

§ 2444.2. On-Board Engine Malfunction Detection System Requirements - Model Year 2007 and Later Spark-Ignition ~~Inboard and Sterndrive/Inboard~~ Marine Engines.

- (a) (1) Engines certified under Option 1 of Section 2442(b)(1):

All 2007 and 2008 model year spark-ignition ~~inboard and standard performance sterndrive/inboard~~ marine engines certified to the 5.0 grams per kilowatt-hour HC+NO_x standard shall comply with the requirements for subsections (b) through (i) below, except as noted. For all 2009 model year and later spark-ignition ~~inboard and standard performance sterndrive/inboard~~ marine engines, the requirements in *italics* shall also apply.

- (2) Engines certified under Option 2 of Section 2442(b)(1):

All 2008-2009 model year spark-ignition ~~inboard and standard performance sterndrive/inboard~~ marine engines shall comply with the requirements for subsections (b) through (i) below, except as noted. For all 2010 model year and later spark-ignition ~~standard performance inboard and sterndrive/inboard~~ marine engines, the requirements in *italics* shall also apply.

- (3) High Performance Engines

All 2009-2010 model year spark-ignition high performance ~~sterndrive/inboard~~ marine engines shall comply with the requirements for subsections (b) through (i) below, except as noted and applicable. For all 2011 model year and later spark-ignition ~~high performance sterndrive/inboard~~ marine engines, the requirements in *italics* shall also apply.

This section shall be implemented according to the provisions of the following subsections or by means determined by the Executive Officer to be equivalent in meeting the requirements of this section.

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- (b) General requirements.

- (1) Spark-ignition ~~sterndrive and inboard/inboard~~ marine engines sold as new shall be equipped with an integrated malfunction detection and notification system, hereinafter known as On-~~b~~Board Diagnostics-Marine (OBD-M) system, to identify emission-related malfunctions of the catalyst, fuel system, primary oxygen sensors used for feedback fuel control, secondary oxygen sensors (if

equipped) used for catalyst monitoring, computer-sensed comprehensive components, and the on-board computer itself, by means of diagnostic trouble codes stored in non-volatile computer memory. For this section, a computer-sensed comprehensive component is any electronic device that:

- (A) provides information to the on-board computer and significantly impacts emissions when malfunctioning; or
 - (B) is used to enable or disable any other OBD-M monitoring strategy.
- (2) ~~For model years 2010 and subsequent, the OBD-M system shall not be required to identify engine misfire per the provisions in subsection (c)(5) unless such monitoring is determined necessary by the Executive Officer to preserve or protect the catalyst system except as otherwise permitted in these regulations. The Executive Officer shall (as part of the in-water testing and development program to be conducted in conjunction with U.S. EPA, the U.S. Coast Guard, the marine industry, and catalyst manufacturers) identify whether, and to what extent, misfire in spark ignition inboard and sterndrive marine engines may affect catalyst durability and performance. If the Executive Officer determines that engine misfire is a significant factor in reducing the durability and/or performance of marine catalysts, engine manufacturers shall be required to incorporate appropriate misfire detection diagnostics into the OBD-M system. In that case, the provisions in subsection (c)(5) shall be considered sufficient for satisfying the obligation to monitor misfire. Alternate misfire monitoring strategies shall be considered by the Executive Officer and may be implemented in lieu of subsection (c)(5) if demonstrated by the engine manufacturer to provide an equivalent degree of catalyst protection. Otherwise the provisions of that subsection shall be voluntary. In making a determination, the Executive Officer shall consider the cost effectiveness of requiring additional monitoring to address the concerns identified by the test program in addition to the leadtime necessary to modify existing hardware and software, to add misfire detection hardware (e.g., sensors) if necessary, and to develop engine-specific calibrations to accommodate misfire monitoring. Notwithstanding, misfire monitoring shall not be required prior to the 2009 model year, and may be delayed beyond that date pending Executive Officer discretion.~~
- (3) The OBD-M system shall not be required to detect any emissions-related malfunction that prevents the engine from starting. The OBD-M system shall not be required to monitor any emissions-related component or system if the only reliable way to accomplish such monitoring would either significantly impair

engine/vessel operability or decrease the safety involved with operating the engine/vessel.

- (4) OBD-M systems shall have the capability to activate an audio or visual alert device located on the marine vessel to inform vessel occupants in the event of a malfunction, and to transmit diagnostic information locally via a standardized data link connector.
- (5) Spark-ignition sterndrive and /inboard marine vessels shall be equipped with an audio alert device and/or visual alert device that is compatible with the activation function of the OBD-M system on the installed engine.
 - (A) If equipped, the audio alert device shall provide sufficient volume and intensity to be readily perceptible to vessel occupants during normal modes of vessel operation and occupant activity, but shall not exceed applicable maximum noise levels as set by authorized federal or State agencies. Further, the audio alert device shall in no way impede the function of required sound-signaling devices, or other safety-related devices, already present on the vessel. The audio alert device shall sound briefly in the engine-run key position before engine cranking to indicate that the audio alert device is functional.
 - (B) If equipped, the visual alert device shall provide sufficient activation and be located such that it is readily visible under normal lighting conditions, but shall in no way impede the function of any visual distress-signaling device, fog signal, or navigational light. The visual alert device shall activate in the engine-run key position before engine cranking to indicate that the visual alert device is functional and shall, when activated, display the phrase "Service Required" or an equivalent standardized phrase or symbol to be determined as specified in Subsection (h).
- (6) Malfunction thresholds for catalyst, misfire, fuel system, oxygen sensor, and computer-sensed comprehensive component diagnostics shall be determined by the engine manufacturer. However, the engine manufacturer must demonstrate that the determination of these thresholds is sufficient for detecting emission-related malfunctions in a timely and meaningful manner subject to Executive Officer approval (see Subsection (f)(2)).
- (7) Regarding diagnostic system monitoring and audio/visual alert device activation requirements, engine manufacturers are required to define monitoring conditions that are representative of typical

in-use operation, and which will result in the routine execution and completion of all OBD-M diagnostics in-use.

- (8) For model years 2007-2008 on engines complying with paragraph (a)(1) of this section, ~~and for model years 2008-2009 on engines complying with paragraph (a)(2) of this section, and for model years 2009-2010 on engines complying with paragraph (a)(3) of this section,~~ activation of the audio/visual alert device upon detection of excessive engine misfire or a catalyst, fuel system, or oxygen sensor malfunction shall be optional. However, there are no exemptions from storing diagnostic trouble codes in non-volatile computer memory during these model years for any malfunction. The OBD-M must be capable of fully communicating stored information to a generic scan tool via the standardized data link connector.
- (9) Engine manufacturers may employ alternate statistical audio/visual alert device activation and diagnostic trouble code storage protocols to those specified in these requirements, subject to Executive Officer approval, based on comparable timeliness in detecting a malfunction and evaluating system performance.
- (10) Should emission control devices/strategies be introduced on the engine in addition to those identified herein as requiring monitoring (e.g., exhaust gas recirculation), the engine manufacturers shall notify the Executive Officer and submit a plan for monitoring the new device/strategy prior to its incorporation into the OBD-M system. This would not apply to carbon canisters, non permeable fuel tanks, or low-permeation hoses ~~should they be used to comply with the supplemental emission reduction requirements of evaporative requirements for high performance engines in § 2442(b)(2), the Option 2 requirements for standard performance engines in § 2442(b)(4), or the alternative requirements for large volume dual category manufacturers in § 2442(b)(5) in Section. 2442(b)(1).~~
- (11) Engine manufacturers may request Executive Officer approval to disable any diagnostic strategy at ambient engine starting temperatures below forty (40) degrees Fahrenheit (low ambient temperature conditions may be determined based on intake air or engine coolant temperature at engine starting), and at elevations above six thousand five hundred (6,500) feet above sea level provided the engine manufacturer submits data and/or an engineering evaluation which adequately demonstrate that monitoring would be unreliable when such conditions exist. Notwithstanding, diagnostic system disablement may be requested at other ambient engine starting temperatures if the engine manufacturer adequately demonstrates with data and/or an

engineering evaluation that misdiagnosis would occur due to the impact of such ambient temperatures on the performance of the component itself.

- (12) Engine manufacturers may disable individual monitors that can be affected by running out of fuel, provided disablement will not occur when the fuel level is above fifteen percent of the nominal capacity of the fuel tank.
- (13) The Executive Officer may grant an extension for compliance with the requirements of this section, with respect to an engine model or engine family, if the engine manufacturer demonstrates that a present electronic control system cannot be modified in time for the 2007, ~~or 2008~~, or 2009 model year, as applicable per subsection (a) of this section, because major design changes, not consistent with the engine manufacturer's projected changeover schedule, would be needed to comply with the provisions of the regulation. The period of extension shall not exceed that period of time necessary to enable modification of the electronic control system in accordance with the engine manufacturer's projected changeover schedule, or a period of two years, whichever first occurs. Engine manufacturers requesting an extension shall, no later than six months prior to the applicable model year, submit to the Executive Officer a written request for exemption, setting forth the required demonstration and specifying the period for which the extension is requested.
- (14) All engines certified to the 5.0 gram per kilowatt-hour NMHC+NO_x standard, including those engines certified using the corporate averaging provisions in 2442(b) and discontinuation allowance in 2442(g)(2), must be equipped with OBD-M for the engine's emission-related components. Notwithstanding, current production engines not yet required to possess an OBD-M system would not be required to incorporate OBD-M under the discontinuation allowance until the allowance had expired.

(c) Monitoring requirements.

(1) Catalyst monitoring.

(A) Purpose and scope:

(i)

1.

The diagnostic system shall monitor the catalyst system on spark-ignited marine engines to ensure that the performance of the catalyst has not been compromised due to engine misfire or other factors that can decrease catalyst durability.

(ii)

2.

Manufacturers of spark-ignited lean-burn marine engines may request that the Executive Officer exempt such applications from these catalyst monitoring requirements if it can be demonstrated that a reliable monitoring technology is not available. The Executive Officer shall approve such a request upon determining that all reasonable monitoring technologies have been considered to the extent possible.

(B) Malfunctioning criteria:

(i)

1.

The catalyst system shall be considered malfunctioning when the temperature of the measured catalyst(s) exceeds a threshold value, as determined by the engine manufacturer, indicating abnormally high operating temperature; or when the catalyst temperature fails to reach a minimum value, as determined by the engine manufacturer, indicating "light-off" of the catalyst after a manufacturer-specified time interval has elapsed.

(ii)

2.

Subject to executive officer approval, alternate malfunction criteria (e.g., correlating oxygen sensor frequencies to catalyst conversion efficiency) may be employed by the engine manufacturer if the alternate criteria are appropriate and would provide for enhanced monitoring capability.

(C) Monitoring conditions:

(i)

1.

The engine manufacturer shall define conditions for monitoring the catalyst with the constraints that the check shall:

- a. be conducted at the earliest acceptable opportunity encountered after the beginning of each operating cycle; and
- b. the monitoring system shall operate at least once per in-use operating cycle during which the engine manufacturer-defined monitoring conditions are met.

(D) Malfunctioning notification and diagnostic trouble code storage:

(i)

1. Upon detection of a catalyst malfunction, the audio/visual alert device shall be activated and a diagnostic trouble code stored no later than the end of the next operating cycle during which monitoring occurs provided the malfunction is again present.

(ii)

2. The diagnostic system shall temporarily disable catalyst monitoring when a malfunction exists that could affect the proper evaluation of catalyst efficiency.

(iii)

3. The monitoring method for the catalyst(s) shall be capable of detecting when a catalyst trouble code has been cleared (except diagnostic system self-clearing), but the catalyst has not been replaced (e.g., catalyst over-temperature approaches may not be acceptable).

(2) Fuel system monitoring.

(A) Purpose and scope:

The diagnostic system shall monitor the fuel delivery system for its ability to dynamically adjust fuel delivery.

(B) Malfunction criteria:

The engine manufacturer shall establish malfunction criteria to monitor the fuel delivery system. If the engine is equipped with fuel trim circuitry, the engine manufacturer shall include as one of the malfunction criteria the condition where the trim circuitry has used up all of the trim adjustment allowed within the engine manufacturer's selected limit(s). Engine manufacturers may compensate the criteria limit(s) appropriately for changes in altitude or for other similar identifiable operating conditions when they occur.

(C) Monitoring conditions:

The fuel system shall be monitored continuously for the presence of a malfunction.

(D) Malfunction notification and diagnostic trouble code storage:

(i)

1.

For fuel systems with short-term trim only capability, the diagnostic system shall store a diagnostic trouble code after the fuel system has attained the criteria limit for an engine manufacturer-defined time interval sufficient to determine a malfunction. If the malfunction criteria limit and time interval are exceeded, the audio/visual alert device shall be activated and a diagnostic trouble code stored no later than the end of the next operating cycle in which the criteria and interval are again exceeded; unless operating conditions similar to those under which the problem was originally detected (manufacturer-defined conditions) have been encountered without such an exceedance, in which case the initial temporary code and stored conditions may be erased. Furthermore, if similar operating conditions are not encountered during forty (40) operating cycles subsequent to the initial detection of a malfunction, the initial temporary code and stored conditions may be erased.

(ii)

2.

For fuel systems with long-term fuel trim capability, upon attaining a long-term based malfunction criteria limit independent of, or in combination with, the short-term trim system status, the audio/visual alert device shall be activated and a diagnostic trouble code stored no later than the end of the next operating cycle if the malfunction is again detected. If the malfunction is not detected during the second operating cycle, the audio/visual alert device shall be activated and a diagnostic trouble code stored no later than the next operating cycle in which the malfunction is again detected; unless operating conditions similar to those under which the problem was originally detected (manufacturer-defined conditions) have been encountered without an indication of a malfunction, in which case the initial temporary code and stored conditions may be erased. Furthermore, if similar operating conditions are not encountered during forty (40) operating cycles subsequent to the initial detection of a malfunction, the initial temporary code and stored conditions may be erased.

(3) Oxygen sensor monitoring.

(A) Purpose and scope:

~~(i)~~

1. The diagnostic system shall monitor the output voltage and response rate of all primary (fuel control) oxygen (lambda) sensors for malfunction. It shall also monitor secondary oxygen sensors when used as a monitoring device for proper output voltage and/or response rate. Response rate is the time required for the oxygen sensor to switch from lean-to-rich once it is exposed to a richer than stoichiometric exhaust gas mixture or from rich-to-lean when exposed to a leaner than stoichiometric exhaust gas mixture. As a precaution, measuring oxygen sensor switching frequency may not be an adequate indicator of oxygen sensor response rate, particularly at low speeds.

~~(ii)~~

2. Either the lean-to-rich or both the lean-to-rich and rich-to-lean response rates shall be checked. Response rate checks shall evaluate the portions of the sensor's dynamic signal that are most affected by sensor malfunctions such as aging or poisoning.

Engine manufacturers may observe the voltage envelope of the sensor when cycled at a frequency of 1.5 Hertz or greater, as determined by the engine manufacturer, to evaluate a slow response rate sensor (i.e., a slow sensor cannot achieve maximum and/or minimum voltage as will a good sensor, given a properly chosen switching frequency and fuel step change for the check). With Executive Officer approval, engine manufacturers may use alternative parameters to comply with this requirement such as voltage ranges and fuel-air switching frequencies based on a determination that the modifications will result in an accurate and timely evaluation of the sensor.

~~(iii)~~

3. For sensors with different characteristics, the engine manufacturer shall submit data and an engineering evaluation to the Executive Officer for approval based on showing equivalent evaluation of the sensor.

(B) Malfunction criteria:

An oxygen sensor shall be considered malfunctioning when the voltage, response rate, or other criteria, as determined by the engine manufacturer, are exceeded, or when sensor output characteristics are no longer sufficient (e.g., lack of sensor switching) for use as a diagnostic system monitoring device (e.g., for catalyst efficiency monitoring).

(C) Monitoring conditions:

(i)

1.

The engine manufacturer shall define conditions for monitoring the oxygen sensor(s) with the constraints that the check shall:

- a. be conducted at the earliest acceptable opportunity encountered after the beginning of each operating cycle; and
- b. operate at least once per in-use operating cycle during which the engine manufacturer-defined monitoring conditions are met.

(ii)

2.

For primary oxygen sensors(s) used for fuel control, the response rate and output voltage shall be monitored for malfunction after the engine has commenced closed-loop operation. If the oxygen sensor(s) is used as part of the monitoring strategy for the catalyst, the oxygen sensor(s) diagnostics should be scheduled to execute before the catalyst diagnostics begin.

(D) Malfunction notification and diagnostic trouble code storage: Upon detection of any oxygen sensor malfunction, the diagnostic system shall store a diagnostic trouble code and the audio/visual alert device shall activate no later than the end of the next operating cycle during which monitoring occurs provided the malfunction is again present.

(4) Computer-sensed comprehensive component monitoring.

(A) Purpose and scope:

The diagnostic system shall monitor for malfunction any computer-sensed electronic engine components not otherwise described in this subsection that provide input to

(directly or indirectly) the on-board computer, and that: 1) can affect emissions during any reasonable in-use operating condition, or 2) are used as part of the diagnostic strategy for any other monitored system or component.

(i)

1. The monitoring system shall have the capability of detecting, at a *minimum*, lack of circuit continuity and out of range values to ensure proper operation of the input device. The determination of out of range values shall include logic evaluation of available information to determine if a component is operating within its normal range (e.g., a low throttle position sensor voltage would not be reasonable at a high engine speed with a high mass airflow sensor reading). To the extent feasible, said logic evaluation shall be "two-sided" (i.e., verify a sensor output is not inappropriately high or low).

(ii)

2. Computer-sensed comprehensive components may include, but are not limited to, the engine speed sensor, crank angle sensor, knock sensor, throttle position sensor, coolant temperature sensor, cam position sensor, and other electronic components such as sensors and fuel injectors.

(iii)

3. The coolant temperature sensor shall be monitored for achieving a stabilized minimum temperature level that is needed to achieve closed-loop operation within an engine manufacturer-specified time interval after starting the engine. The time interval shall be a function of starting engine coolant temperature and/or a function of intake air temperature. Engine manufacturers may suspend or delay the diagnostic if the engine is subjected to conditions which could lead to false diagnosis (e.g., engine operation at idle for more than 50 to 75 percent of the warm-up time).

(B) Malfunction criteria:

Computer-sensed comprehensive components shall be considered malfunctioning when, at a *minimum*, lack of circuit continuity or engine manufacturer-specified out-of-range values occur.

(C) Monitoring conditions:

Computer-sensed components shall be monitored continuously for proper range of values and circuit continuity.

For rationality monitoring (where applicable), engine manufacturers shall define appropriate operating conditions that are representative of typical in-use operation and will result in the routine execution and completion of all diagnostics in-use. Rationality monitoring shall occur at least once per operating cycle during which the engine manufacturer-defined monitoring conditions are met.

(D) Malfunction notification and diagnostic trouble code storage:

Upon detecting a malfunction, the diagnostic system shall store a diagnostic trouble code and activate the audio/visual alert device no later than the end of the next operating cycle during which monitoring occurs provided the malfunction is again detected.

(5) Misfire monitoring.

~~The provisions in this subsection shall be considered voluntary unless otherwise determined by the Executive Officer according to subsection (b)(2) above.~~

(A) Purpose and scope:

The diagnostic system shall identify the occurrence of engine misfire that can result in damage to the catalyst system. Identification of the misfiring cylinder is not required, however all patterns of misfire must be identified regardless of whether it occurs in a single or multiple number of cylinders.

(B) Malfunctioning criteria:

The diagnostic system shall identify a malfunction when the total number of misfires evaluated in 200 crankshaft-revolution increments for each engine speed and load condition exceeds a percentage (determined by the engine manufacturer to cause damage to the catalyst system) of the total number of firing events in each increment. These threshold percentages shall be provided in the certification documentation. Subject to Executive Officer approval, an interval longer than 200 crankshaft-revolutions may be used. The engine manufacturer shall submit in the certification documentation catalyst temperature data versus percent misfire over the full range of engine speed and load conditions. Alternatively, catalyst temperature data may be submitted for every 500 rpm increment along the Propeller Law curve beginning

at engine idle and continuing throughout the "Not to Exceed Zone" for marine propulsion engines with Fixed- and Variable-pitch propellers, as defined in 40 CFR, section 94.106, (July 1, 2001), which is incorporated by reference herein. The data shall be obtained from a representative cross section (from small to large displacements) of an engine manufacturer's production. Up to three such engine evaluations shall be documented per engine manufacturer, though an engine manufacturer may submit more data, if desired. An engineering evaluation shall be provided for establishing malfunction criteria for the remainder of engine families in the engine 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.

(C) Monitoring conditions:

~~(i)~~

1. Monitoring for misfire shall be continuous from engine starting under all steady-state positive torque engine speeds and load conditions.

~~(ii)~~

2. As an exception to monitoring misfire during all positive torque operating conditions, engine manufacturers may disable misfire monitoring in 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:

- a. an engine speed of 3,000 rpm with the engine load at the positive torque line; and
- b. the redline engine speed (defined in section 2441) with the engine's manifold vacuum at four inches of mercury lower than that at the positive torque line.

Misfire detection systems unable to detect all misfire patterns under all required conditions shall be evaluated for compliance by the Executive Officer based on, but not limited to, the following factors:

- c. the magnitude of the region(s) in which misfire detection is limited,

- d. the degree to which misfire detection is limited in the region(s) (i.e., the probability of detection of misfire events),
- e. the frequency with which said region(s) are expected to be encountered in-use,
- f. the type of misfire patterns for which misfire detection is troublesome, and
- g. 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:

- h. equally spaced misfire occurring on randomly selected cylinders,
- i. single cylinder continuous misfire; and
- j. paired cylinder (cylinders firing at the same crank angle) continuous misfire.

Further, with Executive Officer approval, the engine manufacturer may disable misfire monitoring or employ higher malfunction criteria when misfire cannot be distinguished from other effects (e.g., turbulence causing the propeller to alternately emerge from then re-submerge into the water.) when using the best reasonably available monitoring technology. The engine manufacturer shall present data and/or an engineering evaluation to the Executive Officer to justify the proposed action. Executive Officer approval shall be based on the extent to which monitoring is expected to be disabled in relation to the capabilities of the best available monitoring technologies as applied to other engines. However, any such disablement occurring within the first 5 seconds after engine starting shall not require Executive Officer approval. Additionally, for engines with greater than eight cylinders, the Executive Officer shall waive the requirements of this section provided the engine manufacturer submits data and/or an engineering evaluation which adequately

demonstrates 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.

(D) Malfunction notification and diagnostic trouble code storage:

(i)

1.

Upon detection of the level of misfire specified in subsection (b)(5)(B) above, the following criteria shall apply for audio/visual alert device activation and diagnostic trouble code storage:

- a. A temporary diagnostic trouble code shall be stored no later than after the third exceedance of the specified misfire level when operating in the region bound by modes 2 through 5 of the spark-ignition marine engine test cycle and no later than after the first exceedance of the specified misfire level when operating at any other engine speed and load condition during a single operating cycle. If the level of misfire is exceeded again (a single exceedance) during the following operating cycle, or the next operating cycle in which similar conditions are encountered (manufacturer defined conditions), the audio/visual alert device shall activate, a diagnostic trouble code shall be stored, and the audio/visual alert device shall remain continuously activated, even if the misfire ceases. The initial temporary code and stored conditions may be erased if misfire is not detected during the following operating cycle and similar conditions have been encountered without an exceedance of the specified misfire level. The code and conditions may also be erased if similar operating conditions are not encountered during forty operating cycles subsequent to the initial detection of a malfunction.
- b. Notwithstanding, in engines that provide fuel shutoff and default fuel control to prevent over fueling during misfire conditions, the audio/visual alert device need not activate

provided that the fuel shutoff and default control shall be 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.

(d) Additional audio/visual alert device activation and diagnostic trouble code storage protocol.

(1) Audio/visual alert device activation: For all emission-related components/systems, upon final determination of a malfunction, the OBD-M system shall activate an audio or visual alert device.

(A) If so equipped, visual alert devices shall remain activated continuously whenever a malfunction has been identified by the OBD-M system, and may be deactivated only according to the provisions in paragraph (2) below, or with a scan tool after appropriate repairs have been effected.

(B) If so equipped, audio alert devices may remain activated continuously when a malfunction has been identified by the OBD-M system; however, the Executive Officer shall consider alternative strategies in which the audio alert is activated on a discontinuous, but repetitive, basis. To be acceptable, discontinuous audio alert strategies must convey a sense of urgency to vessel operators regarding the presence of OBD-M malfunctions.

Upon fulfillment of the standardization processes referred to in subsection (g) below, a protocol for audio alert device activation shall be specified authorizing only discontinuous activation. A standardized notification format is necessary to facilitate consumer association of the audio alert pattern with the identification of an OBD-M malfunction independent of manufacturer or platform. OBD-M system designers are encouraged to cooperate fully with each other and the ARB early on in this endeavor to minimize the redesigning of OBD-M audio alert activation algorithms once a standardized protocol has been finalized.

(C) The diagnostic system shall store a diagnostic trouble code whenever the audio/visual alert device is activated. The diagnostic system shall activate the audio/visual alert device and shall store a diagnostic trouble code whenever the engine enters a default or "limp home" mode of operation. The diagnostic system shall activate the audio/visual alert device and shall store a diagnostic trouble code whenever the engine control system fails to enter closed-loop operation

(if employed) within an engine manufacturer specified minimum time interval.

- (2) Audio/visual alert device deactivation:
 - (A) *Misfire and Fuel System Malfunctions*: For *misfire* or fuel system malfunctions, the audio/visual alert device may be deactivated if the fault does not recur when monitored during three subsequent sequential operating cycles in which conditions are similar to those under which the malfunction was first determined.
 - (B) *All Other Malfunctions*: For all other faults, the audio/visual alert device may be deactivated after three subsequent sequential operating cycles during which the monitoring system responsible for activating the audio/visual alert device functions without detecting the malfunction and if no other malfunction has been identified that would independently activate the audio/visual alert device according to the requirements outlined above.
- (3) Erasing a diagnostic trouble code: The diagnostic system may erase a diagnostic trouble code if the same fault is not re-registered in at least forty (40) engine warm-up cycles, and the audio/visual alert device is not activated for that diagnostic trouble code.
- (e) Tampering protection: Computer-coded engine operating parameters shall 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, engine manufacturers may exempt from this requirement those product lines that are unlikely to require protection. Criteria to be evaluated in making an exemption include, but are not limited to, current availability of performance chips, high performance capability of the engine, and sales volume.
- (f) Certification documentation: The engine manufacturer shall submit the following documentation for each engine family at the time of certification. With Executive Officer approval, one or more of the documentation requirements specified in this section may be waived or altered if the information required would be redundant or unnecessarily burdensome to generate:
 - (1) A written description of the functional operation of each monitoring strategy within the diagnostic system.

- (2) A table providing the following information for each monitored component or system (either computer-sensed or -controlled) of the emission control system:
 - (A) corresponding diagnostic trouble 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 activating the audio/visual alert device.
- (3) A logic flowchart describing the general method of detecting malfunctions for each monitored emission-related component or system. To the extent possible, abbreviations in SAE J1930 "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms," May 1998, shall be used. J1930 is incorporated by reference herein. The information required in the ~~chart~~ table under (2) above may instead be included in this flow chart, provided all of the information required in (2) is included.
- (4) 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.
- (5) Any other information determined by the Executive Officer to be necessary to demonstrate compliance with the requirements of this section.
- (g) Confirmatory testing: The ARB may perform confirmatory testing of engine manufacturers' diagnostic systems for compliance with requirements of this section in accordance with malfunction criteria submitted in the engine manufacturer's approved certification documentation. The ARB or its designee may install appropriately deteriorated or malfunctioning components in an otherwise properly functioning test engine (or simulate a deteriorated or malfunctioning component response) in order to test the fuel system, oxygen sensor, catalyst system, and misfire (if applicable) monitors for compliance with the applicable constraints in this section.

Diagnostic systems of a representative sample of engines that uniformly fail to meet the requirements of this section may be recalled for correction.

- (h) Standardization: ~~The spark ignition inboard and stern drive marine industry, in cooperation with ARB, will develop and adhere to standardized specifications for the implementation of OBD-M, including diagnostics trouble code formats, communication, and scan tool protocols.~~ To ensure universal compatibility regarding diagnostic trouble code formats, communication protocols, and scan tool connectivity, OBD-M systems must incorporate the standardized conventions defined in the Society of Automotive Engineers (SAE) implementation guidance document J1939-05, issued February 2008, as well as the other standardized conventions referenced elsewhere in this section. Manufacturers may petition the Executive Officer to use updated versions of the referenced standardized conventions or the temporary employment of alternative conventions under the provisions of § 2442(g)(3).
- (i) Implementation schedule.
 - (1) These OBD-M requirements, unless otherwise specified, shall be implemented beginning with the 2007 model year for engines complying with (a)(1) of this section, ~~and with the 2008 model year for engines complying with (a)(2) of this section, and with the 2009 model year for engines complying with (a)(3) of this section.~~
 - (2) All engine manufacturers shall meet these OBD-M requirements by the 2009 model year for engines complying with (a)(1) of this section, ~~and the 2010 model year for engines complying with (a)(2) of this section, and the 2011 model year for engines complying with (a)(3) of this section.~~
 - (3) The Executive Officer, upon receipt of an application from the engine manufacturer, may certify the engines in question even though said engines may not comply with one or more of the requirements of these subsections. Such certification is contingent upon the extent to which these requirements are satisfied overall on the engine applications in question and a demonstrated good-faith effort to meet these requirements in full by evaluating and considering the best available monitoring technology. Each incident of non-compliance will be recorded as a deficiency.
 - (A) Engine manufacturers of non-complying systems shall be subject to fines pursuant to section 43016 of the California Health and Safety Code for each deficiency identified subject to the following limitations:

- ~~(i)~~
1. The specified fines shall 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-M system; and
 - ~~(ii)~~
2. Engine manufacturers may not carry over monitoring system deficiencies for more than two model years unless it can be adequately demonstrated that substantial engine hardware modifications and additional lead time beyond two years would be necessary to correct the deficiency, in which case the deficiency may be carried over for three model years.
 - (B) For the third deficiency and every deficiency thereafter identified in an engine model, the fines shall be in the amount of \$25 per deficiency per engine for non-compliance with any of the monitoring requirements specified in this section. Total fines per engine under this section shall not exceed \$250 per engine and shall be payable to the State Treasurer for deposit in the Air Pollution Control Fund.

NOTE: Authority cited: Sections 39515, 39600, 39601, 43013, 43018, 43104, and 44036.2, Health and Safety Code; Sections 27156 and 38395 Vehicle Code.
Reference: Sections 39002, 39003, 39667, 43000, 43004, 43008.6, 43013, 43016, 43018, 43100, 43101, 43101.5, 43102, 43104, 43105, 43106, 43204, and 44036.2, Health and Safety Code; Sections 27156, 38391, and 38395, Vehicle Code.