedures in this section shall not apply.

(f)(1) In 1985 and future years, the executive officer may authorize use of engines certified to meet federal emission standards, or which are demonstrated to meet appropriate federal emission standards, in up to a total of 100 heavy-duty vehicles, including otto-cycle and diesel heavy-duty vehicles, in any one calendar year when the executive officer has determined that no engine certified to meet California emission standards exists which is suitable for use in the vehicles.

(2) In order to qualify for an exemption, the vehicle manufacturer shall submit, in writing, to the executive officer the justification for such exemption. The exemption request shall show that, due to circumstances beyond the control of the vehicle manufacturer, California certified engines are unavailable for use in the vehicle. The request shall further show that redesign or discontinuation of the vehicle will result in extreme cost penalties and disruption of business. In evaluating a request for an exemption, the executive officer shall consider all relevant factors, including the number of individual vehicles covered by the request and the anti-competitive effect, if any, of granting the request. If a request is denied, the executive officer shall state in writing the reasons for the denial.

(3) In the event the executive officer determines that an applicant may meet the criteria for an exemption under this subsection, but that granting the exemption will, together with previous exemptions granted, result in over 100 vehicles being permitted under this subsection to use non-California engines in heavy-duty vehicles in any one calendar year, the exemption may be granted only by the state board, under the criteria set forth herein.

(g) The exhaust emissions from new 1995 through 2003 model-year engines used in incomplete medium-duty vehicles or diesel engines used in medium-duty vehicles shall not exceed:

Exhaust Emission Standards [A]
(grams per brake horsepower-hour, or g/bhp-hr)

Model Year	*Carbon Monoxide*	*NMHC + NOx [B]*	*Particulates [C]*
1995[D] through 2003	14.4	3.9	0.10

[A] This set of standards is optional. Manufacturers of engines used in incomplete medium-duty vehicles or diesel engines used in medium-duty vehicles from 8501-14,000 pounds, gross vehicle weight may choose to comply with these standards as a alternative to the primary emission standards and test procedures specified in section 1960.1, Title 13, California Code of Regulations. Manufacturers that choose to comply with these optional heavy-duty standards and test procedures shall specify, in the application for certification, an in-use compliance test procedure, as provided in section 2139(c), Title 13, California Code of Regulations.

[B] This standard is the sum of the individual non-methane hydrocarbon emissions and oxides of nitrogen emissions. For methanol-fueled engines, non-methane hydrocarbons shall mean organic material hydrocarbon equivalent.

[C] This standard shall only apply to diesel engines and vehicles.

[D] In the 1995 model-year only, manufacturers may certify up to 50 percent of their medium-duty engines or vehicles to the applicable 1994 model-year standards and test procedures. For the 1995 through 1997 models, alternative in-use compliance is available for medium-duty manufacturers. A manufacturer may use alternative in-use compliance for up to 100 percent of its fleet in the 1995 and 1996 model years and up to 50 percent of its fleet in the 1997 model year. The percentages shall be determined from the manufacturers' projected California sales of medium-duty vehicles. For engines certified to the standards and test procedures of this subsection, "alternative in-use compliance" shall consist of an allowance of 25 percent over the HC + NOx standard. In-use compliance testing shall be limited to vehicles or engines with less than 90,000 miles.

(h) The exhaust emissions from new:

(1) 1992 through 2004 model-year Otto-cycle engines used in incomplete medium-duty low-emission vehicles, ultra-low-emission vehicles, and super-ultra-low-emission vehicles; and

(2) 1992 and subsequent model diesel engines used in medium-duty low-emission vehicles, ultra-low-emission vehicles, and super-ultra-low-emission vehicles shall not exceed:

Exhaust Emission Standards for Engines Used in 1992 through 2004 Model Incomplete Otto-Cycle Medium-Duty Low-Emission Vehicles, Ultra-Low-Emission Vehicles, and Super Ultra-Low-Emission Vehicles, and 1992 and Subsequent Model Diesel Engines Used in Medium-Duty Low-Emission Vehicles, Ultra-Low-Emission Vehicles, and Super Ultra-Low-Emission Vehicles[A,F]
(grams per brake horsepower-hour)

Model Year	*Vehicle Emissions Category*[B]	*Carbon Monoxide*	*NMHC + NOx*[C]	*Non-Methane Hydrocarbons*	*Oxides of Nitrogen*	*Formaldehyde*	*Particulates*[D]
1992[E]-2001	LEV	14.4	3.5[K]	n/a	n/a	0.050	0.10[K]
2002-2003[E]	LEV	14.4	3.0[K]	n/a	n/a	0.050	0.10[K]
1992-2003[E,H]	ULEV	14.4	2.5[K]	n/a	n/a	0.050	0.10[K]
2004 – 2006[L]	ULEV – Opt A	14.4	2.5[I,J,K]	n/a	n/a	0.050	0.10[J,K]
2004 – 2006[L]	ULEV – Opt. Bn/a	14.4	2.4[I,J,K]	n/a	n/a	0.050	0.10[J,K]
2007 and subsequent[D] (diesel only)	ULEV	15.5	n/a	0.14	0.20	0.050	0.01
1992 – 2006[L]	SULEV	7.2	2.0[K]	n/a	n/a	0.025	0.05[K]
2007 and subsequent[D] (diesel only)	SULEV	7.7	n/a	0.07	0.10	0.025	0.005

[A]This set of standards is optional. For the 1992 through 2019 model years, manufacturers of engines used in incomplete medium-duty vehicles or diesel engines used in medium-duty vehicles from 8501-10,000 pounds gross vehicle weight rating may choose to comply with these standards as a alternative to the primary emission standards and test procedures specified in section 1960.1, section 1961, or section 1961.2, Title 13, California Code of Regulations. For the 1992 and subsequent model years, manufacturers of engines used in incomplete medium-duty vehicles or diesel engines used in medium-duty vehicles from 10,001-14,000 pounds gross vehicle weight rating may choose to comply with these standards as an alternative to the primary emission standards and test procedures specified in section 1960.1, section 1961, or section 1961.2, Title 13, California Code of Regulations. For the 2020 and subsequent model years, both incomplete medium-duty vehicles and medium-duty vehicles that use a diesel engine 8,501 to 10,000 pounds GVW must certify to the primary emission standards and test procedures for complete vehicles specified in section 1961.2, title 13, CCR. Manufacturers that choose to comply with these optional heavy-duty standards and test procedures shall specify, in the application for certification, an in-use compliance test procedure, as provided in section 2139(c), Title 13, California Code of Regulations.

[B]"LEV" means low-emission vehicle.

"ULEV" means ultra-low-emission vehicle.

"SULEV" means super ultra-low-emission vehicle.

[C]This standard is the sum of the individual non-methane hydrocarbon emissions and oxides of nitrogen emissions. For methanol-fueled engines, non-methane hydrocarbons shall mean organic material hydrocarbon equivalent ("OMHCE").

[D]These standards apply only to diesel engines and vehicles.

[E]Manufacturers may certify engines used in incomplete medium-duty vehicles or diesel engines used in medium-duty vehicles to these standards to meet the requirements of section 1956.8 (g), Title 13, California Code of Regulations.

[F]In-use compliance testing shall be limited to vehicles or engines with fewer than 90,000 miles.

[G][Reserved]

[H]For engines certified to the 3.5 grams per brake horsepower-hour (g/bhp-hr) LEV standards, the in-use compliance standard shall be 3.7 g/bhp-hr for the first two model years of introduction. For engines certified to the 2002 and 2003 model year LEV standards, the in-use compliance standard shall be 3.2 g/bhp-hr. For engines certified to the 1992 through 2003 model year ULEV standards, the in-use compliance standard shall be 2.7 g/bhp-hr for the first two model years of introduction. For engines certified to the 1992 and subsequent SULEV standards, the in-use compliance standard shall be 2.2 g/bhp-hr for the first two model years of introduction.

[I]Manufacturers have the option of certifying to either option A or B. Manufacturers electing to certify to Option A must demonstrate that the NMHC emissions do not exceed 0.5 g/bhp-hr.

[J]Emissions averaging may be used to meet these standards for diesel engines, using the requirements for participation in averaging, banking and trading programs, as set forth in the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles," incorporated by reference in section 1956.8(b), above.

[K]Engines of 1998 and subsequent model years may be eligible to generate averaging, banking and trading credits based on these standards according to the requirements of the averaging, banking and trading programs described in the "California Exhaust Emission Standards and Test Procedures for 1985 through 2003 Model Heavy-Duty Diesel Engines and Vehicles" and the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles," incorporated by reference in section 1956.8(b), above.

[L]For the 2005 and 2006 model years, these emission standards only apply to diesel engines and vehicles.

(3) 2007 and later model year engines subject to (h)(2) have the following Phase-in Options.

(A) Early NOx compliant engines. For model years 2007, 2008, and 2009, a manufacturer may, at their option, certify one or more of their engine families to the combined NOx plus NMHC standard or FEL applicable to model year 2006 engines under section 1956.8(h)(2), in lieu of the separate NOx and NMHC standards or FELs applicable to the 2007 and subsequent model years, specified in section 1956.8(h)(2). Each engine certified under this phase-in option must comply with all other emission requirements applicable to model year 2007 engines. To qualify for this option, a manufacturer must satisfy the U.S.-directed production requirement of certifying no more than 50 percent of engines to the NOx plus NMHC standards or FELs applicable to 2006 engines, as specified in 40

Code of Federal Regulations, part 86, section 86.007-11(g)(1), as adopted January 18, 2001. In addition, a manufacturer may reduce the quantity of engines that are required to be phased-in using the early certification credit program specified in 40 Code of Federal Regulations, part 86, section 86.007-11(g)(2), as adopted January 18, 2001, and the "Blue Sky" engine program specified in 40 Code of Federal Regulations, part 86, section 86.007-11(g)(4), as adopted January 18, 2001.

(B) Early PM compliant engines. A manufacturer certifying engines to the 2007 and subsequent model year PM standard listed in section 1956.8 (h)(2) (without using credits, as determined in any averaging, banking, or trading program described in "California Exhaust Emission Standards and Test Procedures for 1985 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles," to comply with the standards) before model year 2007 may reduce the number of engines that are required to meet the 2007 and subsequent model year PM standard listed in section 1956.8(h)(2) in model year 2007, 2008 and/or 2009. To qualify for this option, a manufacturer must satisfy the PM emission requirements pursuant to the methods detailed in 40 Code of Federal Regulations, part 86, section 86.007-11(g)(2)(ii), as adopted January 18, 2001.

(4) No crankcase emissions shall be discharged directly into the ambient atmosphere from any new 2007 or later model year diesel heavy-duty diesel engine, with the following exception: heavy-duty diesel engines equipped with turbochargers, pumps, blowers, or superchargers for air induction may discharge crankcase emissions to the ambient atmosphere if the emissions are added to the exhaust emissions (either physically or mathematically) during all emission testing. Manufacturers taking advantage of this exception must manufacture the engines so that all crankcase emission can be routed into a dilution tunnel (or other sampling system approved in advance by the Executive Officer), and must account for deterioration in crankcase emissions when determining exhaust deterioration factors. For the purpose of section 1956.8(h)(2), crankcase emissions that are routed to the exhaust upstream of exhaust aftertreatment during all operation are not considered to be "discharged directly into the ambient atmosphere."

(5) *Optional Standards for Complete and Incomplete Heavy-Duty Vehicles that Use Heavy-Duty Diesel Engines*. Manufacturers may request to group complete and incomplete heavy-duty diesel vehicles into the same test group as medium-duty diesel vehicles certifying to the LEV III exhaust emission standards and test procedures specified in title 13, CCR, §1961.2, so long as those complete and incomplete heavy-duty diesel vehicles meet the most stringent LEV III standards to which any vehicle within that test group certifies.

(6) Greenhouse Gas Emission Standards for New 2014 and Subsequent Model Heavy-Duty Diesel Engines and 2016 and Subsequent Heavy-Duty Otto-Cycle Engines Used in Medium-Duty Low-Emission Vehicles, Ultra-Low-Emission Vehicles, and Super-Ultra-Low-Emission Vehicles.

(A) The CO_2 emissions from new 2014 and subsequent model heavy-duty diesel engines and new 2016 and subsequent heavy-duty Otto-cycle engines used in medium-duty low-emission vehicles, ultra-low-emission vehicles, and super-ultra-low-emission vehicles shall not exceed:

CO_2 Emission Standards for 2014 and Subsequent Model Heavy-Duty Diesel Engines and 2016 and Subsequent Model Heavy-Duty Otto-Cycle Engines Used in Medium-Duty Low-Emission Vehicles, Ultra-Low-Emission Vehicles, and Super-Ultra-Low Emission Vehicles [A, B] (in g/hp-hr)

Model Years	Diesel Engines [C]	Otto-Cycle Engines
2014	600	-
2015	600	-
2016	600	627
2017 and later	576	627

A *Family Certification Levels.* An FCL must be specified for each engine family, which may not be less than the certified emission level for the engine family. The FEL for the engine family is equal to the FCL multiplied by 1.03. The FCL serves as the CO_2 emission standard for the engine family with respect to certification and confirmatory testing instead of the standards specified in this subsection (h)(6)(A). The FEL serves as the emission standard for the engine family with respect to all other testing.

B *Averaging, Banking, and Trading Program and Credits.* The requirements for the optional averaging, banking, and trading program and for generating credits are described in the applicable test procedures incorporated by reference in subsection (b).

C *Alternate Emission Standards Based on 2011 Model Year Engines.* For model years 2014 through 2016, heavy-duty diesel engines may be certified to these alternate emission standards if they are not part of an averaging set in which a balance of banked credits remain. These alternate standards are determined from the measured emission rate of the test engine of the applicable baseline 2011 engine family(ies) as described in the California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel-Engines and Vehicles, as incorporated by reference in section (b). The alternate CO_2 standard for light heavy-duty vocational-certified engines is equal to the baseline 2011 emission rate multiplied by 0.975.

(B) The CH_4 emissions from new 2014 and subsequent model heavy-duty diesel engines and new 2016 and subsequent heavy-duty Otto-cycle engines used in medium-duty low-emission vehicles, ultra-low-emission vehicles, and super-ultra-low-emission vehicles shall not exceed 0.10 g/hp-hr.

(C) The N_2O emissions from new 2014 and subsequent model heavy-duty diesel engines and new 2016 and subsequent heavy-duty Otto-cycle engines used in medium-duty low-emission vehicles, ultra-low-emission vehicles, and super-ultra-low-emission vehicles shall not exceed 0.10 g/hp-hr.

(i) Definitions Specific to this Section. The following definitions apply to this section 1956.8.

(1) "Certified emission level" means the highest deteriorated emission level in an engine family for a given pollutant from the applicable transient and/or steady-state testing, rounded to the same number of decimal places as the applicable standard. Note that there may be two certified emission levels for CO_2 if a family is certified for both vocational and tractor use.

(2) "Family certification level" (FCL) means a CO_2 emission level declared by the manufacturer that is at or above emission test results for all emission-data engines. The FCL serves as the emission standard for the engine family with respect to certification testing if it is different than the otherwise applicable standard. The FCL must be expressed to the same number of decimal places as the emission standard it replaces.

(3) "Family emission limit" (FEL) means an emission level declared by the manufacturer to serve in place of an otherwise applicable emission standard (other than CO_2 standards) under the Average, Banking, and Trading Program. The FEL must be expressed to the same number of decimal places as the emission standard it replaces. The FEL serves as the emission standard for the engine family with respect to all required testing except certification testing for CO_2. The CO_2 FEL is equal to the CO_2 FCL multiplied by 1.03 and rounded to the same number of decimal places as the standard (e.g., the nearest whole g/hp-hr for the 2016 CO_2 standards).

(4) "Heavy heavy-duty engine" means an engine used in a vehicle that normally exceeds 33,000 pounds GVWR. Heavy heavy-duty engines are designed for multiple rebuilds and have cylinder liners. Vehicles in this group are normally tractors, trucks, and buses used in inter-city, long-haul applications.

(5) "Light heavy-duty engine" means an engine used in a vehicle that is normally below 19,500 pounds GVWR. Light heavy-duty engines usually are not designed for rebuild and do not have cylinder liners. Vehicle body types in this group might include any heavy-duty vehicle built for a light-duty truck chassis, van trucks, multi-stop vans, motor homes and other recreational vehicles, and some straight trucks with a single rear axle. Typical applications would include personal transportation, light-load commercial delivery, passenger service, agriculture, and construction.

(6) "Medium heavy-duty engine" mean an engine used in a vehicle that is normally between 19,500 to 33,000 pounds GVWR. Medium heavy-duty engines may be designed for rebuild and may have cylinder liners. Vehicle body types in this group would typically include school buses, straight trucks with dual rear axles, city tractors, and a variety of special purpose vehicles such as small dump trucks, and refuse trucks. Typical applications would include commercial short haul and intra-city delivery and pickup.

(7) "Primary intended service class" means the class that best describes the vehicle for which the manufacturer designs and markets the engine. The three primary intended service classes are light heavy-duty, medium heavy-duty, and heavy heavy-duty.

(8) "Tractor" means a vehicle meeting the definition of "tractor" in 40 CFR §1037.801, but not classified as a "vocational tractor" under 40 CFR §1037.630, or relating to such a vehicle.

(9) "Tractor engine" means an engine certified for use in tractors. Where an engine family is certified for use in both tractors and vocational vehicles, "tractor engine" means an engine that the engine manufacturer reasonably believes will be (or has been) installed in a tractor. Note that the Executive Officer may require a manufacturer to document how it determines that an engine is a tractor engine.

(10) "Vocational engine" means an engine certified for use in vocational vehicles. Where an engine family is certified for use in both tractors and vocational vehicles, "vocational engine" means an engine that the engine manufacturer reasonably believes will be (or has been) installed in a vocational vehicle. Note that the provisions of this part may require a manufacturer to document how it determines that an engine is a vocational engine.

(11) "Vocational vehicle" means a vehicle meeting the definition of "vocational" vehicle in 40 CFR §1037.801.

Note: Authority cited: Sections 38501, 38505, 38510, 38560, 38580, 39500, 39600, 39601, 40000, 43013, 43018, 43100, 43101, 43102, 43104, 43105, 43106, 43107 and 43806, Health and Safety Code; and Section 28114, Vehicle Code. Reference: Sections 38501, 38505, 38510, 38560, 38580, 39002, 39003, 39010, 39017, 39033, 39500, 39600, 39601, 39610, 39650, 39657, 39667, 39701, 40000, 43000, 43000.5, 43009, 43009.5, 43013, 43017, 43018, 43100, 43101, 43101.5, 43102, 43104, 43105, 43106, 43107, 43202, 43204, 43205, 43205.5, 43206, 43210, 43211, 43212, 43213 and 43806, Health and Safety Code; and Section 28114, Vehicle Code.

§1968.2.1. Malfunction and Diagnostic System Requirements--2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines. (Alternative)

For purposes of this section, any cross-referenced section in title 13 or title 17 of the California Code of Regulations shall refer to the section identified as the alternative version "(Alternative)" for the corresponding section, to the extent an alternative version of that section exists.

(a) *Purpose.*

The purpose of this regulation is to reduce motor vehicle and motor vehicle engine emissions by establishing emission standards and other requirements for onboard diagnostic systems (OBD 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 OBD 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. The use and operation of OBD systems will ensure reductions in in-use motor vehicle and motor vehicle engine emissions through improvements of emission system durability and performance.

(b) *Applicability.*

Except as specified elsewhere in this regulation (title 13, CCR section 1968.2.1), all 2004 and subsequent model-year vehicles, 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 OBD II system and shall meet all applicable requirements of this regulation (title 13, CCR section 1968.2.1). 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 unless specifically stated otherwise in section (e) or (f)) 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 scheduled to begin in 2004 or subsequent 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 AECD that is activated solely due to any of the following conditions 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 OBD system; (5) execution of an OBD 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 Diagnostic Test Modes", (SAE J1979), incorporated by reference (section (g)(1.4)[1]). For diesel applications, in lieu of the definition in SAE J1979, the calculated load value may alternatively be 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 OBD 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

[1] Unless otherwise noted, all section references refer to section 1968.2.1 of title 13, CCR.

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 unit(s). 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.

"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 vehicle. 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 1971.1.1 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.

"*Emission standard*," as it applies to OBD compliance and the remedies provided for in the Health and Safety Code for noncompliance, relates to the emission characteristics of a motor vehicle and engine and means:

(1) a numerical limit on the amount of a given pollutant that a motor vehicle or motor vehicle engine may emit into the atmosphere; or

(2) a requirement that a motor vehicle or motor vehicle engine be equipped with a certain type of pollution-control device or some other design feature related to the control of emissions.

"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 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.

"*Evaporative emission standards*" are a subset of emission standards that refer to the specific motor vehicle fuel evaporative emission standards and test procedures incorporated by reference in title 13, CCR section 1976 to which a vehicle is certified.

"*Exhaust emission standards*" or "*tailpipe emission standards*" are a subset of emission standards that collectively refer to the specific FTP standards and SET standards to which a vehicle is certified.

"*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.

"Fueled engine operation" is the state where any fuel is introduced into the engine for the purpose of combustion.

"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.

"*Hybrid vehicle*" refers to a vehicle (including a plug-in hybrid electric vehicle) that can draw propulsion energy from either or both of the following on-vehicle sources of stored energy: 1) a consumable fuel and 2) an energy storage device such as a battery, capacitor, or flywheel.

"*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 certified 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 (i.e., 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 (i.e., the Federal bin) for purposes of determining the malfunction thresholds in sections (e) and (f).

"PC/LDT SULEV II vehicles" refer only to passenger car and light-duty truck Low Emission Vehicle II applications certified to the SULEV vehicle emission category.

"MDV SULEV II vehicles" refer only to medium-duty Low Emission Vehicle II applications certified to the SULEV vehicle emission category.

"LEV II vehicles" refer only to Low Emission Vehicle II applications certified to the LEV vehicle emission category.

"ULEV II 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 (e) and (f).

"Medium-duty vehicle" is defined in title 13, CCR section 1900 (b).

"Medium-duty passenger vehicle" or *"MDPV"* 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).

"*Plug-in hybrid electric vehicle*" refers to a hybrid vehicle that has 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.

"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).

"Propulsion system active" is the state where the powertrain (e.g., engine, electric machine) is enabled by the driver (e.g., after ignition on for conventional vehicles, after power button pushed for some hybrid vehicles, or after remote start activation) such that the vehicle is ready to be used (e.g., vehicle is ready to be driven, ready to be shifted from "park" to "drive", heating, ventilation, and air conditioning (HVAC) turned on to condition cabin prior to driving). For purposes of this definition, "the state where the powertrain is enabled" does not include activations that are not driver-initiated (e.g., conditions where portions of the vehicle system wake up to perform OBD II monitoring or off-board charging).

"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 (A/F) sensors, response rate is the delay from when the sensor is exposed to a different A/F ratio to the time it indicates the different A/F 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 (A/C) 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 (i.e., 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 definitions 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 a driving cycle with 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). Alternatively, manufacturers may define warm-up cycle as a driving cycle with vehicle operation in which the criteria specified in sections (d)(2.5.2)(B)(iii)a., b., and c. are met.

(d) *General Requirements.*

Section (d) sets forth the general requirements of the OBD 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 II System.*

(1.1) If a malfunction is present as specified in sections (e) and (f), the OBD 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 OBD 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 OBD 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 phrase "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 OBD II system shall 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 OBD 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)(D), 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 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.

(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. The OBD system shall erase a permanent fault code under the following conditions:

(2.5.1) If the OBD II system is commanding the MIL on, the OBD II system shall erase a permanent fault code only if the OBD 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 section (d)(2.3) (which for 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 driving cycle that begins with the MIL commanded off.

(2.5.2) If all fault information in the on-board computer other than the permanent fault code has been cleared (i.e., through the use of a scan tool or battery disconnect) and the OBD 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 OBD 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)(D) 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 OBD 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)(i) are satisfied):

a. Except as provided in section (d)(2.5.2)(B)(iii)f. below, 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, 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 1150 rpm in lieu of at or above 25 miles per hour for purposes of this criteria);

c. 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 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. For 2013 and subsequent model year engines, 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 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)(2.5.2)(B)(iii)b. above.

f. For hybrid vehicles, manufacturers shall use "cumulative propulsion system active time" in lieu of "cumulative time since engine start" for the criterion in section (d)(2.5.2)(B)(iii)a.

(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 section (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), manufacturers 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 (i.e., tools that are not generic SAE J1978 scan tools) 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);

(B) For evaporative system monitors:

(i) 0.260 for monitors designed to detect malfunctions identified in section (e)(4.2.2)(C) (i.e., 0.020 inch leak detection); and

(ii) 0.520 for monitors designed to detect malfunctions identified in section (e)(4.2.2)(A) and (B) (i.e., 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 interim 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

imbalance 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;

(v) through the 2016 model year for plug-in hybrid electric vehicles, 0.100 for all monitors specifically required in sections (e) and (f) to meet the monitoring condition requirements of section (d)(3.2) and that are for systems or components that require engine operation;

(vi) for 2016 through 2018 model year medium-duty vehicles certified to an engine dynamometer tailpipe emission standard, 0.100 for diesel PM filter filtering performance monitors (section (f)(9.2.1)) and missing substrate monitors (section (f)(9.2.5)) not using the denominator criteria in section(d)(4.3.2)(G).

(3.2.2) In addition to meeting the requirements of section (d)(3.2.1), manufacturers shall implement 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 (e)(7.3.1)(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 VVT 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));

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" (i.e., 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) Except as provided for in sections (d)(4.3.2)(H), (J), and (K), 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, 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 1150 rpm in lieu of at or above 25 miles per hour for purposes of this criteria);

(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 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 OBD II system may not include time during intrusive operation of the secondary air system solely for the purposes of monitoring;

(D) Except as provided for in sections (d)(4.3.2)(D)(iv) and (d)(4.3.2)(L), the evaporative system monitor denominator(s) shall be incremented if and only if:

(i) The requirements of section (d)(4.3.2)(B) have been met;

(ii) 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

(iii) 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.

(iv) For plug-in hybrid electric vehicles, manufacturers may choose to increment the evaporative system denominator(s) using the criteria under section (d)(4.3.2)(L) in lieu of the criteria under sections (d)(4.3.2)(D)(i) through (iii) above.

(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 Emission 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 OBD 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 the requirements of section (d)(4.3.2)(B) above, the denominator(s) for the following monitors of 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.)

(v) PM sensor heater (section (f)(5.2.4)(A))

(vi) PM filter active/intrusive injection (section (f)(9.2.6))

For the PM sensor heater monitor, as an alternative for 2013 through 2015 model year vehicles, the manufacturer may use the criteria in section (d)(4.3.2)(B) in lieu of the criteria specified in section (d)(4.3.2)(F) above.

For the PM filter active/intrusive injection monitor, as an alternative for 2013 through 2015 model year vehicles, the manufacturer may use the criteria in section (d)(4.3.2)(I) in lieu of the criteria specified in section (d)(4.3.2)(F) above.

(G) For the following monitors, the denominator(s) shall be incremented by one during a driving cycle in which the following two criteria are met: (1) the requirements of section (d)(4.3.2)(B) have been met on at least one driving cycle since the denominator was last incremented, and (2) the number of cumulative miles of vehicle operation since the denominator was last incremented is greater than or equal to 500 miles:

(i) Diesel NMHC converting catalyst (section (f)(1.2.2))

(ii) Diesel NMHC converting catalyst other aftertreatment assistance functions (sections (f)(1.2.3)(B) and (f)(1.2.3)(D))

(iii) Diesel PM filter NMHC conversion (section (f)(9.2.4))

(iv) Diesel PM filter filtering performance and missing substrate (sections (f)(9.2.1) and (f)(9.2.5)) for passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard

(v) Diesel PM filter filtering performance and missing substrate (sections (f)(9.2.1) and (f)(9.2.5)) for 2004 through 2015 model year medium-duty vehicles certified to an engine dynamometer tailpipe emission standard

(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 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 (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))

(viii) PM sensor monitoring capablity monitor (section (f)(5.2.2)(D))

(I) For 2013 and subsequent model year vehicles, 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) Diesel NMHC converting catalyst other aftertreatment assistance functions (sections (f)(1.2.3)(A) and (f)(1.2.3)(C))

(ii) PM filter incomplete regeneration (section (f)(9.2.3))

(J) For 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.

(K) For 2014 and subsequent model year hybrid vehicles, in lieu of the criteria in section (d)(4.3.2)(B) above, 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 propulsion system active time 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 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 1150 rpm in lieu of at or above 25 miles per hour for purposes of this criteria);

(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 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; and

(iv) Cumulative fueled engine operation for greater than or equal to 10 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.

(L) For 2015 and subsequent model year plug-in hybrid electric vehicles, in addition to the requirements of sections (d)(4.3.2)(K)(i) through (iii) above, the evaporative system monitor denominator(s) shall be incremented if and only if:

(i) Cumulative propulsion system active time 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;

(ii) Engine coolant temperature at the start of propulsion system active is greater than or equal to 40 degrees Fahrenheit but less than or equal to 95 degrees Fahrenheit; and

(iii) Continuous time while the vehicle is not in the state of 'propulsion system active' during the period immediately preceding the start of the driving cycle is greater than or equal to 6 hours.

(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 ten seconds of a malfunction that disables a monitor required to meet the monitoring conditions in section (d)(3.2.1) being detected (i.e., a pending or confirmed code is stored), the OBD II system shall disable further incrementing of the corresponding numerator and denominator for each monitor that is disabled. When the malfunction is no longer detected (i.e., 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 meet the monitoring conditions in section (d)(3.2.1), the OBD 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.

(4.5.3) The OBD II 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)(B) through (D) are satisfied (i.e., 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). 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 required 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 OBD 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, primary oxygen/exhaust gas sensor bank 1, primary oxygen/exhaust gas sensor bank 2, evaporative 0.020 inch leak detection system, EGR/VVT 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 OBD 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 sensor

characteristics), the OBD 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 OBD 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(s) (d)(5.5.2)(B) and (C).

(B) Except as required in section (d)(5.5.1)(C) below, the OBD II system shall report one ignition cycle counter (as defined in section (d)(5.5.2)(B)).

(C) For 2014 and subsequent model year plug-in hybrid electric vehicles, the OBD II system shall report two ignition cycle counters (as defined in sections (d)(5.5.2)(B) and (C)).

(D) 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(s), when incremented, shall be incremented by an integer of one. The ignition cycle counter(s) 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 following criteria are met:

(i) Except as required in section (d)(5.5.2)(B)(ii) below, the vehicle meets

the engine start definition (see section (c)) for at least two seconds plus or minus one second.

(ii) For hybrid vehicles, the vehicle meets the propulsion system active definition (see section (c)) for at least two seconds plus or minus one second.

(C) In addition to the counter described in section (d)(5.5.2)(B) above, 2014 and subsequent model year plug-in hybrid electric vehicles shall track and report a second ignition cycle counter that shall be incremented within ten seconds if and only if the vehicle has met the fueled engine operation definition (see section (c)) for at least two seconds plus or minus one second.

(D) The OBD II system shall disable further incrementing of the ignition cycle counter(s) within ten seconds if a malfunction of any component used to determine if the criteria in section (d)(5.5.2)(B) and (C) are satisfied (e.g., engine speed or time of operation) has been detected and the corresponding pending fault code has been stored. The ignition cycle counter(s) may not be disabled from incrementing for any other condition. Incrementing of the ignition cycle counter(s) 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 (i.e., 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 (i.e., FTP or SET) determined by the manufacturer, through use of data and/or engineering analysis, to be more stringent (i.e., 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), for each monitor on medium-duty vehicles 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 the 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 lieu 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 1968.5.1, 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 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) 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 1968.5.1, 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 1968.2.1 are set forth in title 13, CCR section 1968.5.1.

(7.2) Consistent with the requirements of title 13, CCR section 1968.5.1(b)(4)(A) for enforcement OBD II 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 OBD II emission testing as defined in title 13, CCR section 1968.5.1. 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, VVT 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 OBD II system shall monitor the catalyst system for proper conversion capability.

(1.2) Malfunction Criteria:

(1.2.1) Low Emission Vehicle I applications: The OBD II 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 (i.e., 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 MDV SULEV II vehicles shall use the malfunction criteria specified for Low Emission Vehicle I applications in section (e)(1.2.1).

(ii) All PC/LDT 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 OBD 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/LDT 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. 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/LDT SULEV II vehicles shall use the same malfunction criteria as 2005 through 2008 model year LEV II, ULEV II, and MDV 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 OBD 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/LDT 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/LDT 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 OBD 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)(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 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) (i.e., 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 OBD 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 OBD 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) (i.e., 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 OBD II system shall monitor the engine for misfire causing catalyst damage and misfire causing excess emissions.

(3.1.2) The OBD 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, manufacturers 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.

(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 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) Except as provided in section (e)(3.3.6) below, from no later than the end of the second crankshaft revolution after engine start,

(B) 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 (i.e., "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 (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.

(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 (i.e., 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.

(3.3.3) 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 (i.e., 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 (i.e., 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 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).

(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 (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.

(3.3.6) For engines that employ engine shutoff strategies that do not require the vehicle operator to restart the engine to continue driving (e.g., hybrid vehicle with engine shutoff at idle), a manufacturer shall request Executive Officer approval of the monitoring conditions under which misfire monitoring occurs after engine fueling begins for the initial start and after each time fueling resumes. Executive Officer approval of the monitoring conditions shall be based on the equivalence of the conditions to those specified in section (e)(3.3.1)(A) above.

(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 OBD 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 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 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 seconds, 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 of the vehicle in conditions that will minimize catalyst damage (e.g., at low engine speeds and loads).

(3.4.2) 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 engine start (defined in section (c)) during which misfire detection is active.

(ii) If a pending fault code is stored, the OBD II system shall illuminate the MIL and store a confirmed fault code within ten 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 (e)(3.2.2) during a single driving cycle.

(ii) If a pending fault code is stored, the OBD II system shall illuminate the MIL and store a confirmed 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 OBD 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 B" orifice with NPT connections with a diameter of the specified dimension (e.g., part number B-20-SS for a stainless steel 0.020 inch diameter orifice).

(4.2.2) The OBD 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 OBD II system;

(B) 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 leak 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)(B) 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)(B) 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)(B) 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 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 II system shall verify the criteria of (e)(4.2.2)(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.

(4.3) Monitoring Conditions:

(4.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (e)(4.2.2)(A) and (B) (i.e., purge flow and 0.040 inch leak detection) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements).

(4.3.2) Manufacturers shall define the monitoring conditions for malfunctions identified in section (e)(4.2.2)(C) (i.e., 0.020 inch leak detection) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., 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 (i.e., 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 OBD 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 and 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 engineering 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 OBD 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)(15).

(5.2) Malfunction Criteria:

(5.2.1) For purposes of section (e)(5), "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 (i.e., 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)(5.2.3) and (5.2.4) 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)(5.2.2)(B) and (e)(5.2.4), the OBD 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 1.5 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)(5.2.2)(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 2005 model year vehicles, manufacturers shall use the malfunction criteria specified for Low Emission Vehicle I applications in section (e)(5.2.2).

(B) For 2006 and subsequent model year vehicles, except as provided in sections (e)(5.2.3)(C) and (e)(5.2.4), the OBD 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 1.5 times any of the applicable FTP standards. For purposes of sections (e)(5.2) and (5.3), "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 OBD 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 accordance 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) (i.e., 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 OBD II system shall monitor the fuel delivery system to determine its ability to provide compliance with applicable standards.

(6.2) Malfunction Criteria:

(6.2.1) The OBD II 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/LDT 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/LDT 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 OBD 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 OBD 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 OBD II system is required to detect a malfunction.

(6.2.4) The OBD 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 OBD 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) (i.e., air-fuel ratio cylinder imbalance malfunctions) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements).

(6.4) MIL Illumination and Fault Code Storage: For malfunctions described under section (6.2.1)(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 (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 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.

(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 OBD 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 OBD 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 driving cycles 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 OBD 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 OBD 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 OBD 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 OBD 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 OBD II system shall detect asymmetric malfunctions (i.e., malfunctions that primarily affect only the lean-to-rich response rate or only the rich-to-lean response rate) and symmetric malfunctions (i.e., malfunctions that affect both the lean-to-rich and rich-to-lean 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-lean (or lean-to-rich) sensor output. For 25 percent of 2011, 50 percent of 2012, and 100 percent of 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 OBD II system shall detect malfunctions of the oxygen sensor caused by either a lack of circuit continuity or out-of-range values.

(C) The OBD 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 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 OBD II 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 OBD II system monitoring device (e.g., for catalyst monitoring).

(7.2.2) Secondary Sensors:

(A) The OBD II system shall detect a malfunction prior to any failure or deterioration of the 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 OBD II system shall detect malfunctions of the oxygen sensor caused by a lack of circuit continuity.

(C) Sufficient sensor performance for other monitors.

(i) The OBD II 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 OBD 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 OBD II 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). 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). Monitoring of the rich-to-lean 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-lean 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 of 2009 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.

(D) The OBD II system shall detect malfunctions of the oxygen sensor caused by out-of-range values.

(7.2.3) Sensor Heaters:

(A) The OBD 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 (i.e., 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)(7.2.3)(A).

(B) The OBD 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)(7.2.1)(A) and (D) (e.g., proper response rate) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., 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 (D) 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) (i.e., 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) (i.e., 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) (i.e., 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 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.

(7.3.3) 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) (i.e., 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 II 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) (i.e., 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)(10.1). 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 OBD 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 manifold 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) (i.e., 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 OBD II system shall monitor the thermostat on vehicles so-equipped for proper operation.

(10.1.2) The OBD II system shall monitor the engine coolant temperature (ECT) sensor for circuit continuity, out-of-range values, and rationality faults.

(10.2) Malfunction Criteria:

(10.2.1) 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 demonstrate 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 OBD 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 OBD 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 (e)(10.2.1) 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 OBD II system shall detect a malfunction if the ECT sensor inappropriately indicates a temperature above the lowest maximum enable temperature required by the OBD 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) (i.e., ECT sensor or thermostat malfunctions) will detect ECT sensor malfunctions as defined in section (e)(10.2.2)(D) 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)(D) 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 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)(10.2.2)(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 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)(D). Additionally, except as provided for in sections (e)(10.3.1)(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) (i.e., 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)(D), monitoring for malfunctions identified in section (e)(10.2.2)(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 (e)(10.2.2)(C) and (D) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements).

(D) 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 OBD II system shall monitor the commanded elements for proper function (e.g., increased engine idle speed, commanded ignition timing retard, etc.), 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 (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 specified in section (e)(11.2.2):

(A) The OBD 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 OBD II 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 applicable FTP standards. For this requirement, the OBD II 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) (i.e., 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).

(12) *Air Conditioning (A/C) 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 A/C system is on, the OBD II system shall monitor all electronic air conditioning system components for malfunctions that cause the system to fail to invoke the alternate control while the A/C system is on or cause the system to invoke the alternate control while the A/C system is off. Additionally, the OBD II system shall monitor for malfunction all electronic air conditioning system components that are used as part of the diagnostic strategy for any other monitored 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 OBD 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 A/C 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 A/C 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 monitor any 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) (i.e., 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 (VVT) 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 OBD 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 OBD 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 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 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 VVT system could result in a vehicle's emissions exceeding 1.5 times any of the applicable standards, the VVT 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 for VVT system malfunctions identified in section (e)(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 VVT 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 ISO/TR 15031-2:April 30, 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 equivalent SAE J1930 term.

(14.2) Malfunction Criteria:

(14.2.1) For vehicles in which the NMOG credit assigned to the DOR 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 OBD II system shall detect a malfunction when the DOR system has no detectable amount of ozone reduction.

(14.2.2) For vehicles in which the NMOG credit assigned to the DOR system, as calculated in accordance with ARB MAC No. 99-06, is greater than 50 percent of the applicable FTP NMOG standard, the OBD II system shall detect a malfunction when the ozone reduction performance of the DOR system deteriorates to a point where the difference between the NMOG credit assigned to the properly operating DOR system and the NMOG credit calculated for a DOR 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 DOR system, the manufacturer 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 DOR 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) + DOR 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) (i.e., 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 OBD 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 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 (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 II 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 II 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 OBD 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 teeth/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 OBD II 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 OBD 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 OBD II 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.

(B) 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) (i.e., 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)(D), monitoring for circuit continuity and circuit faults shall be conducted continuously.

(B) 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) (i.e., 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) (i.e., 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 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 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 (e)(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 (e)(15.4.2)(A) are exceeded, if the approved testing conditions are comprised of an emission test cycle with an exhaust emission standard, the measured increase shall be compared to a percentage of the exhaust emission standard (e.g., if the increase is equal to or more than 15 percent of the exhaust 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 exhaust 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), 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, 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 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 (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) the most reliable monitoring method developed requires a higher threshold to prevent significant errors of commission in detecting a malfunction.

(17.1.1) For PC/LDT 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/LDT 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/LDT 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 1968.2.1 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).

(17.3) Manufacturers may request Executive Officer approval to disable an OBD II 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 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 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 OBD 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 OBD 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 PTO unit is active, and the OBD II readiness status is cleared by the on-board computer (i.e., all monitors set to indicate "not complete") while the PTO unit is activated (see section (g)(4.1)). If the disablement occurs, the readiness status may be restored to its state prior to PTO 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 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)).

(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 Diesel/Compression-Ignition Engines.*

(1) *Non-Methane Hydrocarbon (NMHC) Converting Catalyst Monitoring*

(1.1) Requirement: The OBD 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 OBD II system shall detect an NMHC catalyst malfunction when the catalyst conversion capability decreases to the point that emissions 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 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 MDPVs) 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 exhaust 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 conversion capability could result in NMHC or NOx emissions exceeding the applicable malfunction criteria of section (f)(1.2.2)(A), the OBD 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 (i.e., 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 OBD 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 2015 and subsequent model year passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard and 2015 and subsequent model year medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, 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 OBD II system shall detect a malfunction when the catalyst is unable to generate the necessary feedgas constituents for proper SCR system operation. Catalysts are exempt from this monitoring if both of the following criteria are satisfied: (1) no malfunction of the catalyst's feedgas generation ability can cause emissions to increase by 15 percent or more of the applicable full useful life standard as measured from an applicable emission test cycle; and (2) no malfunction of the catalyst's feedgas generation ability can cause emissions to exceed the applicable full useful life standard as measured from an applicable emission test cycle.

(C) For catalysts located downstream of a PM filter and used to convert NMHC emissions during PM filter regeneration, the OBD II 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., prevent ammonia slip), the OBD 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 (i.e., 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 shall 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 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 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) (i.e., 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 Nitrogen (NOx) Converting Catalyst Monitoring*

(2.1) Requirement: The OBD II 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 OBD II 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 active/intrusive 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 OBD II system shall detect a NOx catalyst malfunction when the catalyst conversion capability decreases to the point that NOx or NMHC emissions 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 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 MDPVs) 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 exhaust 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 0.4 g/bhp-hr (e.g., cause NOx emissions to exceed 0.6 g/bhp-hr if the exhaust 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;

c. 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 exhaust 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 through 2015 model year vehicles; and

d. 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 exhaust 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 2016 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 OBD 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 from the requirements for NOx 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 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 Active/Intrusive Reductant Injection System Performance:

(A) Reductant Delivery Performance:

(i) For 2007 and subsequent model year vehicles, the OBD 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 OBD 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 OBD 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 OBD 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).

(D) 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 OBD II system shall detect a malfunction:

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

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

(iii) If the 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 (f)(2.2.3)(D)(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 OBD 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)(D)(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 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 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 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 (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), (f)(2.2.3)(A), and (f)(2.2.3)(C) (i.e., catalyst efficiency, reductant delivery performance, and improper reductant) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., 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), the OBD II system shall monitor continuously for malfunctions identified in sections (f)(2.2.3)(B) and (D) (i.e., 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 OBD 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 OBD 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 OBD II system shall monitor the engine for misfire. The OBD 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 OBD 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 OBD 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 OBD II system shall detect a misfire malfunction when one or more cylinders are continuously misfiring.

(3.2.2) Additionally, for all combustion sensor or combustion quality sensor-equipped (e.g., for use in homogeneous charge compression ignition control systems) 2010 and subsequent model year passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard, for all combustion sensor or combustion quality sensor-equipped 2010 through 2015 model year medium-duty vehicles, and for 20 percent of 2016 model year, 50 percent of 2017 model year, and 100 percent of 2018 model year medium-duty vehicles (percentage based on the manufacturer's projected California sales volume for all medium-duty diesel vehicles):

(A) The OBD II system shall detect a misfire malfunction as follows:

(i) For passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard, the OBD II system shall detect a misfire malfunction that would cause a vehicle's NMHC, CO, NOx, or PM emissions to exceed1.5 times any of the applicable FTP standards.

(ii) For medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, the OBD II system shall detect a misfire malfunction when the percentage of misfire is equal to or exceeds five percent.

(B) The manufacturers shall evaluate the percentage of misfire as follows:

(i) For passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard, 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 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.

(ii) For medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, the manufacturer shall evaluate the percentage of misfire in 1000 revolution increments.

(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) 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 of all engine firings, the OBD II system shall only be required to detect a misfire malfunction for situations that are caused by a single component failure.

(3.2.5) 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 percentage of misfire malfunction criteria in section (f)(3.2.2)(A)(ii) upward to exclude detection of misfire that cannot cause the vehicle's NMHC, CO, and NOx emissions to exceed 2.0 times the applicable standards and the vehicle's PM emissions to exceed 0.03 g/bhp-hr as measured from an applicable cycle emission test.

(3.3) Monitoring Conditions:

(3.3.1) Except as provided in section (f)(3.3.2), the OBD II system shall monitor for misfires identified in section (f)(3.2.1) 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) in lieu of the monitoring conditions specified in section (f)(3.3.1). 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) For misfires identified in section (f)(3.2.2), the OBD II system shall monitor for misfire as follows:

(A) For passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard, the OBD II system shall continuously monitor for misfire under all positive torque engine speeds and load conditions.

(B) For medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, the OBD II system shall continuously monitor for misfire under the following conditions:

(i) For 2010 through 2018 model year vehicles and 2019 and subsequent model year vehicles that are not included in the phase-in specified in section (f)(3.3.3)(B)(ii), under positive torque conditions up to75 percent of peak torque with engine speed up to 75 percent of the maximum engine speed except within the following range: the engine operating region bound by the positive torque line (i.e., engine torque with transmission in neutral) and the two following points: engine speed of 50 percent of maximum engine speed with the engine torque at the positive torque line, and 75 percent of the maximum engine speed with the engine torque at 5 percent of peak torque above the positive torque line.

(ii) For 20 percent of 2019 model year, 50 percent of 2020 model year, and 100 percent of 2021 model year medium-duty vehicles (percentage based on the manufacturer's projected California sales volume for all medium-duty diesel vehicles), under all positive torque engine speed conditions except within the following range: the engine operating region bound by the positive torque line (i.e., engine load with transmission in neutral) and the two following points: engine speed of 50 percent of maximum engine speed with the engine torque at the positive torque line, and 100 percent of the maximum engine speed with the engine torque at 10 percent of peak torque above the positive torque line.

(C) 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) and (B), 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, demonstration that the monitoring technology employed is not inherently incapable of detecting misfire under required conditions (i.e., compliance can be achieved on other engines), and the extent to which the most reliable monitoring method developed is unable to ensure robust detection of misfire in the region(s). 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.

(D) 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. 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. Such disablements may include but are not limited to events 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) intrusive diagnostics during portions that can significantly affect engine stability, or

(vii) infrequent regeneration events during portions that can significantly affect engine stability.

(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), 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) during a single driving cycle.

(ii) If a pending fault code is stored, the OBD 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) 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 OBD 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 OBD 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.

(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.

(4) *Fuel System Monitoring*

(4.1) Requirement:

The OBD II system shall monitor the fuel delivery system to determine its ability to comply with applicable 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 OBD 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 MDPVs 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 MDPVs) 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 exhaust 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 exhaust 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 OBD 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 OBD 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 MDPVs 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 MDPVs) 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 OBD 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 OBD 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 OBD 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 OBD II system shall detect a malfunction:

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

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

(iii) If control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the 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 OBD 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 (f)(4.2.1) through (4.2.3) for medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, the manufacturer shall do the following:

(A) For 2004 through 2012 model year vehicles, 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 (f)(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 (f)(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 (f)(4.3.2) and (f)(4.3.4), the OBD II system shall monitor continuously for malfunctions identified in sections (f)(4.2.1) and (f)(4.2.4) (i.e., fuel 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 (f)(4.2.1) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., 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.

(4.3.3) 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 (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. 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 requirements 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 OBD 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 OBD 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 OBD 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 OBD 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 MDPVs 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 MDPVs) 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 exhaust 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 exhaust 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 OBD 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 OBD 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 OBD 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 OBD 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 OBD 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 MDPVs 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 MDPVs) 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 exhaust 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-hr (e.g., cause NOx emissions to exceed 0.5 g/bhp-hr if the exhaust 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 exhaust 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 OBD 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 OBD 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 OBD 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 OBD 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 OBD 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 MDPVs 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 MDPVs) 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 exhaust 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 0.4 g/bhp-hr (e.g., cause NOx emissions to exceed 0.6 g/bhp-hr if the exhaust 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;

c. 2.0 times the applicable NMHC standard, 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 exhaust 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 through 2015 model year vehicles; and

d. 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 exhaust 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 2016 and subsequent model year vehicles.

(B) Circuit faults: The OBD II system shall detect malfunctions of the sensor caused by either a lack of circuit continuity or out-of-range values.

(C) Feedback faults: The OBD 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).

(D) Monitoring capability: To the extent feasible, the OBD 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 OBD II 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, NOx sensors, and PM sensors under sections (f)(5.2.1) and (f)(5.2.2).

(5.2.4) Sensor Heaters:

(A) The OBD 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 (i.e., 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 OBD 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), (5.2.2)(A), and (5.2.2)(D) (e.g., sensor performance faults) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., 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), (5.2.2)(A), and for 2016 and subsequent model year medium-duty vehicles, section (f)(5.2.2)(D) 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) and (5.2.1)(B)(iv) (e.g., monitoring capability) 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).

(C) Except as provided in section (f)(5.3.1)(D), 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) (i.e., 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) (i.e., sensor heater performance) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements).

(B) Monitoring for malfunctions identified in section (f)(5.2.4)(B) (i.e., circuit malfunctions) shall be conducted continuously.

(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) *Exhaust Gas Recirculation (EGR) System Monitoring*

(6.1) Requirement:

(6.1.1) The OBD 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 OBD 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 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 (f)(6).

(6.2) Malfunction Criteria:

(6.2.1) Low Flow:

(A) The OBD 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 MDPVs 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 MDPVs) 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 exhaust 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 exhaust 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 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 OBD 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 OBD II system shall detect a malfunction of the EGR system, including a leaking EGR valve (i.e., 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 OBD 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 OBD II system shall detect a malfunction of the EGR system at or prior to any failure or deterioration in the EGR system response (e.g., capability to achieve the 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 OBD II system shall monitor the EGR system response under both increasing and decreasing EGR flow rates. 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 throttle or exhaust backpressure), the OBD II system shall detect a malfunction:

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

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

(iii) If the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the 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 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)(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 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 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 more 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 (f)(6.2.5)(A) 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 (f)(6.2.5)(A).

(6.2.6) EGR Catalyst Performance: For catalysts located in the EGR system 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):

(A) 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).

(B) For 2013 and subsequent model year vehicles, except as provided for in section (f)(6.2.6)(C) below, the OBD II system shall detect a malfunction when the catalyst has no detectable amount of constituent (e.g., hydrocarbons, soluble organic fractions) oxidation.

(C) Monitoring of the catalyst is not required if there is no measurable emission impact on the criteria pollutants (i.e., NMHC, CO, NOx, and PM) during any reasonable driving condition in which the catalyst is most likely to affect criteria pollutants.

(6.3) Monitoring Conditions:

(6.3.1) For malfunctions identified in sections (f)(6.2.1) and (f)(6.2.2) (i.e., EGR low and high flow) manufacturers shall:

(A) Define monitoring conditions in accordance with sections (d)(3.1) and (d)(3.2) (i.e., 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 (f)(6.3.5), ensure that monitoring is 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) (i.e., slow response) 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). 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 OBD II system shall monitor continuously for malfunctions identified in section (f)(6.2.4) (i.e., 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) (i.e., cooler performance and EGR catalyst performance) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., 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 continuous 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 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.

(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 OBD II 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 charge air cooler systems, the OBD II 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 MDPVs 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 MDPVs) 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 exhaust 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 exhaust 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 OBD 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 OBD 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 pressure 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 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 OBD 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) Slow response:

(A) For 2010 through 2012 model year vehicles equipped with variable geometry turbochargers (VGT), the OBD 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 section (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 OBD II system shall detect a malfunction of the VGT system when no detectable response to a change in commanded turbocharger geometry occurs.

(B) For 2013 and subsequent model year vehicles, the OBD 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 OBD II system shall detect a malfunction of the boost system when no detectable response to a commanded or expected change in boost pressure occurs.

(7.2.4) Charge Air Undercooling:

(A) The OBD 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 OBD 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 OBD II system shall detect a malfunction:

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

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

(iii) If the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the 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 OBD 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 (f)(7.3.4), the OBD II system shall monitor continuously for malfunctions identified in sections (f)(7.2.1), (7.2.2), and (7.2.5) (i.e., over and under boost, feedback control).

(7.3.2) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(7.2.3) (i.e., slow response) 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). 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)(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) (i.e., charge air cooler performance) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., 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 OBD 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 OBD 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 OBD 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 MDPVs 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 MDPVs) 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 exhaust 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 exhaust 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 exhaust 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 OBD 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 OBD 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 OBD II system shall detect a malfunction:

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

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

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

(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 OBD 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 adsorber system 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 repaired/replaced in-use, and the ability of the component monitor(s) to accurately verify 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 shall define the monitoring conditions for malfunctions identified in section (f)(8.2.1) (i.e., adsorber capability) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., 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 (f)(8.3.3), the OBD 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 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) *Particulate Matter (PM) Filter Monitoring*

(9.1) Requirement: The OBD 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 OBD 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. 0.07 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.

(iii) For 2014 through 2015 model year medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard, the manufacturer shall use the malfunction criteria in section (f)(9.2.1)(A)(ii)c. above without using the provisions of section (f)(17.1) to exclude specific failure modes on vehicles under one of the following two options below:

a. At least 20 percent of 2014 model year vehicles and at least 20 percent of 2015 model year vehicles (percentage based on the manufacturer's projected California sales volume for all medium-duty diesel vehicles), or

b. At least 50 percent of 2015 model year vehicles (percentage based on the manufacturer's projected California sales volume for all medium-duty diesel vehicles).

(iv) For the phase-in schedules described in section (f)(9.2.1)(A)(iii) above, the manufacturer may not use an alternate phase-in schedule as defined in section (c) in lieu of the required phase-in schedules.

(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 exhaust 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 exhaust 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 OBD 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 regeneration: For 2010 and subsequent model year vehicles, the OBD 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) Catalyzed PM Filter:

(A) NMHC conversion: For 2015 and subsequent model year passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard and 2015 and subsequent model year medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard with catalyzed PM filters that convert NMHC emissions, the OBD 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 OBD II system shall detect a malfunction when the system has no detectable amount of NMHC conversion capability. PM filters are exempt from this monitoring if both of the following criteria are satisfied: (1) no malfunction of the PM filter's NMHC conversion capability can cause emissions to increase by 15 percent or more of the applicable full useful life standard as measured from an applicable emission test cycle; and (2) no malfunction of the PM filter's NMHC conversion capability can cause emissions to exceed the applicable full useful life standard as measured from an applicable emission test cycle.

(B) Feedgas generation: For 2016 and subsequent model year medium-duty vehicles with catalyzed PM filters used to generate a feedgas constituency to assist SCR systems (e.g., to increase NO_2 concentration upstream of an SCR system), the OBD II system shall detect a malfunction when the system is unable to generate the necessary feedgas constituents for proper SCR system operation. Catalyzed PM filters are exempt from this monitoring if both of the following criteria are satisfied: (1) no malfunction of the catalyzed PM filter's feedgas generation ability can cause emissions to increase by 15 percent or more of the applicable full useful life standard as measured from an applicable emission test cycle; and (2) no malfunction of the catalyzed PM filter's feedgas generation ability can cause emissions to exceed the applicable full useful life standard as measured from an applicable emission test cycle.

(9.2.5) Missing substrate: The OBD 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/Intrusive 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 OBD 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 OBD II system shall detect a malfunction:

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

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

(iii) If the control system has used up all of the adjustment allowed by the manufacturer or reached its maximum authority and cannot achieve the 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 (9.2.6) 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). 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) (i.e., 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 OBD 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 (i.e., 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 OBD 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 OBD II system shall monitor the integrity 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) (i.e., 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 OBD II system shall monitor the thermostat on vehicles so-equipped for proper operation.

(11.1.2) The OBD 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 OBD 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 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, 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 OBD 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 (ii), the coolant temperature drops below the temperature indicated in section (f)(11.2.1)(A)(i).

(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.

(D) For monitoring of malfunctions under section (f)(11.2.1)(A), with 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.

(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 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 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 function 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 OBD 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 OBD 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).

(D) Stuck in Range Above the Lowest Maximum Enable Temperature.

(i) To the extent feasible when using all available information, the OBD II system shall detect a malfunction if the ECT sensor inappropriately indicates a temperature above the lowest maximum enable temperature required by the OBD 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 (f)(11.2.1), (f)(11.2.2)(B), or (f)(11.2.2)(C) (i.e., ECT sensor or thermostat malfunctions) will detect ECT sensor malfunctions as defined in section (f)(11.2.2)(D) 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)(D) 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 OBD 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)(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)(B) 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.

(C) Manufacturers may disable thermostat monitoring at ambient temperatures below 20 degrees Fahrenheit.

(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.

(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)(D), 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 (D) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements).

(D) 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 OBD II 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.

(12.2) Malfunction Criteria: The OBD 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 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);

(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 MDPVs 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 FTP PM standard for 2013 and subsequent model year vehicles.

(B) For medium-duty vehicles (including MDPVs) certified to an engine dynamometer tailpipe emission standard:

(i) 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 exhaust 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 OBD II 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 OBD 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 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 (f)(12.2.2). For strategies where it is not feasible to be monitored as a system, the OBD 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) (i.e., 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 (VVT) System Monitoring*

(13.1) Requirement: On all 2006 and subsequent model year applications, the OBD 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 (f)(15).

(13.2) Malfunction Criteria:

(13.2.1) Target Error: The OBD 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 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 MDPVs 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 MDPVs) 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 exhaust 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 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 exhaust 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 OBD 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 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 VVT system could result in a vehicle's emissions exceeding the levels specified in sections (f)(13.2.1), the VVT 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 VVT 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 VVT 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 II 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 OBD II 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 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.

(15.2.2) Output Components/Systems:

(A) The OBD II 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 OBD 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 (f)(15).

(B) The idle fuel control system shall be monitored for proper functional response to computer commands. A malfunction shall be detected when any of the following conditions occur:

(i) The idle control system cannot achieve or maintain the idle speed within +/- 30 percent of the manufacturer-specified target or desired engine speed.

(ii) The idle control system cannot achieve the target idle speed within the smallest engine speed tolerance range required by the OBD II 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 OBD 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 plug/intake 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).

(D) The wait-to-start lamp circuit shall be monitored for malfunctions that cause 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 (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 OBD 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.

(F) For 2015 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.

(i) 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.

(ii) Monitoring of the fuel control system components under section (f)(15.2.2)(F)(i) is not required if the manufacturer demonstrates that both of the following criteria are satisfied: (1) no fault of the components' tolerance compensation features (e.g., wrong compensation being used) could cause emissions to increase by 15 percent or more of the applicable full useful life standard as measured from an applicable emission test cycle; and (2) no fault of the components' tolerance compensation features could cause emissions to exceed the applicable full useful life standard as measured from an applicable emission test cycle. For purposes of determining if the emission criteria above are met, the manufacturers shall request Executive Officer approval of the test plan for which the emission impact will be determined. The test plan shall include the combination of failed components and the degree of mismatch (e.g., wrong compensation) used as well as the test procedure and emission test cycles used to demonstrate the emission impact, including the necessary preconditioning cycles used by the system to correct or adapt for any mismatch and mitigate the emission impact. Executive Officer approval shall be granted upon determining that the manufacturer has submitted data and/or engineering analysis that demonstrate that the conditions necessary for the system to correct or adapt will readily occur in a timely manner during in-use operation and that the test conditions represent worst case emissions from typical in-use service actions when considering the distribution and variance of the compensation values and parts (e.g., replacement of one or more

plus-one-sigma injectors with minus-one-sigma injectors without updating of the compensation value).

(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.

(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) (i.e., 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 continuity and circuit faults shall be conducted continuously.

(B) 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) (i.e., 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) (i.e., 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 exhaust emission standard, the measured increase shall be compared to a percentage of the exhaust emission standard (e.g., if the increase is equal to or more than 15 percent of the exhaust 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 exhaust 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 false indications of a malfunction. Additionally, except as specified in section (f)(9.2.1)(A)(iii), for 2007 through 2013 model year light-duty vehicles and 2007 through 2015 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 false indications of a malfunction.

(17.1.1) For PC/LDT 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/LDT 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 MDPVs) 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-hr PM (e.g., unable to maintain PM emissions at or below 0.03 g/bhp-hr if the exhaust 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 exhaust 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 MDPVs) 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 2004 through 2015 model year medium-duty diesel vehicles (except MDPVs) 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 certified to), considering the best available monitoring technology to the extent that it is known or should have been known to the manufacturer,

(D) 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.

(17.1.6) For 2016 and subsequent model year medium-duty diesel vehicles (except MDPVs) certified to a chassis dynamometer tailpipe emission standard, the following monitoring requirements and malfunction criteria shall apply:

(A) Except as provided for in sections (f)(17.1.6)(B) and (C) below, the monitoring requirements and malfunction criteria in section (f) applicable to passenger cars, light-duty trucks, and MDPVs certified to a chassis dynamometer tailpipe emission standard shall apply.

(B) For NMHC catalyst conversion efficiency monitoring (section (f)(1.2.2)), the manufacturer shall detect an NMHC catalyst malfunction when the catalyst conversion capability decreases to the point that emissions exceed 1.75 times the applicable FTP NMHC or NOx standards.

(C) For misfire monitoring (section (f)(3)), the manufacturer shall use the monitoring requirements and malfunction criteria applicable to medium-duty vehicles certified to an engine dynamometer tailpipe emission standard.

(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 all vehicles subject to the requirements of title 13, CCR section 1968.2.1 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 for in-use monitor performance ratio monitoring conditions in section (d)(3.2) and the PM filter monitor in section (f)(9.2.1)(A).

(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 use a different schedule as follows:

(A) For the diesel PM filter monitor phase-in schedule in section (f)(9.2.1)(A)(iii), the manufacturer may use the malfunction criteria in section (f)(9.2.1)(A)(ii)c. for all 2014 and 2015 model year medium-duty vehicles in lieu of the malfunction criteria and required phase-in schedule in section (f)(9.2.1)(A)(iii).

(B) For phase-in schedules not listed in section (f)(17.2.3)(A) above, the manufacturer 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 OBD II 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 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 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 OBD 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 OBD 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 request Executive Officer approval to disable monitors that can be affected by PTO activation on vehicles designed to accommodate the installation of PTO units (as defined in section (c)).

(17.6.1) Except as allowed in section (g)(17.6.2) below, a manufacturer may request Executive Officer approval to disable an affected monitor provided disablement occurs only while the PTO unit is active and the OBD II readiness status (specified under section (g)(4.1)) and PTO activation time are appropriately tracked and erased as described in this section. The Executive Officer shall approve the request for disablement based on the manufacturer's demonstration that the affected monitor cannot robustly detect malfunctions (e.g., cannot avoid false passes or false indications of malfunctions) while the PTO unit is active. The OBD II system shall track the cumulative engine runtime with PTO active and clear OBD II readiness status (i.e., set all monitors to indicate "not complete") no later than the start of the next ignition cycle if 750 minutes of cumulative engine runtime with PTO active has occurred since the last time the affected monitor has

determined the component or system monitored by the affected monitor is or is not malfunctioning (i.e., has completed). The PTO timer shall pause whenever PTO changes from active to not active and resume counting when PTO is re-activated. The timer shall be reset to zero after the affected monitor has completed and no later than the start of the next ignition cycle. Once the PTO timer has reached 750 minutes and the OBD II readiness status has been cleared, the PTO timer may not cause the OBD system to clear the readiness status again until after the PTO timer has reset to zero (after the monitor has completed) and again reached 750 minutes.

(17.6.2) In lieu of requesting Executive Officer approval for disabling an affected monitor according to section (f)(17.6.1) above, a manufacturer may disable affected monitors, provided disablement occurs only while the PTO unit is active, and the OBD II readiness status is cleared by the on-board computer (i.e., all monitors set to indicate "not complete") while the PTO unit is activated. 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 ISO/TR 15031-2", October 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).

(1.4.1) SAE J1979-DA, "Digital Annex of E/E Diagnostic Test Modes", October 2011.

(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", December 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:

(1.10.1) J1939 "Recommended Practice for a Serial Control and Communications Vehicle Network" March 2009;

(1.10.2) 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;

(1.10.4) 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;

(1.10.9) 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 (i.e., 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 OBD 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 monitoring 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 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 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 (i.e., 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, OBD requirements to which the engine is certified (e.g., California OBD II, EPA OBD, European OBD, non-OBD) and MIL status (i.e., 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 model year 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 (i.e., 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 temperature, 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 OBD 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 (i.e., 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; and

(D) 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 (i.e., 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 (i.e., inside control area, outside control area, inside manufacturer-specific PM NTE carve-out area, or NTE deficiency for PM active area);

(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 fill level), alcohol fuel percentage, NOx adsorber regeneration status, NOx adsorber deSOx status, hybrid battery pack remaining charge; and

(B) distance traveled while low/empty SCR reductant driver warning/inducement active.

(4.2.7) Additionally, for all 2015 and subsequent model year vehicles: type of fuel currently being used.

(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)(D) shall be made available on demand through the standardized data link connector in accordance with SAE J1979 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, OBD 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)(D), (g)(4.2.5)(F), (g)(4.2.6)(A), and (g)(4.2.7) 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 additional 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-range low, out-of-range high, open circuit, etc.).

(4.4.3) Manufacturers shall use appropriate SAE-defined fault codes of SAE J2012 (e.g., P0xxx, P2xxx) whenever possible. With Executive 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.

(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).

(B) On all 2005 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 available 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.

(D) 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 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 OBD 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 OBD 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 OBD 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 (i.e., 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 (i.e., SAE J1979 OBDMIDs 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 standardized 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 VVT systems, VVT monitoring test results and limits shall be stored and available in the standardized format specified in SAE J1979.

(D) 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 OBD II system computer is cleared. For monitors with multiple pass/fail criteria (e.g., a purge flow diagnostic that 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 vehicles, 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 OBD II system shall store and report unique test results for each separate diagnostic (e.g., an OBD 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 ID) 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 OBD II system shall use a single software calibration identification number (CAL ID) 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 ID 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 ID 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 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 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 OBD 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 ID. For 50 percent of 2010 and 100 percent of 2011 and subsequent model year vehicles, one CVN shall be made available for each CAL ID 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 ID.

(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 generic scan tool in accordance with SAE J1979 specifications. The stored CVN value may not be erased when fault memory is erased by a generic scan tool in accordance with SAE J1979 specifications or during normal vehicle shut down (i.e., key off, engine off).

(4.7.4) For purposes of Inspection and Maintenance (I/M) testing, manufacturers shall make the CVN and CAL ID combination information available for all 2008 and subsequent model year vehicles in a standardized electronic

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[2] The requirements of section (g)(4.7) shall supercede the requirements set forth in title 13, CCR section 1968.1(l)(4.0).

format that allows for off-board verification that the CVN is valid and appropriate for a specific vehicle and CAL ID. The standardized electronic format is detailed in Attachment E: CAL ID and CVN Data of ARB Mail-Out #MSC 06-23, December 21, 2006, 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 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 (i.e., all information required to be erased in accordance with SAE J1979 specifications when a Mode/Service $04 clear/reset 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 (i.e., ECUNAME in Service/Mode $09, InfoType $0A). 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 incremented 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 0.000122.

(B) 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, 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), 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 #1active;

(6.1.5) Total run time with EI-AECD #2 active; and so on up to

(6.1.6) Total run time with EI-AECD #n active.

(6.1.7) For 2010 through 2012 model year vehicles, manufacturers may define "idle" in section (g)(6.1.2) above as accelerator pedal released by driver, vehicle speed less than or equal to one mile per hour, and PTO not 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) Total engine run time;

(6.2.2) Total run time with EI-AECD #1active;

(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.

(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.

(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.

(6.4) 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 EI-AECD when it is activated (e.g., EGR valve protection);

(B) "Action" is defined as a specific component/element act that is commanded when the EI-AECD is activated (e.g., EGR system is derated);

(C) "Parameter" is defined as a component/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.

(6.4.2) 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.

(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 follows:

(i) The first of the two 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 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).

(ii) The second of the two timers shall be incremented whenever the EI-AECD 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-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)(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.

(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).

(6.4.6) 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).

(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 SAE J1979, 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 diagnostic connector, communication protocol, and emission-related message format and structure requested by the manufacturer meet the standardization requirements in title 13, CCR section 1971.1.1 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 available 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 Demonstration Requirements 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 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 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 specified 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 determined 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 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).

(3.4.2) 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 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 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)(B) 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 Diesel/Compression-ignition 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 (i.e., 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 (i.e., 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)(A)(i) or (f)(3.2.5), the manufacturer shall perform a test at the malfunction criteria limit specified in section (f)(3.2.2)(A)(i) or (f)(3.2.5). A misfire monitor demonstration test is not required for vehicles not subject to section (f)(3.2.2)(A)(i) and not subject to section (f)(3.2.5).

(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 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.

(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 OBD 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).

(4.11) 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) and (f)(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 to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction.

(4.12) For each of the testing 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 analysis 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 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.

(4.14) 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, very 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 component 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) Except for testing of the catalyst (i.e., 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 O2 sensor malfunction is determined, etc.), the test vehicle shall be retested with the component adjusted to the worst acceptable limit (i.e., 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 (i.e., 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 (i.e., 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 standard); 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 OBD II 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 OBD 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 OBD II 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 "OBD II groups". Executive Officer approval shall be granted for those groupings that include test groups using the same OBD II strategies and similar calibrations. If approved by the Executive Officer, the manufacturer may submit one set of documentation from one or more representative test group(s) that are a part of the OBD II group. The Executive Officer shall determine whether a selected test group(s) is representative of the OBD II group as a whole. To be approved as representative, the test group(s) must possess the most stringent exhaust emission standards and OBD II monitoring requirements and cover all of the emission control devices within the OBD II 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 OBD 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, 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 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 (°C) 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 (/rev) 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) Data supporting the misfire monitor:

(2.5.1) For gasoline vehicles, data supporting the misfire monitor shall include:

(A) The established percentage of misfire that can be tolerated without damaging the catalyst over the full range of engine speed and load conditions.

(B) 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.

(C) 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.

(D) Manufacturers are not required to use the durability demonstration vehicle to collect the misfire data for sections (i)(2.5.1)(A) though (C).

(2.5.2) For diesel medium-duty vehicles subject to the monitoring requirements of section (f)(3.2.2), data supporting the misfire monitor shall include:

(A) Data demonstrating the probability of detection of misfire events of the misfire monitoring system over the required engine speed and load

operating range for the following misfire patterns: random cylinders misfiring at the malfunction criteria established in section (f)(3.2.2), one cylinder continuously misfiring, and paired cylinders continuously misfiring.

(B) Data identifying all disablement of misfire monitoring that occurs during the chassis dynamometer FTP and Unified cycles. For every disablement that occurs during the cycles, the data shall 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 number of 1000-revolution intervals completed and the number of 1000-revoluation intervals in which the misfire threshold was exceeded shall also be identified. The data shall be submitted in the standardized format detailed in Attachment A: Misfire Disablement and Detection Chart of ARB Mail-Out #06-23.

(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 OBD 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 cover letter 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 Evaluation 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 group. 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 SAE J1699-3 committee and available through www.sourceforge.net and SAE J2534 compliant hardware configured specifically for SAE J1699-3 testing.

(1.4) Required Testing (i.e., "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 ID, 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

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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 vehicle 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 of 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 II 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 selection 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 1968.2.1.

(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)(i.e., 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 malfunction threshold (e.g., 1.5 times the applicable standards) is 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 (i.e., 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 of fifteen 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 1968.2.1. In granting the certification, the Executive Officer shall consider the following factors: the extent to which the requirements of section 1968.2.1 are satisfied overall based on a review of the vehicle applications in question, the relative performance of the resultant OBD II system compared to systems fully compliant with the requirements of title 13, CCR section 1968.2.1, 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. 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 1968.5.1 (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 and medium-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 OBD 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 1968.2.1. 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. For all deficiencies except for deficiencies associated with PM filter monitoring section (f)(9.2.1)(A), 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. For deficiencies associated with PM filter monitoring section (f)(9.2.1)(A), if the manufacturer can demonstrate that substantial vehicle hardware modifications and additional lead time would be necessary to correct the deficiency, the Executive shall allow the deficiency to be carried over up to and including the 2013 model year.

(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 1968.2.1; 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).

(7) Exceptions to Fines Requirements.

(7.1) 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 all 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 OBD system still applies.

(7.2) For 2013 through 2014 model year light-duty and medium-duty diesel vehicles that utilize PM sensors for PM filter filtering performance monitoring (section (f)(9.2.1)(A)), in cases where the deficiency is for a monitor required to detect malfunctions of the PM filter filtering performance (section (f)(9.2.1)(A)), the PM sensor (section (f)(5.2.2)), or the PM sensor heater (section (f)(5.2.4)), the deficiency shall be exempt from the specified fines of section (k)(3) and the deficiency shall not be included in the count of deficiencies used in (k)(2) to determine the number of deficiencies subject to fines.

(8) Any OBD II system installed on a production vehicle that fails to conform with the certified OBD II system for that vehicle or otherwise fails to meet the requirements of section 1968.2.1 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 1968.5.1.

NOTE: Authority cited: Sections 39010, 39600, 39601, 43000.5, 43013, 43018, 43100, 43101, 43104, 43105, 43105.5 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.

§ 1968.5.1. Enforcement of Malfunction and Diagnostic System Requirements for 2004 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles and Engines. (Alternative)

For purposes of this section, any cross-referenced section in title 13 or title 17 of the California Code of Regulations shall refer to the section identified as the alternative version "(Alternative)" for the corresponding section, to the extent an alternative version of that section exists.

(a) *General*

(1) *Applicability.*

(A) These procedures shall be used to assure compliance with the requirements of title 13, California Code of Regulations (CCR) section 1968.2.1 for all 2004 and subsequent model year passenger cars, light-duty trucks, medium-duty vehicles, and engines certified on an engine dynamometer for use in medium-duty vehicles (the classifications of which shall jointly be referred to for purposes of this regulation as vehicles) equipped with OBD II systems that have been certified for sale in California.

(B) Vehicles manufactured prior to the 2004 model year are covered by the general enforcement and penalty provisions of the Health and Safety Code, and the specific provisions of title 13, CCR sections 1968.1 and 2111 through 2149.

(2) *Purpose.*

The purpose of this section is to establish the enforcement protocol that shall be used by the ARB to assure that vehicles certified for sale in California are equipped with OBD II systems that properly function and meet the purposes and requirements of title 13, CCR section 1968.2.1.

(3) *Definitions.*

The definitions applicable to these rules include those set forth in Health and Safety Code section 39010 et seq. and in title 13, CCR sections 1900(b) and 1968.2.1(c), which are incorporated by reference herein. The following definitions are specifically applicable to section 1968.5.1 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.

"Executive Officer" means the Executive Officer of the Air Resources Board or his or her authorized representative.

"Influenced OBD II-Related Recall" 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 OBD II system for which direct notification of vehicle owners is necessary.

"Major Monitor" means those monitors covered by the requirements set forth in title 13, CCR sections 1968.2.1(e)(1.0) through (e)(8.0), (e)(11.0) through (e)(14.0), (e)(16.0), (f)(1.0) through (f)(9), (f)(12), (f)(13), and (f)(16).

"Motor Vehicle Class" means a group or set of vehicles subject to enforcement testing that have been determined by the Executive Officer to share common or similar hardware, software, OBD II monitoring strategy, or emission control strategy.

"Motor Vehicle Manufacturer" means the manufacturer granted certification to sell motor vehicles in the State of California.

"Nonconforming OBD II System" means an OBD II system on a production vehicle that has been determined not to comply with the emission standards as defined in title 13, CCR section 1968.2.1(c), irrespective of whether vehicles in the motor vehicle class, on average, meet other applicable emission standards (e.g., exhaust emission standards defined in title 13, CCR section 1960.1, evaporative emission standards defined in title 13, CCR section 1976).

"OBD II Emission Testing" refers to testing conducted to determine compliance with the malfunction criteria in title 13, CCR sections 1968.2.1(e) and (f) 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 FTP emission standards, PM standard plus 0.02 g/bhp-hr, PM level of 0.03 g/bhp-hr as measured from an applicable emission test cycle).

"OBD II Ratio Testing" refers to testing conducted to determine compliance with the required in-use monitor performance ratio in title 13, CCR section 1968.2.1(d)(3.2.1).

"Ordered OBD II-Related Recall" means an inspection, repair, adjustment, or modification program required by the ARB to be conducted by the manufacturer to correct any nonconforming OBD II system for which direct notification of vehicle 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 vehicles in a designated motor vehicle class that are equipped with OBD II systems and are selected and tested as part of the ARB enforcement testing program set forth in section (b).

"Voluntary OBD II-Related Recall" means an inspection, repair, adjustment, or modification program voluntarily initiated and conducted by a manufacturer to correct any nonconforming OBD II system for which direct notification of vehicle owners is necessary.

(b) *Testing Procedures*

(1) *Purpose.*

To assure that OBD II systems on production motor vehicles comply with the requirements of title 13, CCR section 1968.2.1, the ARB may periodically evaluate vehicles from a motor vehicle class.

(2) *Preliminary Testing and Evaluation.*

(A) As part of his or her evaluation of vehicles to determine compliance with the requirements of title 13, CCR section 1968.2.1, the Executive Officer may routinely conduct testing on any production vehicles that have been certified for sale in California.

(B) Based upon such testing or any other information, including data from California or other State Inspection and Maintenance (I/M) stations, warranty information reports, and field information reports, the Executive Officer may conduct enforcement testing pursuant to sections (b)(3) through (5) below.

(3) *Vehicle Selection for Enforcement Testing.*

(A) *Determining the Motor Vehicle Class.*

(i) Upon deciding to conduct enforcement testing, the Executive Officer shall determine the motor vehicle class to be tested. In determining the scope of the motor vehicle class to be tested, the Executive Officer shall consider the similarities and differences in the OBD II systems of potentially affected vehicles. Among other things, the Executive Officer shall consider whether vehicles share similar computer hardware and software, calibrations, or OBD II monitoring and emission control strategies.

(ii) The default motor vehicle class is the test group or OBD II group used by the manufacturer to certify the vehicles to be tested. However, upon concluding that a subgroup of vehicles differs from other vehicles in the identified test group or OBD II 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 test group or OBD II group is the appropriate motor vehicle class for testing.

(iii) Similarly, upon concluding that vehicles from several OBD II groups (which may include OBD II 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 a motor vehicle class larger than a specific test group or OBD II group, the Executive Officer may determine that the appropriate motor vehicle class includes more than one test group or OBD II group.

(iv) Except for testing to determine if an OBD II system has been designed to deactivate based on age and/or mileage (title 13, CCR section 1968.2.1

(d)(1.3)), the Executive Officer may not conduct testing of a motor vehicle class whose vehicles, on average, exceed the defined full useful life of the motor vehicle class. For purposes of the determination of this average, the Executive Officer shall use the accrual rates appropriate for vehicles in the motor vehicle class as defined in EMFAC2000 "Public Meeting to Consider Approval of Revisions to the State's On-Road Motor Vehicle Emissions Inventory: Technical Support Document, Section 7.1, 'Estimation of Average Mileage Accrual Rates from Smog Check Data,'" May 2000, incorporated by reference.

(B) *Size of Test Sample Group*. After determining the motor vehicle class to be tested, the Executive Officer shall determine the appropriate number of vehicles to include in the test sample group for enforcement testing in accordance with the following guidelines:

(i) For OBD II emission testing, the Executive Officer shall follow the provisions of title 13, CCR section 2137 regarding test sample size. In accordance with section 2137, the Executive Officer shall test 10 vehicles that have been procured following the protocol of section (b)(3)(C) below and meet the selection criteria of section (b)(3)(D)(i) below to determine the emissions characteristics of the motor vehicle class being tested.

(ii) For OBD II ratio testing, the Executive Officer shall collect data from a test sample group of 30 vehicles that have been procured following the protocol of section (b)(3)(C) below and meet the selection criteria of section (b)(3)(D)(ii) below to determine the in-use OBD II monitoring performance of the motor vehicle class being tested.

(iii) In determining compliance with any other requirements of title 13, CCR section 1968.2.1 (e.g., diagnostic connector 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 vehicles meeting the selection criteria of section (b)(3)(D)(iii) needed to assure that the results of such testing may be reasonably inferred to the motor vehicle class. The Executive Officer's determination shall be based upon the nature of the noncompliance and the scope of the motor vehicle class. The test sample group could be as few as two test vehicles.

(C) *Protocol for Procuring Vehicles for Test Sample Group.*

(i) For OBD II emission and ratio testing, the Executive Officer shall procure vehicles consistent with the procurement process followed by the Executive Officer under title 13, CCR 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 vehicles for OBD II emission testing, the

Executive Officer shall include only vehicles meeting the criteria set forth in section (b)(3)(D)(i) below. For OBD II ratio testing, the Executive Officer shall include only vehicles meeting the criteria set forth in section (b)(3)(D)(ii) below.

(ii) For all other testing, the Executive Officer shall, on a case by case basis, determine the appropriate manner for procuring vehicles. In making his or her determination, the Executive Officer shall consider the nature of the noncompliance and the scope of the motor vehicle class. If the Executive Officer concludes that a reasonable basis exists to believe that a vehicle operator's driving or maintenance habits would not substantially impact test results to determine noncompliance, he or she may procure vehicle(s) by any means that assures effective collection and testing of vehicles (e.g., rental car agencies, fleet vehicles, etc.). In all cases, however, the selection process must ensure proper selection of vehicles in accord with section (b)(3)(D)(iii) below.

(D) *Vehicles to be included in a Test Sample Group.*

(i) In selecting vehicles to be included in a test sample group for enforcement OBD II emission testing, the Executive Officer shall include only vehicles that:

a. Are certified to the requirements of title 13, CCR section 1968.2.1 and California exhaust emission standards.

b. Are registered for operation in California.

c. Have mileage that is equal to or 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 OBD II system not to comply with the requirements of title 13, CCR section 1968.2.1 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 OBD II system not to comply with the requirements of title 13, CCR section 1968.2.1 or would have a permanent effect on exhaust emission performance.

f. Have no detected or known malfunction(s) that would affect the performance of the OBD II system and are unrelated to the monitor or system being evaluated. At its discretion, the ARB may elect to repair a vehicle with a detected or known malfunction and then include the vehicle in the test sample group.

g. Have had no major repair to the engine or major repair of the vehicle resulting from a collision.

h. Have no problem that might jeopardize the safety of laboratory personnel.

(ii) In selecting vehicles to be included in a test sample group for enforcement OBD II ratio testing, the Executive Officer shall include only vehicles that:

a. Are certified to the requirements of title 13, CCR section 1968.2.1.

b. Have collected sufficient vehicle 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 title 13, CCR section 1968.2.1(d)(3.2), sufficient vehicle operation data shall mean the denominator meets the criteria set forth in sections (b)(3)(D)(ii)1. through 3. below. For monitors required to meet the in-use monitor performance ratio but not required to track and report ratio data pursuant to title 13, CCR section 1968.2.1(d)(3.2), sufficient vehicle operation data shall mean that vehicles that have a denominator that meets the criteria set forth in sections (b)(3)(D)(ii)1. through 3. below after undergoing testing as set forth in section (b)(4)(C)(ii) below. Specifically, the denominator, as defined in title 13, CCR section 1968.2.1(d)(4.3), for the monitor to be tested must have a value equal to or greater than:

1. 150 for evaporative system monitors, secondary air system monitors, and monitors utilizing a denominator incremented in accordance with title 13, CCR sections 1968.2.1(d)(4.3.2)(E) or (F) (e.g., cold start monitors, air conditioning system monitors, etc.) and not covered in section (b)(3)(D)(ii)2. below, or

2. 50 for PM filter monitors, NMHC converting catalyst monitors, PM sensor monitors, and PM sensor heater monitors utilizing a denominator incremented in accordance with title 13, CCR section 1968.2.1(d)(4.3.2)(F), (G), (H), or (I), or

3. 300 for catalyst, oxygen sensor, EGR, VVT, and all other component monitors not covered in sections (b)(3)(D)(ii)1. and 2. above.

c. Have not been tampered with or equipped with add-on or modified parts that would cause the OBD II system not to comply with the requirements of title 13, CCR section 1968.2.1.

d. Have mileage and age that are less than or equal to the certified full useful life mileage and age for the subject vehicles.

(iii) In selecting vehicles to be included in a test sample group for enforcement testing of any other requirement of title 13, CCR section 1968.2.1 (not covered by sections (b)(3)(D)(i) or (ii) above), the Executive Officer shall include only vehicles that:

a. Are certified to the requirements of title 13, CCR section 1968.2.1.

b. Have not been tampered with or equipped with add-on or modified parts that would cause the OBD II system not to comply with the requirements of title 13, CCR section 1968.2.1.

c. Have no detected or known malfunction(s) that would affect the performance of the OBD II system and are unrelated to the monitor or system being evaluated. At its discretion, the ARB may elect to repair a vehicle with a detected or known malfunction and then include the vehicle 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 vehicles.

(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 a vehicle fails to meet one or more of the applicable criteria of section (b)(3)(D)(i) through (iii), the Executive Officer shall remove the vehicle from the test sample group. The Executive Officer may replace any vehicle removed with an additional vehicle selected in accordance with sections (b)(3)(C) and (D) above. Test results relying on data from the removed vehicle shall be recalculated without using the data from the removed vehicle.

(4) *Enforcement Testing Procedures.*

(A) Prior to conducting any testing under section (b)(4), the Executive Officer may replace components monitored by the OBD II system with components that are sufficiently deteriorated or simulated to cause malfunctions that exceed the malfunction criteria established pursuant to title 13, CCR sections 1968.2.1(e) and (f) 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 vehicle, etc.). Upon request by the Executive Officer, the manufacturer shall make available all test equipment (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 OBD II emission testing.

(B) OBD II 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 title 13, CCR sections 2138 and 2139.

(ii) On-road or dynamometer testing with the vehicle being driven 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) *OBD II Ratio Testing.*

(i) For OBD II ratio testing of monitors required to meet the in-use monitor performance ratio and to track and report ratio data pursuant to title 13, CCR section 1968.2.1(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 OBD II ratio testing of monitors required to meet the in-use monitor performance ratio but not required to track and report ratio data pursuant to title 13, CCR section 1968.2.1(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 vehicles. After installation of the equipment, the vehicles shall be returned to the vehicle owner/operator to continue to operate the vehicle until the minimum denominator criteria (see section (b)(3)(D)(ii)b.) are satisfied. The Executive Officer shall then calculate the ratio from the data collected in a manner that will allow the Executive Officer to effectively determine the in-use monitor performance ratio in accordance with the requirements of title 13, CCR section 1968.2.1(d)(3.2).

(D) *Testing for compliance with any other requirement of title 13, CCR section 1968.2.1.* 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 cycle or other applicable emission test cycle used for measuring exhaust or evaporative emissions.

(ii) On-road or dynamometer testing with the vehicle being driven 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.

(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 motor vehicle 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 vehicles from the motor vehicle class if the Executive Officer has determined that:

(i) a subgroup of tested vehicles differs sufficiently enough from other vehicles in the tested motor vehicle class, and

(ii) a reasonable basis exists to believe that the identified differences may indicate that the subgroup may be nonconforming whereas the tested motor vehicle class as a whole is not.

(B) Hereinafter all references to motor vehicle class shall be applicable to the subgroup meeting the conditions of section (b)(5)(A) above.

(C) In any testing of a subgroup of vehicles under section (b)(5), the Executive Officer shall follow the vehicle 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 OBD II system in the identified motor vehicle class if:

(A) *OBD II Emission Testing.*

(i) Intermediate In-Use Gasoline Thresholds. For 2004 through 2008 model year vehicles subject to gasoline/spark ignited monitoring requirements in title 13, CCR section 1968.2.1(e) , the results of the OBD II emission tests indicate that 50 percent or more of the vehicles in the test sample do not properly illuminate the MIL when emissions exceed:

a. 2.0 times the FTP standards for malfunction criteria defined in title 13, CCR section 1968.2.1(e) that require MIL illumination at 1.5 or 1.75 times the FTP standards;

b. 3.5 times the FTP standards for malfunction criteria defined in title 13, CCR section 1968.2.1(e) that require MIL illumination at 2.5 times the FTP standards; or

c. 4.5 times the FTP standards for malfunction criteria defined in title 13, CCR section 1968.2.1(e) that require MIL illumination at 3.5 times the FTP standards.

(ii) *Intermediate In-Use Diesel Thresholds.*

a. For 2007 through 2012 model year vehicles subject to diesel/compression-ignition monitoring requirements in title 13, CCR section 1968.2.1(f), the results of the OBD II emission tests indicate that 50 percent or more of the vehicles in the test sample do not properly illuminate the MIL when emissions exceed:

1. an additional 1.0 times the applicable standards above the malfunction criteria for malfunction criteria defined in title 13, CCR section 1968.2.1(f) that require MIL illumination at less than 3.5 times the applicable standards (e.g., 3.5 times the applicable standards for a malfunction criteria of 2.5 times the applicable standards); or

2. an additional 1.5 times the applicable standards above the malfunction criteria for malfunction criteria defined in title 13, CCR section 1968.2.1(f) that require MIL illumination at greater than or equal to 3.5 times the applicable standards (e.g., 6.5 times the

applicable standards for a malfunction criteria of 5.0 times the applicable standards); or

3. an additional 1.0 times the applicable standards above the malfunction criteria for malfunction criteria defined in title 13, CCR section 1968.2.1(f) that require MIL illumination at an additive threshold of less than or equal to 0.3 g/bhp-hr NOx, an additive threshold of less than or equal to 0.02 g/bhp-hr PM, or an absolute threshold of less than or equal to 0.03 g/bhp-hr (e.g., 0.07 g/bhp-hr PM for an additive malfunction criteria of 0.03 g/bhp-hr with a standard of 0.02 g/bhp-hr); or

4. an additional 1.5 times the applicable standards above the malfunction criteria for malfunction criteria defined in title 13, CCR section 1968.2.1(f) that require MIL illumination at an additive threshold of greater than 0.3 g/bhp-hr NOx, an additive threshold of greater than 0.02 g/bhp-hr PM, or an absolute threshold of greater than 0.03 g/bhp-hr PM (e.g., 1.0 g/bhp-hr NOx for an additive malfunction criteria of 0.5 g/bhp-hr with a standard of 0.2 g/bhp-hr).

b. For 2010 through 2012 model year medium-duty vehicles certified to an engine dynamometer standard, the "applicable standards" used in section (b)(6)(A)(ii) shall be limited to the emission test cycle and standard (i.e., FTP or SET) determined by the manufacturer to be more stringent and documented as such in the certification application in accordance with title 13, CCR section 1968.2.1(d)(6.1).

c. For 2007 through 2009 model year vehicles subject to adjustment for infrequent regeneration events in accordance with title 13, CCR section 1968.2.1(d)(6.2), OBD II emission enforcement testing for monitors using the provisions of title 13, CCR section 1968.2.1(d)(6.2.3) (baseline-derived adjustment factors instead of malfunction threshold component-specific adjustment factors) shall be limited to using emission test results without the infrequent regeneration event occurring and applying the same baseline-derived adjustment factors used by the manufacturer at the time of certification.

d. For 2013 through 2015 model year medium-duty vehicles, with respect to the NOx malfunction criteria for the NOx converting catalyst conversion efficiency monitor (title 13, CCR section 1968.2.1(f)(2.2.2)), reductant delivery performance monitor (title 13, CCR section 1968.2.1(f)(2.2.3)(A)), and NOx sensor monitor (title 13, CCR section 1968.2.1(f)(5.2.2)(A)), the Executive Officer shall make a finding of nonconformance of the OBD II system if the results of the OBD II emission tests indicate that 50 percent or more of the vehicles in the test sample do not properly illuminate the MIL when emissions exceed an additional 0.2 g/bhp-hr above the NOx malfunction criteria defined in title 13, CCR section 1968.2.1(f)(2.2.2)(A)(ii)c. or 1968.2.1(f)(5.2.2)(A)(ii)c.

e. For 2013 through 2015 model year medium-duty vehicles, for the PM filter filtering performance monitor (title 13, CCR section 1968.2.1(f)(9.2.1)), the Executive Officer shall make a finding of nonconformance of the OBD II system if the results of the OBD II emission tests indicate that 50 percent or more of the vehicles in the test sample do not properly illuminate the MIL when emissions exceed 0.05 g/bhp-hr.

(iii) *Final In-Use Thresholds.* For 2009 and subsequent model year vehicles subject to the gasoline/spark-ignited requirements of title 13, CCR section 1968.2.1(e) and, except as provided in sections (b)(6)(A)(ii)d. and e. above, for 2013 and subsequent model year vehicles subject to the diesel/compression-ignition requirements of title 13, CCR section 1968.2.1(f), the results of the OBD II emission tests indicate that 50 percent or more of the vehicles in the test sample do not properly illuminate the MIL when the emission malfunction criteria defined in title 13, CCR sections 1968.2.1(e) or (f) are exceeded.

(B) *OBD II Ratio Testing.*

(i) For monitors specified in sections (b)(6)(B)(i)a. through e. below, the data collected from the vehicles in the test sample 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 0.100 or that 66.0 percent or more of the vehicles in the test sample group have an in-use monitor performance ratio of less than 0.100 for the same monitor:

a. monitors on 2004 through 2018 model year vehicles certified to a ratio of 0.100 in accordance with title 13, CCR section 1968.2.1(d)(3.2.1) (D),

b. monitors specified in title 13, CCR section 1968.2.1(e) on 2007 through 2012 model year vehicles for the first three model years the monitor is certified to the in-use performance ratio monitoring requirements of title 13, CCR sections 1968.2.1(d)(3.2.1)(A) through (C),

c. the fuel system air-fuel ratio cylinder imbalance monitor specified in title 13, CCR section 1968.2.1(e)(6.2.1)(C) on 2015 through 2017 model year vehicles,

d. the secondary exhaust gas sensor monitor specified in title 13, CCR section 1968.2.1(e)(7.2.2)(C) on 2012 through 2014 model year vehicles, and

e. monitors specified in title 13, CCR section 1968.2.1(f) on 2013 through 2015 model year vehicles.

(ii) For monitors that are certified to the ratios in title 13, CCR sections 1968.2.1(d)(3.2.1)(A) through (C) and are not described in sections (b)(6)(B)(i)b. through e. above, the data collected from the vehicles in the test sample indicate either that 66.0 percent or more of the vehicles in the

test sample group have an in-use monitor performance ratio of less than the required minimum ratio defined in title 13, CCR section 1968.2.1(d)(3.2.1) for the same monitor or that the average in-use monitor performance ratio for one or more of the monitors in the motor vehicle class is less than the required minimum ratio defined in title 13, CCR section 1968.2.1(d)(3.2.1) as defined by determining the average in-use monitor performance ratio for one or more of the monitors in the test sample group is less than:

a. 0.230 for secondary air system monitors and other cold start related monitors utilizing a denominator incremented in accordance with title 13, CCR section 1968.2.1(d)(4.3.2)(E) (e.g., cold start strategy monitors, etc.);

b. For evaporative system monitors:

1. 0.230 for monitors designed to detect malfunctions identified in title 13, CCR section 1968.2.1(e)(4.2.2)(C) (i.e., 0.020 inch leak detection);

2. 0.460 for monitors designed to detect malfunctions identified in title 13, CCR section 1968.2.1(e)(4.2.2)(A) and (B) (i.e., purge flow and 0.040 inch leak detection);

c. 0.297 for catalyst, oxygen sensor, EGR, VVT system, and all other monitors specifically required in section title 13, CCR sections 1968.2.1(e) and (f) to meet the monitoring condition requirements of title 13, CCR section 1968.2.1(d)(3.2).

(C) *All Other OBD II Testing.*

(i) The results of the testing indicate that at least 30 percent of the vehicles in the test sample do not comply with the same requirement of title 13, CCR section 1968.2.1.

(ii) The results of the testing indicate that at least 30 percent of the vehicles in the test sample do not comply with one or more of the requirements of title 13, CCR section 1968.2.1 while the engine is running and while in the key on, engine off position such that Inspection and Maintenance or scan tool equipment designed to access the following parameters via the standards referenced in title 13, CCR section 1968.2.1 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) as incorporated by reference in title 13, CCR section 1968.2.1(g)(1) and section 1968.2.1(g)(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 and title 13, CCR section 1968.2.1(g)(4.2), and in accordance with SAE J1979

and title 13, CCR sections 1968.2.1(d)(2.1.2) during the MIL functional check and, if applicable, title 13, CCR 1968.2.1(g)(4.1.3) during the MIL readiness status check;

c. The current permanent fault code(s) in accordance with SAE J1979 and section title 13, CCR 1968.2.1(g)(4.4);

d. The data stream parameters (Mode/Service $01) for: engine speed (PID $0C) and OBD requirements to which the vehicle or engine is certified (PID $1C); and for 2008 and subsequent model year vehicles using the ISO 15765-4 protocol that have not implemented permanent fault codes subject to (b)(6)(C)(ii)c., number of warm-up cycles since codes cleared (PID $30), distance since codes cleared (PID $31), and engine run time since codes cleared (PID $4E); as required in title 13, CCR section 1968.2.1(g)(4.2) and in accordance with SAE J1979;

e. The CAL ID, CVN, and VIN (Mode $09 PIDs $01 through $06) as required in title 13, CCR sections 1968.2.1(g)(4.6), (g)(4.7.1), (g)(4.7.3), and (g)(4.8) and in accordance with SAE J1979;

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 title 13, CCR section 1968.2.1(g)(4) and in accordance with SAE J1979 (e.g., Mode/Service $01, PIDs $00, $20, $40; Mode/Service $09, PID $00, etc.); or

g. For vehicles using an alternate connector and communication protocol (e.g., SAE J1939) as provided for in title 13, CCR section 1968.2.1(g)(7.1), the parameters and data identified in sections (b)(6)(C)(ii)a. through f. in accordance with title 13, CCR section 1968.2.1(g)(4) and with the specified alternate connector and communication protocol in lieu of in accordance with SAE J1979.

(iii) If the finding of nonconformance under section (b)(6)(C)(i) above concerns vehicles that do not comply with the requirements of title 13, CCR section 1968.2.1(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 II ratio enforcement test result that would be subject to an ordered OBD II-related recall in accord with the criterion in section (c)(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 II-related recall under section (c)(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 vehicles in the motor vehicle 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 7920.000 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 motor vehicle class is equipped with a nonconforming OBD II 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 vehicle testing that may rebut or mitigate the results of the ARB testing, including any evidence that a motor vehicle class, if determined to be nonconforming, should be exempted from mandatory recall. (See section (c)(3)(B) below.).

(i) For OBD II emission testing and OBD II ratio testing:

a. The manufacturer may submit evidence to demonstrate that vehicles in the test sample group used by the Executive Officer were inappropriately selected, procured, or tested in support of a request to have vehicles excluded from the test sample group in accordance with section (b)(3)(D)(iv).

b. If the manufacturer elects to conduct additional testing of vehicles in the motor vehicle class and submit the results of such testing to the Executive Officer, the manufacturer shall:

1. Present evidence that it has followed the vehicle procurement and test procedures set forth in sections (b)(3) and (4) above, or

2. If the manufacturer elects to use different procurement 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 motor vehicle class.

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(ii) If the manufacturer objects to the size of the test sample group or the method used to procure vehicles 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 vehicles 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)(ii) above, the manufacturer shall demonstrate that the vehicles in the motor vehicle class comply with in-use monitor performance ratio requirements of title 13, CCR section 1968.2.1(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 vehicles operated in California comply with the in-use monitor performance ratio requirements.

(D) The Executive Officer may, but is not required to, 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 unless the manufacturer could not have reasonably foreseen the need for providing the information within the time period provided. 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 OBD II system in the motor vehicle 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 test group(s), OBD II group(s), or subgroups thereof, that has been determined to have a nonconforming OBD II 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 shall 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) *Remedial Action*

(1) *Voluntary OBD II-Related Recalls.* If a manufacturer initiates a voluntary OBD II-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 OBD II-related recall plan for approval, as prescribed under section (d)(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 II-Related Recalls.*

(A) Upon being notified by the Executive Officer, pursuant to section (b)(7)(G), that a motor vehicle class is equipped with a nonconforming OBD II system, the manufacturer may, within 45 days from the date of service of such notification, elect to conduct an influenced OBD II-related recall of all vehicles within the motor vehicle class for the purpose of correcting the nonconforming OBD II systems. Upon such an election, the manufacturer shall submit an influenced OBD II-related recall plan for approval, as prescribed under section (d)(1) below.

(B) If a manufacturer does not elect to conduct an influenced OBD II-related recall under section (c)(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 OBD II systems.

(3) *Ordered Remedial Action-Mandatory Recall.*

(A) Except as provided in sections (c)(3)(B) below, the Executive Officer shall order the recall and repair of all vehicles in a motor vehicle class that have been determined to be equipped with a nonconforming OBD II system if

enforcement testing conducted pursuant to section (b) above or information received from the manufacturer indicates that:

(i) For monitors on 2007 and subsequent model year vehicles certified to the ratios in title 13, CCR sections 1968.2.1(d)(3.2.1)(A) through (C), 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 title 13, CCR section 1968.2.1(d)(3.2.1) (e.g., if the required ratio is 0.336, less than or equal to a ratio of 0.111) 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 title 13, CCR section 1968.2.1(d)(3.2.1) for the same major monitor. For monitors on 2004 through 2018 model year vehicles certified to the 0.100 ratio in title 13, CCR section 1968.2.1(d)(3.2.1)(D), the Executive Officer shall determine the remedial action for nonconformances regarding the in-use monitor performance ratio in accordance with section (c)(4) below.

(ii) When the vehicle is tested on-road and driven so as to reasonably encounter all monitoring conditions disclosed in the manufacturer's certification application, the OBD II system is unable to detect and illuminate the MIL for a malfunction of a component/system monitored by a major monitor (other than the monitors for misfire causing catalyst damage and the evaporative system) prior to emissions exceeding two times the malfunction criteria of title 13, CCR sections 1968.2.1(e) and (f) (e.g., if the malfunction criteria is 1.75 times the applicable FTP standard, recall would be required when emissions exceed 3.5 times the applicable FTP 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 exceed 0.06 g/bhp-hr). Additionally, for the first two years that a new major monitor is required in title 13, CCR section 1968.2.1(e) (e.g., 2006 and 2007 model year for cold start strategy monitoring in title 13, CCR section 1968.2.1(e)(11)), the Executive Officer shall use three times the malfunction criteria in lieu of two times the malfunction criteria (e.g., if the malfunction criterion is 1.5 times the applicable FTP standard, recall would be required when emissions exceed 4.5 times the applicable FTP standard). Additionally, for major monitors on 2007 through 2009 model year vehicles certified to the monitoring requirements in title 13, CCR section 1968.2.1(f) and for the PM filter filtering performance monitor (title 13, CCR section 1968.2.1(f)(9.2.1)) on 2013 model year medium-duty vehicles, the Executive Officer shall determine the remedial action for nonconformances regarding emission exceedance in accordance with section (c)(4) below in lieu of the criteria in section (c)(3)(ii). For purposes of the emission exceedance determination, carbon monoxide (CO) emissions are not considered.

(iii) For misfire monitors:

a. Gasoline misfire monitor: 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).

b. Diesel misfire monitor: For 2019 and subsequent model year medium-duty diesel vehicles, the misfire monitor is unable to properly detect and illuminate the MIL for misfire rates that are more than 10 percentage points greater than the misfire malfunction criteria specified in title 13, CCR section 1968.2.1(f)(3.2.2) (e.g., misfire rate more than 15 percent if the misfire malfunction criteria is 5 percent).

(iv) When the vehicle is tested on-road and driven 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 title 13, CCR section 1968.2.1(e)(4.2.2)(C).

(v) When the vehicle is tested on-road and driven so as to reasonably encounter all monitoring conditions disclosed in the manufacturer's certification application, the OBD II 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 (c)(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) For 2013 and subsequent model year medium-duty diesel vehicles, when the vehicle is tested on-road and driven so as to reasonably encounter all monitoring conditions disclosed in the manufacturer's certification application, the PM filter monitor is unable to detect and illuminate the MIL for any of the following:

a. a missing substrate fault in accordance with title 13, CCR section 1968.2.1(f)(9.2.5); or

b. a malfunction of the PM filter that causes PM emissions to be equal to or greater than the emission level of the engine or vehicle, as measured from an applicable emission test cycle (i.e., FTP or SET), with the PM filter substrate completely removed.

(vii) The motor vehicle 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 OBD II system.

(B) A motor vehicle 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 (c)(3)(A)(i)-(vi) for mandatory recall:

(i) The OBD II 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 vehicle to be undriveable (e.g., vehicle stalls continuously or the transmission will not shift out of first gear, etc.) or causes an overt indication such that the driver 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 (B) above may still be subject to remedial action pursuant to section (c)(4) below.

(4) *Other Ordered Remedial Action.*

(A) If the Executive Officer has determined based upon enforcement testing conducted pursuant to section (b) above or information received from the manufacturer that a motor vehicle class is equipped with a nonconforming OBD II system and the nonconformance does not fall within the provisions of section (c)(3)(A) above, he or she may require the manufacturer to undertake remedial action up to and including recall of the affected motor vehicle class.

(B) In making his or her findings regarding remedial action, the Executive Officer shall consider the capability of the OBD II 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 the ARB about the nonconformance(s) or whether the 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 title 13, CCR section 1968.2.1(d)(3.2.1), and

b. the amount of the emission exceedance(s) over the established malfunction criteria set forth in title 13, CCR sections 1968.2.1(e) and (f) 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 title 13, CCR section 1968.2.1(d)(3.2.1),

b. the degree to which the monitored component must be malfunctioning or exceed the established malfunction criteria set forth in title 13, CCR sections 1968.2.1(e) and (f) 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 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 ability to follow California I/M testing protocol when performing a California I/M inspection.

(vii) The failure of the data link connector of the motor vehicle class to meet the requirements of title 13, CCR section 1968.2.1(g)(2).

(viii) The failure of the crankcase ventilation system in a motor vehicle class to comply with the requirements of title 13, CCR sections 1968.2.1(e)(9) or (f)(10).

(ix) The failure of the cooling system monitor in a motor vehicle class to properly verify that the cooling system reaches the highest enable temperature used for any other monitor when the vehicle is operated in the monitoring conditions disclosed in the manufacturer's certification application, or failure to comply with any requirement in title 13, CCR sections 1968.2.1(e)(10) or (f)(11).

(x) The estimated frequency that a monitor detects a malfunction and illuminates the MIL when no component malfunction is present (i.e., 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 (i.e., false passes).

(xii) Whether the manufacturer submitted false, inaccurate, or incomplete documentation regarding the identified nonconformance at the time of certification pursuant to title 13, CCR section 1968.2.1(i) 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 vehicles within the affected motor vehicle 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 title 13, CCR section 1968.2.1 or for production vehicles otherwise failing to be equipped with OBD II systems that have been certified by the ARB. In determining the penalty amounts that the 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 the 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 OBD II-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 title 13, CCR section 1968.2.1.

(D) The manufacturer's history of compliance with the OBD II requirements.

(E) The preventative efforts taken by the manufacturer to avoid noncompliance, 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 title 13, CCR section 1968.2.1(i).

(J) The nature and degree that OBD II systems on production vehicles differ from the systems that have been certified by the 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 test group(s), OBD II group(s), or subgroup(s) thereof, that has been determined to have a nonconforming OBD II system,

(iii) set forth the factual bases for the determination, and

(iv) designate a date at least 45 days from the date of receipt of such notice by which the manufacturer shall submit a plan, pursuant to section (d)(1) below, outlining the remedial action to be undertaken consistent with the Executive Officer's order. Except as provided in section (c)(7)(C) below, all plans shall be submitted to the Chief, Emissions Certification and Compliance Division, CA Air Resources Board, 4001 Iowa Avenue, Riverside, California 92507, 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 the 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 title 13, CCR section 1968.2.1. The notice must include a description of the test group(s), OBD II group(s), or subgroup(s) thereof, that have been determined to have a nonconforming OBD II 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 (c)(6) above, the manufacturer may request a public hearing pursuant to the procedures set forth in title 17, CCR 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. (Title 17, CCR section 60055.32(d)(1).) Each issue of controversy shall be decided based upon the preponderance of the evidence presented at the hearing. (Title 17, CCR section 60055.32(h).)

(B) Notwithstanding the provisions of title 17, CCR 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 title 17, CCR section 60055.1 et seq.

(C) If a manufacturer requests a public hearing pursuant to section (c)(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 (d)(1) below within 30 days after receipt of the Board's decision.

(d) *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 test group, OBD II group, or subgroup thereof covered by the remedial action, including the number of vehicles, the engine families, test groups, or subgroups within the identified class(es), the make(s), model(s), and model years of the covered vehicles, and such other information as may be required to identify the covered vehicles.

(ii) A description of the nonconforming OBD II 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 OBD II 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 owners and the manufacturer's method and schedule for notifying the service facilities and vehicle 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 OBD II systems.

(v) A description of the procedure to be followed by vehicle owners to obtain remedial action for the nonconforming OBD II 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 OBD II 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 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 vehicle from the motor vehicle class to be remedied.

(xi) A description of the impact, if any, and supporting data and/or engineering evaluation, that the proposed remedial action will have on fuel economy, driveability, performance, and safety of the motor vehicle 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 (d)(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 (d)(1)(A) above and is designed to notify the vehicle 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 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 (c)(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 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 owner's eligibility for remedial action required under section 1968.5.1 on the proper maintenance or use of the vehicle.

(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 in the motor vehicle 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 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 vehicles 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 owner used parts not manufactured by the original equipment vehicle manufacturer, or had repairs performed by outlets other than the vehicle manufacturer's franchised dealers.

(v) Instructions to the vehicle owners on how to obtain remedial action, including instructions on whom to contact (i.e., a description of the facilities

where the vehicles should be taken for the remedial action), the first date that a vehicle 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 owners to call to report difficulty in obtaining remedial action.

(viii) A card to be used by a vehicle owner in the event the vehicle 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 indicate the name and address of the person to whom the vehicle 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 nonconformity, if not corrected, may cause the vehicle to fail an emission inspection or I/M smog check test.

c. A statement describing the adverse effects, if any, of an uncorrected nonconforming OBD II system on the performance, fuel economy, or durability of the vehicle.

d. A statement that after remedial action has been taken, the manufacturer will have the service facility issue a certificate showing that a vehicle 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 owners or dealers may not contain any statement, expressed or implied, that the OBD II system is compliant or that the OBD II system will not degrade air quality.

(E) The Executive Officer shall inform the manufacturer of any other requirements pertaining to the notification under section (d)(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 a test group(s), OBD II 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 that have had the remedial action performed a certificate that confirms that the vehicle has been recalled and that required inspection and/or repairs have been performed. The certificate must be in a format prescribed by the Executive Officer, however, the Executive Officer may not require a format different in any way from the format of the certificate required in title 13, CCR sections 2117 and 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, Emissions Certification and Compliance Division, CA Air Resources Board, 4001 Iowa Avenue, Riverside, California 92507. For each recall campaign, the quarterly report must contain the following:

(i) The test group 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 vehicles involved in the remedial action campaign.

(iv) The number of vehicles known or estimated to be equipped with the nonconforming OBD II system and an explanation of the means by which this number was determined.

(v) The number of vehicles inspected during the campaign since its inception.

(vi) The number of vehicles found to be affected by the nonconformity during the campaign since its inception.

(vii) The number of vehicles receiving remedial action during the campaign since its inception.

(viii) The number of vehicles 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 vehicles, during the campaign since its inception, determined to be ineligible for remedial action under section (d)(2)(B).

(x) An initial list, using the following data elements and designated positions, indicating all vehicles subject to recall that the manufacturer has not been invoiced for, or a subsequent list indicating all vehicles 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 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 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 title 13, CCR sections 2119(a)(10) and 2133(a)(10).

Data Elements	*Positions*
• File Code (designated by DMV)	1
• License Plate Number	2-8
• Last three VIN positions	9-11
• Recall ID Number	12-17
• Mfg. ID Number	18-22
(Mfg. Occupational License Number)	
• Recall Start Date (mmddyyyy)	23-30
• Add or Delete Flag (A/D)	31
• Complete VIN if personalized license plate	32-48
(File Code "L" or "S")	

(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 II system and the remedial action and have not previously been reported to the Executive Officer.

(xii) A copy of all communications transmitted to vehicle owners that relate to the nonconforming OBD II 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 (d) 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 shall make available to the Executive Officer or his or her authorized representative upon request, the names and addresses of vehicle owners:

(i) To whom notification was sent;

(ii) Whose vehicles were repaired or inspected under the recall campaign;

(iii) Whose vehicles were determined not to be eligible for remedial action because the vehicles were modified, altered, or unavailable due to exportation, theft, scrapping, or other reason specified in the answer to sections (d)(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 vehicles and must be made available to authorized personnel of the 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 1968.5.1(d) upon finding that the manufacturer has demonstrated good cause for the requested extension.

(e) *Penalties for Failing to Comply with the Requirements of Section (d).*

(1) In addition to the penalties that may be assessed by the Executive Officer pursuant to section (c) because of a manufacturer's failure to comply with the requirements of title 13, CCR section 1968.2.1, a manufacturer may be subject to penalties pursuant to section 43016, Health and Safety Code for failing to comply with the requirements of section (d).

(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 (c) above.

NOTE: Authority cited: Sections 39010, 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.