ATTACHMENT A

PROPOSED 15-DAY MODIFIED REGULATION ORDER

This attachment shows the modifications to the originally proposed regulatory language. The originally proposed regulatory language is shown in underline to indicate additions and ~~strikeout~~ to indicate deletions. The suggested modifications to the proposed regulation are shown in double underline to indicate additions and ~~double strikeout~~ to indicate deletions. Text that is both ~~single underlined and double strikeout~~ is text that staff proposed to add during the 45-day public notice period but later retracted as part of this 15-day public notice period. Text that is both ~~double underlined and single strikeout~~ is text that staff proposed to delete during the 45-day notice period but later retracted as part of this 15-day notice period. Various portions of the regulations that are not modified by the proposed amendments are omitted from the text shown and indicated by " * * * * ".

Amend sections 1971.1 and 1971.5, title 13**,** California Code of Regulations, to read as follows:

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

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(c) *Definitions*.

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"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 as it existed on January 25, 2018).

"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 meets (1) or (2): (1) the need for the AECD is justified in terms of protecting the vehicle against damage or accident, or (2) for ~~2022~~ 2024 and subsequent model year engines, is related to adaptation or learning (e.g., selective catalytic reduction (SCR) system adaptation). 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.

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"Charge sustaining target SOC value" means the nominal target SOC that the control system is designed to maintain, on average, when operating as a conventional hybrid vehicle after depletion of any grid energy in the battery.

"Chassis odometer" refers to lifetime vehicle distance.

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"Engine family" means a grouping of vehicles or engines in a manufacturer's product line determined in accordance with 40 CFR ~~86.098-24~~86.096-24 as it existed on January 25, 2018.

"Engine odometer" refers to lifetime vehicle distance with the current engine installed.

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"~~Stop-start~~ Start-stop technology" refers to a technology that shuts down a vehicle's engine within a threshold inactivity period (e.g., 5 seconds) after the vehicle's brake pedal is depressed when the vehicle speed is zero.

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(d) *General Requirements.*

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(2.1) MIL and Fault Code Requirements.

(2.1) MIL Specifications.

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(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 ~~2022~~ 2024 and subsequent model year vehicles containing a non-analog MIL (e.g., liquid-crystal display (LCD)), any delay in MIL illumination prior to the functional check may not exceed 5 seconds. The MIL shall continuously illuminate during this functional check for a minimum of 15 seconds. During this functional check of the MIL, the data stream value for MIL status shall indicate commanded off (see section (h)(4.2)) unless the MIL has also been commanded on for a detected malfunction. This functional check of the MIL is not required during vehicle operation in the key on, engine off position subsequent to the initial engine cranking of an ignition cycle (e.g., due to an engine stall or other non-commanded engine shutoff).

* * * *

(2.2) MIL Illumination and Fault Code Storage Protocol.

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

* * * *

(D) Storage and erasure of freeze frame conditions.

* * * *

(iii) For 2016 and subsequent model year engines, except as provided for in section (d)(2.2.1)(D)(iv), the OBD system shall store freeze frame conditions in conjunction with the storage of a pending fault code.

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b. If the pending fault code matures to a confirmed fault code (as described in section (d)(2.2.1)(B)), the OBD system shall either

retain the currently stored freeze frame conditions or replace the stored freeze frame conditions with freeze frame conditions regarding the confirmed fault code. ~~Except as provided for in section (d)(2.2.1)(D)(vi),~~ ~~T~~the OBD system shall erase the freeze frame information in conjunction with the erasure of the confirmed fault code (as described under section (d)(2.3.1)(B)).

* * * *

(v) If freeze frame conditions are currently stored for a fault code, the freeze frame conditions may not be replaced with freeze frame conditions for another fault code except as allowed for confirmed fault codes in sections (d)(2.2.1)(D)(ii) and (iii) above, ~~for pending fault codes in section (d)(2.2.1)(D)(vi) below,~~ and for gasoline and diesel misfire and fuel system monitors under sections (e)(1.4.2)(D), (e)(2.4.2)(B), (f)(1.4.4), and (f)(2.4.3).

~~(vi) For 2022 and subsequent model year engines, in the event a malfunction is detected and a pending fault code is stored, if all available freeze frames are filled and freeze frame conditions are currently stored for a confirmed fault code that is currently not commanding the MIL on, the freeze frame conditions shall be replaced with freeze frame conditions for the pending fault code.~~

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

* * * *

(D) Storage and erasure of freeze frame conditions.

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(iv) If the pending fault code matures to a MIL-on fault code (as described under section (d)(2.2.2)(B)), the OBD system shall either retain the currently stored freeze frame conditions or replace the stored freeze frame conditions with freeze frame conditions regarding the MIL-on fault code. ~~Except as provided for in section (d)(2.2.2)(D)(vii),~~ ~~T~~the OBD system shall erase the freeze frame information in conjunction with the erasure of the previously MIL-on fault code (as described under section (d)(2.3.2)(C)).

* * * *

(vi) If freeze frame conditions are currently stored for a fault code, the freeze frame conditions may not be replaced with freeze frame conditions for another fault code except as allowed for MIL-on fault codes in section (d)(2.2.2)(D)(iv) above, ~~for pending fault codes in section (e)(2.2.2)(D)(vii) below,~~ and for gasoline and diesel misfire and fuel system monitors under sections (e)(1.4.2)(D), (e)(2.4.2)(B), (f)(1.4.4), and (f)(2.4.3).

~~(vii) For 2022 and subsequent model year engines, in the event a malfunction is detected and a pending fault code is stored, if all available freeze frames are filled and freeze frame conditions are~~

~~currently stored for a previously MIL-on fault code, the freeze frame conditions shall be replaced with freeze frame conditions for the pending fault code.~~

* * * *

(2.3) MIL Extinguishing and Fault Code Erasure Protocol.

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

(A) Extinguishing the MIL. Except as otherwise provided in sections (e)(1.4.2)(F), (e)(2.4.2)(D), (e)(3.4.2)(E), (e)(4.4.2)(E), (e)(6.4.2), (f)(1.4.6), (f)(2.4.5), and (f)(7.4.2) (for diesel fuel system, diesel misfire, diesel EGR system, diesel boost pressure control system, diesel empty reductant tank, gasoline fuel system, gasoline misfire, and gasoline evaporative system malfunctions), once the MIL has been illuminated~~,~~:

(i) For 2010 through ~~2021~~ 2023 model year engines, ~~it~~ the MIL shall be extinguished after at least 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.

(ii) For ~~2022~~ 2024 and subsequent model year engines, the MIL shall 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.

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

(A) Extinguishing the MIL. Except as otherwise provided in sections (e)(1.4.2)(F), (e)(2.4.2)(D), (e)(3.4.2)(E), (e)(4.4.2)(E), ~~and~~ (e)(6.4.2), (f)(1.4.6), (f)(2.4.5), and (f)(7.4.2) (for diesel fuel system ~~malfunctions~~, diesel misfire ~~malfunctions~~, diesel EGR system, diesel boost pressure control system, ~~and~~ diesel empty reductant tank~~s~~, gasoline fuel system, gasoline misfire, and gasoline evaporative system malfunctions), once the MIL has been illuminated~~,~~:

(i) For 2010 through ~~2021~~ 2023 model year engines, ~~it~~the MIL shall be extinguished after at least 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.

(ii) For ~~2022~~ 2024 and subsequent model year engines, except as provided for below, the MIL shall 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. For hybrid vehicles with hybrid control units that use SPN 6810 to indicate hybrid-related malfunctions, in lieu of the three subsequent sequential driving cycles provided above, the MIL may be extinguished after more than three subsequent sequential driving cycles but may not be extinguished after more than six subsequent sequential driving cycles.

* * * *

(3) Monitoring Conditions.

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

(3.1) For all engines:

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(3.1.3) Manufacturers may request Executive Officer approval to define monitoring conditions that are not encountered during the FTP cycle as required in section (d)(3.1.1). Except as provided in section (d)(3.1.3)(A) below, i~~I~~n evaluating the manufacturer's request, the Executive Officer shall consider the degree to which the requirement to run during the FTP cycle restricts in-use monitoring, the technical necessity for defining monitoring conditions that are not encountered during the FTP cycle, data and/or an engineering evaluation submitted by the manufacturer which demonstrate that the component/system does not normally function, or monitoring is otherwise not feasible, during the FTP cycle, and, where applicable in section (d)(3.2), the ability of the manufacturer to demonstrate the monitoring conditions will satisfy the minimum acceptable in-use monitor performance ratio requirement as defined in section (d)(3.2) (e.g., data which show in-use driving meets the minimum requirements). ~~Additionally, for 2022 and subsequent model year engines, the manufacturer may request to define monitoring conditions designed to ensure monitoring will occur during the SET cycle only for monitors for which the in-use monitor performance is tracked and reported as required under section (d)(3.2.1).~~

(A) For a monitor on 2024 and subsequent model year engines for which the in-use monitor performance is not required to be tracked and reported under section (d)(3.2.1), if a manufacturer requests Executive Officer approval to define monitoring conditions that are designed to ensure

monitoring will occur during the SET cycle, the Executive Officer shall approve the request only if the following conditions are met:

(i) The manufacturer has submitted information and/or engineering evaluation that demonstrate that the monitoring conditions are appropriate for the monitor based on the considerations specified under section (d)(3.1.3) above;

(ii) The manufacturer has implemented enhanced tracking and reporting of the in-use monitor performance of the monitor (i.e., software algorithms to track the numerator and denominator in accordance with the specifications in sections (d)(4), (d)(5), and (h)(5.1) and report the data through an engineering or manufacturer-specific tool); and

(iii) The manufacturer has submitted a plan for the collection of in-use monitor performance data mentioned in section (d)(3.1.3)(A)(ii) above from in-use vehicles. The plan shall provide for effective collection of data that are representative of California drivers and temperatures, shall not, by design, exclude or include specific vehicles in an attempt to collect data only from vehicles with the highest in-use monitor performance ratios, and shall include an estimated deadline of when the manufacturer will submit the data to the Executive Officer that does not exceed 12 months after the production vehicles were first introduced into commerce. The data may be collected from the same vehicles described in section (l)(3).

(3.1.4) For intrusive diagnostics, the manufacturers shall submit a monitoring strategy plan to the Executive Officer for review and approval. The Executive Officer shall approve the plan if the manufacturer has submitted data and/or engineering evaluation demonstrating any of the following:

(A) Running the intrusive diagnostic will not affect the effectiveness of the emission control system during any reasonable in-use driving conditions.

(B) If running the intrusive diagnostic reduces the effectiveness of the emission control system during any reasonable in-use driving conditions, the intrusive diagnostic meets any of the following:

(i) The diagnostic runs only once after the MIL is illuminated for the fault by a non-intrusive diagnostic~~,~~, or

(ii) The manufacturer is applying the best available monitoring technology that, to the extent feasible, results in the least possible emissions impact during any reasonable in-use driving conditions (e.g., exhaust gas sensor rationality monitor that runs during a fuel cut event). For purposes of this section, “to the extent feasible” is defined in section (g)(5.9).

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

* * * *

(3.2.2) For all 2013 and subsequent model year engines, manufacturers shall

define monitoring conditions that, in addition to meeting the criteria in sections (d)(3.1) (if applicable) and (d)(3.2.1), ensure that the monitor yields an in-use performance ratio (as defined in section (d)(4)) that meets or exceeds the minimum acceptable in-use monitor performance ratio for in-use vehicles. For purposes of this regulation, the following minimum acceptable in-use monitor performance ratio ~~is~~ shall apply for monitors specifically required in sections (e) through (g) to meet the monitoring condition requirements of section (d)(3.2):

(A) For 2013 through ~~2021~~ 2023 model year engines, 0.100 for all monitors ~~specifically required in sections (e) through (g) to meet the monitoring condition requirements of section (d)(3.2)~~.

(B) Except as provided below in section (d)(3.2.2)(C), for ~~2022~~ 2024 and subsequent model year engines, 0.300 for all monitors.

(C) For interim years:

(i) For ~~2022~~ 2024 through ~~2029~~ 2031 model year engines, 0.100 for crankcase ventilation (CV) system monitors specified in section (g)(2.2.3).

(ii) For ~~2022~~ 2024 through ~~2023~~ 2025 model year alternate-fueled engines, 0.100 for all monitors.

(iii) For hybrid systems on plug-in hybrid electric vehicles first certified in the 2022 through ~~2025~~ 2027 model years, 0.100 for the first three model years of hybrid system production for all monitors that are for systems or components that require engine operation. For example, the 0.100 ratio shall apply to the ~~2020, 2021, and 2022~~ 2022, 2023, and 2024 model years for hybrid systems first certified in the ~~2020~~ 2022 model year and to the ~~2025, 2026, and 2027~~ 2027, 2028, and 2029 model years for hybrid systems first certified in the ~~2025~~ 2027 model year. If the hybrid system is first certified in the ~~2026~~ 2028 or subsequent model year, the applicable ratios for all monitors are specified under section (d)(3.2.2)(B) above.

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(4) In-Use Monitor Performance Ratio Definition.

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(4.3) Denominator Specifications

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(4.3.2) Specifications for incrementing:

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(B) Except as provided for in sections (d)(4.3.2)(~~F~~C)~~,~~ through ~~(I), and~~ (~~J~~L~~L~~M), the denominator for each monitor shall be incremented within 10 seconds if and only if the following criteria are satisfied on a single driving cycle:

* * * *

(C) Except as provided for in sections (d)(4.3.2)(K), ~~I~~in addition to the requirements of section (d)(4.3.2)(B) ~~above~~or (J) (whichever is applicable), for the evaporative system monitor (sections (f)(7.2.2)(A) and (B)), the comprehensive component input component temperature sensor

rationality ~~monitors~~ fault diagnostics (section (g)(3)) (e.g., intake air temperature sensor, ambient temperature sensor, fuel temperature sensor, hybrid component temperature sensor), and the engine cooling system input component~~s~~ rationality fault diagnostics (section (g)(1)), the denominator(s) shall be incremented if and only if:

* * * *

(F) For the following component monitors, 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~~ or (J) (whichever is applicable) 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) "Other emission control systems" (section (g)(4))

(ii) Comprehensive component input components that require extended monitoring evaluation (section (g)(3)) (e.g., stuck fuel level sensor rationality)

(iii) 2010 through ~~2021~~ 2023 model year diesel PM filter frequent regeneration (section (e)(8.2.2))

(iv) PM sensor monitoring capability monitor (section (e)(9.2.2)(D))

(G) For the following monitors of components or other emission controls that experience infrequent regeneration events, the denominator(s) shall be incremented during a driving cycle in which the following two criteria are met: (1) the requirements of section (d)(4.3.2)(B) or (J) (whichever is applicable) are met on the current driving cycle, and (2) the number of minutes of cumulative engine run time since the denominator was last incremented is greater than or equal to 800 minutes. The 800-minute engine run time counter shall be reset to zero and begin counting again after the denominator has been incremented and no later than the start of the next ignition cycle:

(i) Diesel NMHC converting catalyst (section (e)(5.2.2)) on 2010 through ~~2021~~ 2023 model year engines

(ii) Diesel NMHC converting catalyst other aftertreatment assistance functions (sections (e)(5.2.3)(B) and (D))

(iii) Diesel ~~C~~catalyzed PM filter NMHC conversion (section (e)(8.2.4)(A))

(iv) ~~2010 through 2015 model year~~ Diesel PM filter filtering performance and missing substrate (sections (e)(8.2.1) and (8.2.5)) on 2010 through 2015 model year engines

(v) Diesel catalyzed PM filter feedgas generation (section (e)(8.2.4)(B)) on ~~2022~~ 2024 and subsequent model year engines

(vi) Diesel PM filter frequent regeneration (section (e)(8.2.2)) on ~~2022~~ 2024 and subsequent model year engines

As an alternative, for 2010 through 2012 model year engines, the manufacturer may request Executive Officer approval to use alternate or

additional criteria to that set forth in section (d)(4.3.2)(G) above for incrementing the denominator. Executive Officer approval of the proposed criteria shall be based on the effectiveness of the proposed criteria in measuring the frequency of monitor operation relative to the amount of vehicle operation.

For the diesel NMHC converting catalyst monitor (section (e)(5.2.2)), as an alternative for 2010 through ~~2021~~ 2023 model year engines, the manufacturer may use the criteria in section (d)(4.3.2)(H) in lieu of the criteria specified in section (d)(4.3.2)(G) above.

(H) For 2013 and subsequent model year engines, in addition to the requirements of section (d)(4.3.2)(B) ~~above~~or (J) (whichever is applicable), the denominator(s) for the following monitors shall be incremented if and only if a regeneration event (e.g., parked/manual regeneration, desulfurization, decrystallization, desoot) is commanded for a time greater than or equal to 10 seconds:

(i) Diesel NMHC converting catalyst other aftertreatment assistance functions (sections (e)(5.2.3)(A) and (C))

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

(iii) Diesel NMHC converting catalyst (section (e)(5.2.2)) on ~~2022~~ 2024 and subsequent model year engines

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(K) For ~~2022~~ 2024 and subsequent model year hybrid systems in plug-in hybrid electric vehicles, the denominators for the evaporative system monitors (sections (f)(7.2.2)(A) and (B)), the comprehensive component input component temperature sensor rationality fault diagnostics (section (g)(3))(e.g., intake air temperature sensor, hybrid component temperature sensor), and the engine cooling system input component rationality monitors (sections (g)(1.2.2)(C) and (D)) shall be incremented if and only if:

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(L) For the evaporative system high-load purge flow monitor (section (f)(7.2.2)(C)) and the crankcase ventilation monitor for lines through which crankcase vapor flows under conditions where the intake manifold pressure is greater than ambient pressure on vehicles with forced induction engines (section (g)(2.2.3)), the denominator(s) shall be incremented if and only if:

(i) The requirements of section (d)(4.3.2)(B) or (J) (whichever is applicable) 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 (or 4.4 degrees Celsius) (hybrid vehicles shall use cumulative propulsion system active time in lieu of cumulative time since engine start); and

(iii) High-load purging conditions occur 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.

(iv) For purposes of section (d)(4.3.2)(L)(iii) above, “high-load purging conditions” means an event during which the engine manifold pressure is greater than or equal to 7 kPa above atmospheric pressure.

As an alternative for 2010 through 2023 model year engines, the manufacturer may use the criteria in section (d)(4.3.2)(C) for the evaporative system high-load purge flow monitor in lieu of the criteria specified above in section (d)(4.3.2)(L).

(~~L~~M) For a monitor designed to detect malfunctions specified under more than one section (e.g., one NMHC converting catalyst monitor to detect malfunctions under sections (e)(5.2.2) and (e)(5.2.3)(A)), if each section is subject to different denominator incrementing criteria, the manufacturer shall request Executive Officer approval of the criteria used for incrementing the monitor denominator. Executive Officer approval of the criteria shall be based manufacturer data and/or engineering evaluation demonstrating that the proposed denominator incrementing criteria results in the lowest in-use monitor performance ratio for the monitor.

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(4.5) Disablement of Numerators and Denominators

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(4.5.4) For ~~2022~~ 2024 and subsequent model year engines, within ten seconds of a malfunction being detected for ~~of~~ any component used to determine if any of the criteria in sections (d)(4.3.2)(C) through (I), ~~and~~ (K), and (L) are satisfied (e.g., engine cold start), the OBD system shall disable further incrementing of the corresponding numerator and denominator for each monitor that is affected. 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 the corresponding numerators and denominators shall resume within 10 seconds.

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(5) Standardized tracking and reporting of monitor performance.

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(5.5) Ignition cycle counter

(5.5.1) Definition:

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(C) For ~~2022~~ 2024 and subsequent model year hybrid systems in plug-in hybrid electric vehicles, the OBD system shall report two ignition cycle counters (as defined in sections (d)(5.5.2)(B) and (C)).

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(5.5.2) Specifications for incrementing:

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(C) In addition to the counter described in section (d)(5.5.2)(B) above, ~~2022~~ 2024 and subsequent model year hybrid systems in 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.

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(5.6) General Denominator

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(5.6.2) Specifications for incrementing:

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(B) The general denominator shall be incremented within 10 seconds if and only if the criteria identified below are satisfied on a single driving cycle:

(i) For non-hybrid vehicles, the criteria identified in section (d)(4.3.2)(B) ~~are satisfied on a single driving cycle~~.

(ii) For hybrid vehicles (except as provided in section 1971.1(d)(5.6.2)(B)(iii) below), the criteria identified in section (d)(4.3.2)(J)(i) through (iv).

(iii) For plug-in hybrid electric vehicles, the criteria identified in sections (d)(4.3.2)(J)(i) through (iii). For 2010 through ~~2021~~ 2023 model year hybrid systems in plug-in hybrid electric vehicles, manufacturers may increment the general denominator using the criteria identified in sections (d)(4.3.2)(J)(i) through (iv).

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(6) Malfunction Criteria Determination and Adjustment Factors.

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(6.3) For ~~2022~~ 2024 and subsequent model year engines equipped with emission controls that experience infrequent regeneration events, a manufacturer shall adjust the emission test results using the procedure described in CFR title 40, part 1065.680 (current as of August 21, 2018 and incorporated by reference in section (d)(6.2)) when determining if a component meets specific test-out criteria to be exempt from monitoring. For calculating the adjustment factors, the manufacturer shall submit a frequency factor derivation plan to the Executive Officer for approval. The Executive Officer shall approve the plan upon determining the frequency factor derivation appropriately incorporates the impact of the malfunction on the regeneration event frequency. The manufacturer shall conduct testing to determine the adjustment factors using the same deteriorated component(s) used to determine if the test-out criteria in the following sections are met:

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(7) Implementation Schedule

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

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

(7.3.2) For the tracking requirements described in sections (h)(5.3) through (5.7) for diesel engines, a manufacturer shall meet one of the following two options:

(A) Option 1: The manufacturer shall meet (i) and may meet (ii) below:

(i) For all 2022 and subsequent model year diesel engines, the manufacturer shall meet all requirements of sections (h)(5.3) through (5.7).

(ii) For demonstration testing of 2022 and 2023 model year diesel engines under section (i), the manufacturer may test 15 Executive Officer-selected component/system monitors in lieu of testing all the monitors listed under sections (i)(3.1) and (3.3). The Executive Officer shall inform the manufacturer of the monitors to be tested during engine selection of the demonstration test engine under section (i)(2.1).

(B) Option 2: The manufacturer shall meet both (i) and (ii) below:

(i) For 2022 and 2023 model year diesel engines, the manufacturer shall meet all the requirements of sections (h)(5.3) through (h)(5.7) with the exception of sections (h)(5.3.2)(A), (h)(5.3.2)(B), (h)(5.7.2)(A), and (h)(5.7.2)(B) (i.e,. the active 100 hour array and stored 100 hour array requirements); and

(ii) For 2024 and subsequent model year diesel engines, the manufacturer shall meet all the requirements of sections (h)(5.3) through (h)(5.7).

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(8) Determination of Requirements for Applicable Engines

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(8.3) For ~~2022~~ 2024 and subsequent model year hybrid systems in plug-in hybrid electric vehicles, malfunction criteria for each monitor in sections (e) through (g) that are required to indicate a malfunction before emissions exceed an emission threshold based on the applicable standard shall be determined in the driving mode that results in the worst case emissions (i.e., charge depleting or charge sustaining operation) for each monitor.

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(e) *Monitoring Requirements for Diesel/Compression-Ignition Engines.*

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(2) Misfire Monitoring

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(2.4) MIL Illumination and Fault Code Storage:

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(2.4.2) Additionally, for misfires identified in section (e)(2.2.2):

* * * *

(B) Storage of freeze frame conditions.

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(ii) If freeze frame conditions are stored for a malfunction other than a misfire or fuel system malfunction (see section (e)(1)) when a misfire fault code is stored as specified in section (e)(2.4.2), the stored freeze frame information shall be replaced with freeze frame information regarding the misfire malfunction. Alternatively, for the 2010 through ~~2021~~ 2023 model years, if freeze frame conditions are stored and reported for a fuel system malfunction (section (e)(1)) when a misfire

fault code is stored as specified in section (e)(2.4.2) above, the stored freeze frame information may be replaced with freeze frame information regarding the misfire malfunction.

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(3) Exhaust Gas Recirculation (EGR) System Monitoring

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(3.3) Monitoring Conditions:

(3.3.1) Except as provided in section (e)(3.3.4), the OBD system shall monitor continuously for malfunctions identified in sections (e)(3.2.1), (e)(3.2.2), and (e)(3.2.4) (i.e., EGR low and high flow, feedback control). Additionally, for all ~~2022~~ 2024 and subsequent model year engines, manufacturers shall define monitoring conditions for malfunctions identified in sections (e)(3.2.1), (e)(3.2.2), and (e)(3.2.4) that are continuous and in accordance with section (d)(3.2) (i.e., the minimum ratio requirements), and manufacturers shall track and report the in-use performance of the EGR system monitors under sections (e)(3.2.1), (e)(3.2.2), and (e)(3.2.4) in accordance with section (d)(3.2.1). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in sections (e)(3.2.1), (e)(3.2.2), and (e)(3.2.4) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

* * * *

(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 malfunctions identified in sections (e)(3.2.1) and (e)(3.2.2) (i.e., EGR low and high flow) on all ~~2022~~ 2024 and subsequent model year engines:

* * * *

(4) Boost Pressure Control System Monitoring

* * * *

(4.3) Monitoring Conditions:

(4.3.1) Except as provided in section (e)(4.3.4), the OBD system shall monitor continuously for malfunctions identified in sections (e)(4.2.1), (4.2.2), and (4.2.5) (i.e., over and under boost, feedback control). Additionally, for all ~~2022~~ 2024 and subsequent model year engines, manufacturers shall define monitoring conditions for malfunctions identified in sections (e)(4.2.1), (e)(4.2.2), and (e)(4.2.5) that are continuous and in accordance with section (d)(3.2) (i.e., the minimum ratio requirements), and manufacturers shall track and report the in-use performance of the boost pressure control system monitors under sections (e)(4.2.1), (e)(4.2.2), and (e)(4.2.5) in accordance with section (d)(3.2.1). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in sections (e)(4.2.1), (e)(4.2.2), and (e)(4.2.5) shall

be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

* * * *

(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 sections (e)(4.2.1) and (e)(4.2.2) (i.e., over and under boost on all ~~2022~~ 2024 and subsequent model year engines:

* * * *

(8) Particulate Matter (PM) Filter Monitoring

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(8.2) Malfunction Criteria:

(8.2.1) Filtering Performance:

* * * *

(D) Except as provided in section (e)(8.2.1)(~~E~~F), for ~~all~~ 2016 ~~and subsequent~~through ~~2021~~ 2023 model year engines, the OBD system shall detect a malfunction prior to a decrease in the filtering capability of the PM filter that would cause an engine's PM emissions to exceed either of the following thresholds, whichever is higher: 0.03 g/bhp-hr as measured from an applicable emission test cycle (i.e., FTP or SET); or the applicable standard plus 0.02 g/bhp-hr (e.g., 0.03 g/bhp-hr if the exhaust emission standard is 0.01 g/bhp-hr). If no failure or deterioration of the PM filtering performance could result in an engine's PM emissions exceeding these levels, the OBD system shall detect a malfunction when no detectable amount of PM filtering occurs.

(E) For all ~~2022~~ 2024 and subsequent model year engines, the OBD system shall detect a malfunction prior to a decrease in the filtering capability of the PM filter that would cause an engine's emissions to exceed the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., 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 either of the following thresholds for PM emissions, whichever is higher: 0.03 g/bhp-hr as measured from an applicable emission test cycle (i.e., FTP or SET); or the applicable standard plus 0.02 g/bhp-hr (e.g., 0.03 g/bhp-hr if the exhaust emission standard is 0.01 g/bhp-hr). If no failure or deterioration of the PM filtering performance could result in an engine's emissions exceeding these levels, the OBD system shall detect a malfunction when no detectable amount of PM filtering occurs.

* * * *

(8.2.4) Catalyzed PM Filter:

(A) NMHC conversion: For 2015 and subsequent model year engines with catalyzed PM filters that convert NMHC emissions:

(i) The OBD 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 following:

a. For 2015 through ~~2021~~ 2023 model year engines, 2.0 times the applicable NMHC standards.

b. For ~~2022~~ 2024 and subsequent model year engines, 2.0 times the applicable NMHC emissions or the applicable NOx standard by more than 0.2 g/bhp-hr (e.g., 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.

* * * *

(8.3) Monitoring Conditions:

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(8.3.2) Manufacturers shall define the monitoring conditions for malfunctions identified in sections (e)(8.2.2) through (8.2.6) 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). Additionally, for all ~~2022~~ 2024 and subsequent model year engines, manufacturers shall track and report the in-use performance of the PM filter monitors under sections (e)(8.2.2), (e)(8.2.5), and (e)(8.2.6) in accordance with section (d)(3.2.1). For purposes of tracking and reporting as required in section (d)(3.2.1), all monitors used to detect malfunctions identified in sections (e)(8.2.2), (e)(8.2.5), and (e)(8.2.6) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2).

* * * *

(9) Exhaust Gas Sensor Monitoring

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(9.2) Malfunction Criteria:

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(9.2.2) NOx and PM sensors:

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(E) NOx sensor activity faults: For 2022 and subsequent model year engines, the OBD system shall detect a malfunction of the NOx sensor (e.g., internal sensor temperature not properly achieved/maintained, stabilization criteria not properly achieved/maintained) when the NOx sensor is not actively reporting NOx concentration data (i.e., the NOx sensor is not "active") under conditions when it is technically feasible for a properly-working NOx sensor to be actively reporting NOx concentration data. The malfunctions include, at a minimum, faults that delay the time it takes for the NOx sensor to become "active" after start (e.g., time after start to satisfy NOx sensor stabilization criteria takes longer than normal) and faults that cause the NOx sensor to not be "active" for longer periods of time than normal (e.g., ratio of sensor "inactive" time to "active" time is

higher than normal). If the NOx sensor activity fault is caused by a malfunction of a component other than the NOx sensor (e.g., a component that is used as an input necessary to make the NOx sensor become "active"), the OBD system shall monitor the component and detect a malfunction that prevents the NOx sensor from being "active".

* * * *

(10) Variable Valve Timing, Lift, and/or Control (VVT) System Monitoring

(10.1) Requirement: The OBD system shall monitor the VVT system on engines so-equipped for target error and slow response malfunctions. ~~Manufacturers must perform a comprehensive failure modes and effects analysis for every reasonable hydraulic or mechanical failure (e.g., partial or complete blockage of hydraulic passages, broken return springs, a failure of a single cylinder-specific pin to move into the desired position on a lift mechanism) to identify target error and slow response malfunctions.~~ Manufacturers must submit data and/or an analysis identifying all possible failure modes of the VVT system (e.g., partial or complete blockage of hydraulic passages, broken return springs, a failure of a single cylinder-specific pin to move into the desired position on a lift mechanism) and the effect each has (e.g., failure modes and effects analysis) across the entire range of operating conditions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the VVT system shall be monitored in accordance with the comprehensive components requirements in section (g)(3).

* * * *

(f) *Monitoring Requirements for Gasoline/Spark-Ignited Engines*.

* * * *

(1) Fuel System Monitoring

(1.1) Requirement: The OBD system shall monitor the fuel delivery system to determine its ability to provide compliance with applicable standards.

(1.2) Malfunction Criteria:

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(1.2.4) Except as provided in section (f)(1.2.4)(D) below, ~~T~~the OBD system shall detect a malfunction whenever the fuel control system fails to enter closed-loop operation within an Executive Officer-approved time interval after engine start. Executive Officer approval of the time interval shall be granted upon determining that the data and/or engineering evaluation submitted by the manufacturer supports the specified times.

(A) For 2010 through ~~2021~~ 2023 model year engines, "closed-loop operation" as specified in section (f)(1.2.4) above shall mean either stoichiometric or non-stoichiometric closed-loop operation, whichever one the manufacturer chooses.

(B) For ~~2022~~ 2024 and subsequent model year engines, "closed-loop operation" as specified in section (f)(1.2.4) above shall mean stoichiometric closed-loop operation.

* * * *

(1.3) Monitoring Conditions:

(1.3.1) Except as provided in section (f)(1.3.5), the OBD system shall monitor continuously for malfunctions identified in sections (f)(1.2.1)(A), (f)(1.2.1)(B), and (f)(1.2.2) (i.e., fuel delivery system, secondary feedback control, adaptive feedback control).

(1.3.2) Manufacturers shall define monitoring conditions for malfunctions identified in section (f)(1.2.1)(C) (i.e., air-fuel ratio cylinder imbalance malfunctions) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements). Additionally, for ~~2022~~ 2024 and subsequent model year engines, manufacturers shall track and report the in-use performance of the fuel system monitors under section (f)(1.2.1)(C) in accordance with section (d)(3.2.1). For purposes of tracking and reporting as required in section (d)(3.2.1), all dedicated monitors used to detect malfunctions identified in section (f)(1.2.1)(C) shall be tracked separately but reported as a single set of values as specified in section (d)(5.2.2). Manufacturers that use other existing monitors (e.g., misfire monitor under section (f)(2), fuel system monitor under section (f)(1.2.1)(A)) to detect malfunctions identified in section (f)(1.2.1)(C) are subject to the tracking and reporting requirements of the other monitors.

* * * *

(1.4) MIL Illumination and Fault Code Storage: For malfunctions described under section (f)(1.2.1)(C) (i.e., air-fuel ratio cylinder imbalance malfunctions), general requirements for MIL illumination and fault code storage are set forth in section (d)(2). The stored fault code shall pinpoint the likely cause of the malfunction to the fullest extent that is inherently possible based on the monitoring strategy used. Further, the stored fault code is not required to specifically identify the air-fuel ratio cylinder imbalance malfunction (e.g., a fault code for misfire monitoring can be stored) if the manufacturer demonstrates that additional monitoring hardware would be necessary to make this identification and that the other monitor(s) robustly detects the malfunction. For all other fuel system malfunctions, the MIL illumination and fault code storage requirements are set forth in sections (f)(1.4.1) through (1.4.6) below.

* * * *

(1.4.4) Storage of freeze frame conditions.

(A) For 2010 through ~~2021~~ 2023 model year engines using the ISO 15765-4 protocol for the standardized functions in section (h), ~~T~~the OBD 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. For ~~2022~~ 2024 and subsequent model year engines using the ISO 15765-4 protocol for the standardized functions in section (h), the OBD system shall store and erase freeze frame conditions in accordance with section (d)(2.2.1)(D)(iii). For engines using the SAE J1939 protocol for the standardized functions in section (h), the OBD system shall store and erase freeze frame conditions in accordance with section (d)(2.2.2)(D).

* * * *

(2) Misfire Monitoring

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(2.4) MIL Illumination and Fault Code Storage:

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(2.4.3) Storage of freeze frame conditions.

(A) For 2010 through ~~2021~~ 2023 model year engines using the ISO 15765-4 protocol for the standardized functions in section (h), ~~T~~the OBD 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. For ~~2022~~ 2024 and subsequent model year engines using the ISO 15765-4 protocol for the standardized functions in section (h), the OBD system shall store and erase freeze frame conditions in accordance with section (d)(2.2.1)(D)(iii). For engines using the SAE J1939 protocol for the standardized functions in section (h), the OBD system shall store and erase freeze frame conditions in accordance with section (d)(2.2.2)(D).

* * * *

(7) Evaporative System Monitoring

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(7.2) Malfunction Criteria:

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(7.2.2) The OBD system shall detect an evaporative system malfunction when any of the following conditions exist:

(A) Except as specified in section (f)(7.2.2)(C), ~~N~~no purge flow from the evaporative system to the engine (i.e., to the enclosed area of the air intake system) can be detected by the OBD system; ~~or~~

(B) The complete evaporative system contains a leak or leaks that cumulatively are greater than or equal to a leak caused by a 0.150 inch diameter orifice~~.~~; or

(C) For high-load purge lines (i.e., lines for purging the evaporative system canister under conditions where the intake manifold pressure is greater than ambient pressure) on vehicles with forced induction engines, no purge flow from the evaporative system to the engine (i.e., to the enclosed area of the air intake system) can be detected by the OBD system.

* * * *

(7.2.~~5~~6) For engines that utilize more than one purge flow path (e.g., a turbo-charged engine with a low-load ~~pressure~~ purge line and a high-load ~~pressure~~ purge line), except as provided for in sections (f)(7.2.6)(B) and (C) below, the OBD system shall verify the criteria of (f)(7.2.2)(A) and (f)(7.2.2)(C) (i.e., purge flow to the engine) for all purge flow paths (i.e., detect disconnections, broken lines, blockages, or any other malfunctions that prevent purge flow delivery to the engine).

(A) A manufacturer may request Executive Officer approval to detect the malfunctions using monitoring strategies that do not directly confirm evaporative purge delivery to the engine but infer it through other sensed parameters or conditions. The Executive Officer shall approve the monitoring strategy upon determining that data and/or engineering analysis submitted by the manufacturer demonstrate equivalent effectiveness in detecting malfunctions.

(B) 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.

(C) For 2010 through 2023 model year engines subject to the requirements of section (f)(7.2.2)(C), a manufacturer may request Executive Officer approval of a monitoring strategy that cannot detect all disconnections, broken lines, blockages, or any other malfunctions that can impact purge flow delivery to the engine as required in section (f)(7.2.2)(C). The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and/or engineering evaluation demonstrating the following: the degree to which purge flow monitoring is limited is small relative to the fully monitored purge lines (e.g., blocked high-load purge lines can be detected but disconnections or broken lines cannot be detected, or high-load purge lines are fully monitored for purge flow delivery except for a one-inch portion after the venturi where a disconnection or broken fitting cannot be detected), the monitoring of the high-load purge lines cannot be fully achieved when employing proven monitoring technology (i.e., a technology that provides for compliance with these requirements on other engines), and the high-load purge system design is inherently resistant to deterioration (e.g., breakage, disconnections, blockage) of the unmonitored portions of the purge lines.

(7.3) Monitoring Conditions:

(7.3.1) Manufacturers shall define the monitoring conditions for malfunctions identified in section (f)(7.2.2)(A) and (C) (i.e., purge flow) in accordance with sections (d)(3.1) and (d)(3.2) (i.e., minimum ratio requirements).

* * * *

(9) Variable Valve Timing, Lift, and/or Control (VVT) System Monitoring

(9.1) Requirement: The OBD system shall monitor the VVT system on engines so-equipped for target error and slow response malfunctions. ~~Manufacturers must perform a comprehensive failure modes and effects analysis for every reasonable hydraulic or mechanical failure (e.g., partial or complete blockage of hydraulic passages, broken return springs, a failure of a single cylinder-specific pin to move into the desired position on a lift mechanism) to identify target error and slow response malfunctions.~~ Manufacturers must submit data and/or an analysis identifying all possible failure modes of the VVT system (e.g., partial or complete blockage of hydraulic passages, broken

return springs, a failure of a single cylinder-specific pin to move into the desired position on a lift mechanism) and the effect each has (e.g., failure modes and effects analysis) across the entire range of operating conditions. The individual electronic components (e.g., actuators, valves, sensors) that are used in the VVT system shall be monitored in accordance with the comprehensive components requirements in section (g)(3).

* * * *

(g) *Monitoring Requirements For All Engines.*

(1) Engine Cooling System Monitoring

(1.1) Requirement:

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(1.1.3) For engines that use an engine and/or engine component temperature sensor or system (e.g., oil temperature, cylinder head temperature) ~~other than~~ in lieu of or in addition to the cooling system and ECT sensor ~~(e.g., oil temperature, cylinder head temperature)~~ for an indication of engine operating temperature for emission control purposes (e.g., to modify spark or fuel injection timing or quantity), the following requirements shall apply:

* * * *

(B) For ~~2022~~ 2024 and subsequent model year engines that use an engine and/or engine component temperature sensor or system in addition to the cooling system and ECT sensor (including systems that use more than one thermostat or flow control device to regulate different temperatures in different cooling circuits and use input from at least two temperature sensors in separate cooling circuits for an indication of engine operating temperatures for emission control purposes), the manufacturer shall submit a monitoring plan to the Executive Officer for approval. The Executive Officer shall approve the request upon determining that the manufacturer has submitted data and an engineering evaluation that demonstrate that the monitoring plan is as reliable and effective as the monitoring required for the engine cooling system under section (g)(1).

* * * *

(1.2) Malfunction Criteria:

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(1.2.2) ECT Sensor

* * * *

(B) Time to Reach Closed-Loop/Feedback/Feed-Forward Enable Temperature.

(i) The OBD system shall detect a malfunction if the ECT sensor does not achieve the highest stabilized minimum temperature which is needed for closed-loop,/ feedback ~~control~~or feed-forward operation of all emission control systems/strategies (e.g., fuel system, EGR system) within an Executive Officer-approved time interval after engine start. For engines that can have either stoichiometric or non-stoichiometric closed-loop operation of the fuel system, “closed-loop” operation shall be defined as follows:

a. For 2010 through ~~2021~~ 2023 model year engines, “closed-loop” operation shall mean either stoichiometric or non-stoichiometric closed-loop operation, whichever one the manufacturer chooses.
b. For ~~2022~~ 2024 and subsequent model year engines, “closed-loop” operation shall mean stoichiometric closed-loop operation across the engine loads observed on the FTP cycle.

* * * *

(3) Comprehensive Component Monitoring

(3.1) Requirement:

(3.1.1) Except as provided in sections (g)(3.1.3), (g)(3.1.4), (g)(3.1.5), (g)(3.1.6), and (g)(4), the OBD system shall monitor for malfunction any electronic powertrain component/system not otherwise described in sections (e)(1) through (g)(2) that either provides input to (directly or indirectly) or receives commands from ~~the~~ an on-board computer~~(s)~~ or smart device, and any of the following: (1) can affect NMHC, NOx, CO, or PM 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, (3) is used as an input to (directly or indirectly) an inducement strategy on ~~2022~~ 2024 and subsequent model year engines, or (4) is used as an input to (directly or indirectly) or output from an AECD strategy. Each input to or output from a smart device that meets criterion (1) or (2) above shall be monitored pursuant to section (g)(3). Further detection or pinpointing of faults internal to the smart device is not required. If the control system detects deterioration or malfunction of the component/system and takes direct action to compensate or adjust for it, manufacturers may not use the criteria under section (g)(3) and are instead subject to the default action requirements of section (d)(2.2.1)(E) or (d)(2.2.2)(E), as applicable.

* * * *

(3.1.5) For hybrid vehicles:

(A) Except as provided in section (d)(7.6) and section (g)(3.1.5)(B), ~~for hybrid vehicles,~~ manufacturers shall submit a plan to the Executive Officer for approval of the hybrid components determined by the manufacturer to be subject to monitoring in section (g)(3.1.1). In general, the Executive Officer shall approve the plan if it includes monitoring of all components/systems used as part of the diagnostic strategy for any other monitored system or component, monitoring of all energy input devices to the electrical propulsion system, monitoring of battery and charging system performance, monitoring of electric motor performance, and monitoring of regenerative braking performance.

(B) For ~~2022~~ 2024 and subsequent model year engines, manufacturers are subject to the applicable requirements specified in section (g)(3.2.3).

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(3.4) MIL Illumination and Fault Code Storage:

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(3.4.2) Exceptions to general requirements for MIL illumination. For 2010 through

~~2021~~ 2023 model year engines, MIL illumination is not required in conjunction with storing a confirmed or MIL-on fault code for any comprehensive component if both conditions (A) and (B) below are met:

* * * *

(5) Exceptions to Monitoring Requirements

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(5.7) The manufacturer may request to exempt a specific component from all monitoring requirements in the following cases:

(5.7.1) The manufacturer may request to exempt a specific component from all monitoring requirements if all malfunctions of the component affect emissions or the diagnostic strategy for any other monitored component or system only when the ambient temperature is below 20 degrees Fahrenheit (or -6.7 degrees Celsius). The Executive Officer shall approve the request upon the manufacturer submittal of data or engineering evaluation supporting that ~~The OBD system is not required to monitor an electronic powertrain component/system if~~ the following criteria are met when the ambient temperature is above 20 degrees Fahrenheit (or -6.7 degrees Celsius): (1) a malfunction of the component does not affect emissions during any reasonable driving condition, (2) a malfunction of the component does not affect the diagnostic strategy for any other monitored component or system, and (3) the ambient temperature is determined based on a temperature sensor monitored by the OBD system (e.g., IAT sensor). ~~The manufacturer shall determine whether a component/system meets these criteria.~~ If the Executive Officer reasonably believes that a manufacturer has incorrectly determined that a component/system meets these criteria, the Executive Officer shall require the manufacturer to provide emission and/or other diagnostic data showing that the component/system, when malfunctioning and installed in a suitable test vehicle, does not have an effect on emissions or other diagnostic strategies. The Executive Officer may request emission data for any reasonable driving condition at ambient temperatures above 20 degrees Fahrenheit (or -6.7 degrees Celsius).

(5.7.2) The manufacturer may request to exempt a specific component from all monitoring requirements if all malfunctions of the component affect emissions or the diagnostic strategy for any other monitored component or system only when the vehicle speed is above 82 miles-per-hour. The Executive Officer shall approve the request upon the manufacturer submittal of data or engineering evaluation supporting that the following criteria are met when the vehicle speed is below 82 miles-per-hour: (1) a malfunction of the component does not affect emissions during any reasonable driving condition, (2) a malfunction of the component does not affect the diagnostic strategy for any other monitored component or system, and (3) the vehicle speed is determined based on a sensor monitored by the OBD system (e.g., vehicle speed sensor). If the Executive Officer reasonably believes that a manufacturer has incorrectly

determined that a component/system meets these criteria, the Executive Officer shall require the manufacturer to provide emission and/or other diagnostic data showing that the component/system, when malfunctioning and installed in a suitable test vehicle, does not have an effect on emissions or other diagnostic strategies.

* * * *

(h) *Standardization Requirements.*

(1) Reference Documents:
The following ~~Society of Automotive Engineers (~~SAE~~)~~ and International Organization of Standards (ISO) documents are incorporated by reference into this regulation:

* * * *

(1.4) SAE J1979 "E/E Diagnostic Test Modes", February ~~2012~~ 2017 (SAE J1979).

(1.4.1) SAE J1979-DA “Digital Annex of E/E Diagnostic Test Modes”, ~~October 2011February 2017~~ May 2019.

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(1.6) ISO 15765-4 "Road Vehicles-Diagnostic~~s~~ ~~C~~communication over Controller Area Network (DoCAN) - Part 4: Requirements for emission-related systems", ~~February 2011~~ April 2016 (ISO 15765-4).

(1.7) SAE J1939 consisting of:

(1.7.1) J1939 ~~Recommended Practice for a~~ Serial Control and Communications Heavy Duty Vehicle Network – Top Level Document, ~~April 2011~~August 2013;

(A) J1939-DA “Digital Annex of Serial Control and Communication Heavy Duty Vehicle Network Data,” ~~February 2018~~ April 2019;

* * * *

(1.11) SAE J3162 “Heavy Duty OBD IUMPR Data Collection Tool Process,” ~~June~~ September 2018 (SAE J3162)

* * * *

(2) Diagnostic Connector:
A standard data link connector conforming to SAE J1962 or SAE J1939-13 specifications (except as specified in section (h)(2.3)) shall be incorporated in each vehicle.

* * * *

(2.3) The location of the connector shall be capable of being easily identified and accessed (e.g., to connect an off-board tool). Except for as allowed in section (h)(2.2.1)(A) and (B), ~~F~~for vehicles equipped with a driver’s side door, the connector shall be capable of being easily identified and accessed by a technician standing (or “crouched”) on the ground outside the driver’s side of the vehicle with the driver’s side door open. For vehicles not equipped with a driver’s side door, the connector shall be capable of being easily identified and accessed by a ~~crouched~~ technician inside the vehicle and observing the foot-well region from an eyesight level located at the bottom of the steering wheel.

* * * *

(4) Required Emission Related Functions:
The following standardized functions shall be implemented in accordance with the specifications in SAE J1979 or SAE J1939 to allow for access to the required information by a scan tool meeting SAE J1978 specifications or designed to communicate with an SAE J1939 network:

(4.1) Readiness Status: In accordance with SAE J1979/J1939-73 specifications, the OBD system shall indicate “complete” or “not complete” since the fault memory was last cleared for each of the installed monitored components and systems identified in sections (e)(1) through (f)(9), and (g)(3) except (e)(11) and (f)(4).

* * * *

(4.1.3) For 2016 and subsequent model year engines, for components and systems not listed in section (h)(4.1.1) above, the readiness status for each component/system readiness bit listed below shall immediately indicate “complete” if any of the following conditions occur: (1) all the respective supported monitors listed below for each component/system have fully executed and determined that the component or system is not malfunctioning, or (2) at least one of the monitors listed below for each component/system has determined that the component or system is malfunctioning after the requisite number of decisions necessary for determining the MIL status have been fully executed, regardless of whether or not the other monitors listed have been fully executed:

* * * *

(H) Diesel PM Filter:

(i) For 2016 through ~~2021~~ 2023 model year engines, sections (e)(8.2.1), (e)(8.2.2), (e)(8.2.5), and (e)(8.2.6)

(ii) For ~~2022~~ 2024 and subsequent model year engines, sections (e)(8.2.1) and (e)(8.2.5)

(I) Diesel Exhaust Gas Sensor:

(i) For 2016 and subsequent model year engines on vehicles using the SAE J1939 protocol for the standardized functions required in section (h), and for 2016 through ~~2021~~ 2023 model year engines on vehicles using the ISO 15765-4 protocol for the standardized functions required in section (h), sections (e)(9.2.1)(A)(i), (e)(9.2.1)(A)(iv), (e)(9.2.1)(B)(i), (e)(9.2.1)(B)(iv), (e)(9.2.2)(A), (e)(9.2.2)(D), and (e)(9.2.3)(A)

(ii) For ~~2022~~ 2024 and subsequent model year engines on vehicles using the ISO 15765-4 protocol for the standardized functions required in section (h), sections (e)(9.2.1)(A)(i), (e)(9.2.1)(A)(iv), (e)(9.2.1)(B)(i), (e)(9.2.1)(B)(iv), (e)(9.2.2)(A), (e)(9.2.2)(D), (e)(9.2.3)(A), and (e)(9.2.4)(A)

* * * *

(4.2) Data Stream: The following signals shall be made available on demand through the standardized data link connector in accordance with SAE J1979/J1939 specifications. The actual signal value shall always be used instead of a default or limp home value.

(4.2.1) For all gasoline engines:

* * * *

(D) For ~~2022~~ 2024 and subsequent model year engines, modeled exhaust flow (mass/time), engine reference torque, actual indicated engine - percent torque, nominal engine friction - percent torque, and engine family.

(4.2.2) For all diesel engines:

(A) Calculated load (engine torque as a percentage of maximum torque available at the current engine speed), driver's demand engine torque (as a percentage of maximum engine torque), actual indicated engine torque (as a percentage of maximum engine torque), nominal engine friction – percent torque (as a percentage of maximum engine torque), reference engine maximum torque, reference maximum engine torque as a function of engine speed (suspect parameter numbers (SPN) 539 through 543 defined by SAE J1939 within parameter group number (PGN) 65251 for engine configuration), engine coolant temperature, engine oil temperature (if used for emission control or any OBD diagnostics), engine speed, time elapsed since engine start;

* * * *

(H) For 2022 and subsequent model year engines, engine rated power~~,~~ ~~engine rated speed,~~ and vehicle speed~~, and engine family~~.

(I) For 2024 and subsequent model year engines, engine rated speed and engine family.

(~~H~~I) For purposes of the calculated load and torque parameters in section (h)(4.2.2)(A) and the torque, fuel rate, and modeled exhaust flow parameters in section (h)(4.2.2)(G), manufacturers shall report the most accurate values that are calculated within the applicable electronic control unit (e.g., the engine control module). "Most accurate values", in this context, shall be of sufficient accuracy, resolution, and filtering to be used for the purposes of in-use emission testing with the engine still in a vehicle (e.g., using portable emission measurement equipment).

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(4.2.3) For all engines so equipped:

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(F) For 2022 and subsequent model year engines, NOx mass emission rate - engine out and NOx mass emission rate – tailpipe.

(~~F~~G) For ~~2022~~ 2024 and subsequent model year engines, commanded DEF dosing, DEF dosing mode (A, B, C, etc.), DEF dosing rate, DEF usage for current driving cycle, target ammonia storage level on SCR, modeled actual ammonia storage level on SCR, SCR intake temperature, SCR outlet temperature, ~~NOx mass emission rate - engine out, NOx mass emission rate – tailpipe,~~ stability of NOx sensor reading, EGR mass flow rate, engine fuel rate, vehicle fuel rate, hydrocarbon doser flow rate, hydrocarbon doser injector duty cycle, aftertreatment fuel pressure, charge air cooler outlet temperature, ~~engine operating state,~~ propulsion

system active, ~~odometer reading~~ chassis odometer reading, engine odometer reading (if available), hybrid/EV charging state, hybrid/EV battery system voltage, hybrid/EV battery system current, commanded/target fresh air flow, crankcase pressure sensor output, crankcase oil separator rotational speed, evaporative system purge pressure sensor output, and vehicle speed limiter speed limit.

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(4.10) Erasure of Emission-Related Diagnostic Information:

(4.10.1) For purposes of section (h)(4.10), "emission-related diagnostic information" includes ~~at least~~ all the following:

* * * *

(5) Tracking Requirements:

* * * *

(5.2) Engine Run Time Tracking Requirements:

(5.2.1) For all ~~gasoline and diesel~~ engines, manufacturers shall implement software algorithms to individually track and report in a standardized format the engine run time while being operated in the following conditions:

* * * *

(D) For 2013 and subsequent model year diesel engines ~~only~~and ~~2022~~ 2024 and subsequent model year gasoline and alternate-fueled engines:

(i) total run time with EI-AECD #1 active;

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

(iii) total run time with EI-AECD #n active.

(E) For ~~2022~~ 2024 and subsequent model year diesel engines:

(i) total run time with no delivery of reductant used to control NOx emissions (e.g., diesel exhaust fluid) due to insufficient exhaust temperature, and

(ii) total run time with exhaust temperature below 200 degrees Celsius as measured just upstream of the NOx converting catalyst. If an engine has more than one NOx converting catalyst, tracking shall be based on the temperature upstream of the catalyst that is closest to the engine.

* * * *

(5.3) NOx Emission Tracking Requirements:

* * * *

(5.3.2) The parameters in section (h)(5.3.1) shall be stored in the four data arrays described below. Data in each array shall be based on signals that are sampled at a frequency of at least 1 Hertz. ~~Data shall continue to be tracked and reported if a malfunction is detected unless the malfunction prevents one of the parameters listed in section (h)(5.3.1) from being determined.~~

(A) Active 100 Hour Array.

(i) When the NOx sensors used to determine the NOx mass parameters listed in section (h)(5.3.1) are ~~both~~ all reporting valid NOx

concentration data, data for all parameters in section (h)(5.3.1) shall be stored in the Active 100 Hour Array.

(ii) When the total engine run time value (or, for hybrid vehicles, propulsion system active run time) that is stored in Bin 1 (defined in section (h)(5.3.3)(A) below) of the Active 100 Hour Array reaches 100 hours, all stored data shall be transferred to the Stored 100 Hour Array described in section (h)(5.3.2)(B). All data in the Active 100 Hour Array shall be reset to zero and begin incrementing anew.

(B) Stored 100 Hour Array.

(i) The Stored 100 Hour Array is a static repository for data stored by the Active 100 Hour Array. Stored 100 Hour Array data are overwritten with the data stored in the Active 100 Hour Array only when the total engine run time (or, for hybrid vehicles, propulsion system active run time) stored in Bin 1 (defined in section (h)(5.3.3)(A) below) of the Active 100 Hour Array reaches 100 hours.

* * * *

(C) Lifetime Array.

(i) When the NOx sensors used to determine the NOx mass parameters listed in section (h)(5.3.1) are ~~both~~ all reporting valid NOx concentration data, data for all parameters in section (h)(5.3.1) shall be stored in the Lifetime Array.

* * * *

(5.3.3) Each parameter in each array in section (h)(5.3.2) shall be stored in a series of bins that are defined as indicated below. References to "rated power" mean the engine's rated net brake power.

* * * *

(H) "Bin 17" stores the total value of the parameter in a given array only when the pause conditions of section (h)(5.3.6)(A) are met.

(~~H~~I) Storage of data in Bins 1 through 14 occurs independently of data storage in Bins 15 and 16, and is not interrupted or otherwise affected by activity related to Bins 15 and 16.

* * * *

(5.3.4) The engine-out and tailpipe NOx mass parameters that are calculated by the OBD system to fulfill the requirements in section (h)(5.3) and data stream requirements in section (h)(4.2) must not have an error of more than +/- 20 percent, or alternatively at the manufacturer's discretion, 0.10 g/bhp-hr when divided by the net brake work of the engine. This requirement applies only to the NOx mass parameters in sections (h)(5.3) and (h)(4.2). Manufacturers shall report the most accurate values that are calculated within the applicable electronic control unit (e.g., the engine control module). The NOx mass values shall furthermore be calculated using the most accurate NOx concentration and exhaust flow rate values that are calculated within the applicable electronic control unit. Manufacturers shall not include a humidity correction factor when calculating NOx mass. The Executive Officer shall determine compliance

with this requirement by comparing data from the OBD system and the test facility that are submitted by the manufacturer as described in section (j)(2.26). Specifically, the Executive Officer shall compare the total tailpipe NOx mass calculated by the OBD system for the test cycle with the total NOx mass measured by the test facility and give consideration to the consistency of the behavior of the two sets of instantaneous NOx mass values over the test cycle. Notwithstanding the compliance determination based on the data submitted as described in section (j)(2.26), manufacturers may not include any calibration/software feature which adversely impacts the accuracy of the calculated NOx mass values relative to the accuracy demonstrated at the time of certification when the engine operates in conditions outside of the certification testing environment.

(5.3.5) Numerical Value Specifications: For each parameter specified in section (h)(5.3.1):

(A) For parameters in arrays described in section (h)(5.3.2)(A), each number shall be reset to zero when any of the following occur:

(i) A scan tool command to clear fault codes is received;

(ii) An NVRAM reset occurs (e.g., reprogramming event); or

(iii) If the numbers are stored in KAM, when KAM is lost due to an interruption in electrical power to the control module (e.g., battery disconnect).

(~~A~~B) For parameters in arrays described in sections (h)(5.3.2)(B), (C), and (D), e~~E~~ach 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) The OBD system shall store each number within 600 seconds after the end of a driving cycle.

(5.3.6) Pause conditions for tracking:

(A) Except for malfunctions described in section (h)(5.3.6)(B) below, the OBD system shall continue tracking all parameters listed in section (h)(5.3.1) if a malfunction has been detected and the MIL is commanded on. Within 10 seconds of the MIL being commanded on, tracked data shall only be stored in Bin 17 as described in section (h)(5.3.3)(H) and storage of data in all other bins (Bins 1-16) shall be paused. When the malfunction is no longer detected and the MIL is no longer commanded on, tracking of all parameters in section (h)(5.3.1) shall resume in Bins 1-16 and shall pause in Bin 17 within 10 seconds.

(B) The OBD system shall pause tracking of all parameters listed in section (h)(5.3.1) within 10 seconds if any of the conditions in sections (h)(5.3.6)(B)(i) through (iii) below occur. When the condition no longer occurs (e.g., the engine stop lamp is not commanded on), tracking of all parameters in section (h)(5.3.1) shall resume within 10 seconds:

(i) A malfunction of any component used to determine vehicle speed has

been detected and the MIL is commanded on for that malfunction;

(ii) A NOx sensor malfunction has been detected and the MIL is commanded on for that malfunction;

(iii) The engine stop lamp (if equipped) is commanded on.

(C) The manufacturer may request Executive Officer approval to pause tracking of all parameters listed in section (h)(5.3.1) if a malfunction occurs that is not covered under sections (h)(5.3.6)(B)(i) through (iii) above (e.g., a light is commanded on for vehicles with no engine stop lamps such that the driver is likely to stop the vehicle, the odometer is lost, a malfunction of any component used as a primary input to the exhaust gas flow model occurs). The Executive Officer shall approve the request upon determining based on manufacturer submitted data and/or engineering evaluation that the malfunction will significantly affect the accuracy of the parameter values specified under section (h)(5.3.1).

(5.3.~~6~~7) The data specified in section (h)(5.3) reflect vehicle operation in various real world conditions including different driving, environmental, and engine load conditions that may not correspond to regulated test procedures. Engine NOx emission levels will vary based on such conditions and as a result, these data may not correspond to the test conditions and/or test procedures associated with California's applicable standards for NOx emissions. Compliance with the applicable standards for NOx emissions for heavy-duty diesel engines and vehicles is determined in accordance with the applicable standards and corresponding test procedures ~~applicable to the test cycle~~.

(5.4) For all 2022 and subsequent model year engines, manufacturers shall implement software algorithms to individually track and report in a standardized format the following:

(5.4.1) Vehicle fuel consumption;

(5.4.2) Engine fuel consumption;

(5.4.3) Engine idle fuel consumption;

(5.4.4) Engine PTO fuel consumption;

(5.4.5) Distance traveled;

(5.4.6) If so equipped, ~~D~~distance traveled while engine WHR technology is active;

(5.4.7) EOE;

~~(5.4.8) WHR output energy;~~

(5.4.~~9~~8) Positive kinetic energy (PKE);

(5.4.~~10~~9) Engine run time;

(5.4.~~11~~10) 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 (1.6 kilometers per hour) or engine speed less than or equal to 200 rpm above normal warmed-up idle);

(5.4.~~12~~11) Urban speed run time (with "urban speed" defined as vehicle speed greater than one mile per hour (1.6 kilometers per hour) and less than or equal to 37 ~~forty~~ miles per hour (60 kilometers per hour));
(5.4.~~13~~12) PTO run time;
(5.4.~~14~~13) If so equipped, WHR technology run time;
(5.4.~~15~~14) For non-hybrid vehicles so equipped, ~~stop/start~~ start-stop technology run time;
(5.4.~~16~~15) If so equipped, ~~A~~automatic engine shutdown technology activation count;
(5.4.~~17~~16) If so equipped, ~~A~~active technology #1 run time;
(5.4.~~18~~17) If so equipped, ~~A~~active technology #2 run time; and so on up to
(5.4.~~19~~18) If so equipped, ~~A~~active technology #n run time;
(5.4.~~20~~19) If so equipped, ~~D~~distance traveled while active technology #1 is active;
(5.4.~~21~~20) If so equipped, ~~D~~distance traveled while active technology #2 is active; and so on up to
(5.4.~~22~~21) If so equipped, ~~D~~distance traveled while active technology #n is active.

* * * *

(5.7) For each parameter specified in sections (h)(5.4), (h)(5.5), and (h)(5.6):

* * * *

(5.7.2) Except as provided below, each parameter shall be stored in three categories:

(A) The active 100 hour category represents the most current up to 100 hours of operation. All values stored in this category shall reset to zero and begin incrementing anew when the engine run time (or, for hybrid vehicles, propulsion system active run time) in this category reaches 100 hours.

(B) The stored 100 hour category represents values transferred from the active 100 hour category when the engine run time (or, for hybrid vehicles, propulsion system active run time) in the active category reaches 100 hours. The parameter specified under section (h)(5.4.~~10~~9) is not required to meet section (h)(5.7.2)(B) (or, for hybrid vehicles, the parameter specified in section (h)(5.5.1) is not required to meet section (h)(5.7.2)(B), but the parameter specified in section (h)(5.4.9) is required to meet section (h)(5.7.2)(B)).

(C) The lifetime category represents aggregate values accumulated since the first initial engine operation after production. Parameters specified under sections (h)(5.4.1), (5.4.5), and (5.4.7) are not required to meet section (h)(5.7.2)(C) if the OBD system meets the requirements of section (h)(5.3). Parameters specified under sections (h)(5.4.~~10~~9), (5.4.~~11~~10), and (5.4.~~13~~12) are not required to meet section (h)(5.7.2)(C).

(5.7.3) For parameters in categories described in section (h)(5.7.2)(A):

(A) Each number shall be reset to zero when any of the following occur:

(i) A scan tool command to clear fault codes is received;

(ii) An NVRAM reset occurs (e.g., reprogramming event) ;or

(iii) If the numbers are stored in KAM, when KAM is lost due to an interruption in electrical power to the control module (e.g., battery disconnect).

(B) The OBD system shall store each number within 600 seconds after the end of a driving cycle.

(5.7.~~3~~4) For parameters in categories described section (h)(5.7.2)(B) and (C):

(A) 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.

(B) The OBD system shall store each number within 600 seconds after the end of a driving cycle.

(5.7.5) The OBD system shall pause tracking of all parameters listed in sections (h)(5.4), (5.5), and (5.6) within 10 seconds if any of the conditions in sections (h)(5.7.5)(A) through (C) below occur. When the condition no longer occurs (e.g., the engine stop lamp is not commanded on), tracking of all parameters in sections (h)(5.4), (5.5), and (5.6) shall resume within 10 seconds:

(A) A malfunction of any component used to determine vehicle speed has been detected and the MIL is commanded on for that malfunction;

(B) A NOx sensor malfunction has been detected and the MIL is commanded on for that malfunction; or

(C) The engine stop lamp (if equipped) is commanded on.

(5.7.6) The manufacturer may request Executive Officer approval to pause tracking of all parameters listed in sections (h)(5.4), (5.5), and (5.6) if a malfunction occurs that is not covered under sections (h)(5.7.5)(A) through (C) above (e.g., a light is commanded on for vehicles with no engine stop lamps such that the driver is likely to stop the vehicle, the odometer is lost, a malfunction of any component used as a primary input to the exhaust gas flow model occurs). The Executive Officer shall approve the request upon determining based on manufacturer submitted data and/or engineering evaluation that the malfunction will significantly affect the accuracy of the parameter values specified under section (h)(5.3.1).

(5.8) For all ~~2022~~ 2024 and subsequent model year diesel engines, manufacturers shall implement software algorithms to track and report in a standardized format the following parameters:

(5.8.1) ~~Distance since~~ Engine odometer reading (or chassis odometer reading if engine odometer is not available) at the beginning and end of the last 3 PM filter regeneration events; and

(5.8.2) Lifetime counter of PM filter regeneration events.

(5.8.3) Each number in section (h)(5.8) 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.

(6) Data Reporting Requirements for Over-the-Air Reprogramming:

(6.1) For all ~~2022~~ 2024 and subsequent model year engines, if any of the data required to be stored and made available pursuant to section (h)(5) would be erased by an over-the-air reprogramming of any control module, the manufacturer shall collect all lifetime data stored in the engine pursuant to this section using the over-air-network prior to their erasure.

(6.2) The manufacturer shall submit a report to the Executive Officer containing the average value and standard deviation of each collected parameter for each affected certified engine family as specified in, "Data Record Reporting Procedures for Over-the-Air Reprogrammed Vehicles and Engines", dated August 16, 2018, and hereby incorporated by reference. The manufacturer shall submit the report within ~~60~~ 75 calendar days of the availability of the calibration/software update to affected engines. The manufacturer shall submit a separate report for each unique calibration/software update.

(7) Exceptions to Standardization Requirements

(7.1) For an engine that is certified for use in both medium-duty and heavy-duty vehicles, a manufacturer may request Executive Officer approval to implement the tracking requirements in title 13, CCR sections 1968.2 (g)(6.3), (6.4), (6.5), (6.6.2), and (6.8) in lieu of the tracking requirements in sections (h)(5.4) through (5.7). The Executive Officer shall approve the request upon determining based on manufacturer-submitted information that the engine will be used in both medium-duty and heavy-duty vehicles and will meet the tracking requirements in title 13, CCR sections 1968.2(g)(6.5) and (6.8) for technologies installed on the heavy-duty vehicle that are also installed (and meeting the same tracking requirements) on the medium-duty vehicle.

(i) Monitoring System Demonstration Requirements for Certification.

* * * *

(2.3) Aging and data collection of diesel test engines:

* * * *

(2.3.3) For 2016 ~~and subsequent~~ through ~~2021~~ 2023 model year test engines:

* * * *

(B) For testing of 2016 ~~and subsequent~~through ~~2021~~ 2023 model year engines, a manufacturer shall use a system (engine, engine emission controls, and aftertreatment) aged by an accelerated aging process to be representative of full useful life. Manufacturers are required to submit for Executive Officer approval a description of the accelerated aging process and supporting data. The Executive Officer shall approve the process upon determining that the submitted description and data demonstrate that the aging process will result in a system representative of the manufacturer's best estimates of the system performance at full useful life

and that the manufacturer has utilized the data collected under section (i)(2.3.3)(A) to validate the correlation of the aging process to actual high mileage systems up to a minimum of full useful life.

(2.3.4) For ~~2022~~ 2024 and subsequent model year engines test engines:

* * * *

(4) Testing Protocol:

(4.1) Implanting of Malfunction and Malfunction Preconditioning Cycles:~~.~~

(4.1.1) Implanting of malfunction:

(A) If the Executive Officer approves the use of a malfunction preconditioning cycle under section (i)(4.1.2), the manufacturer shall set the system or component on the test engine for which detection is to be tested at the malfunction criteria limit(s) immediately prior to conducting the first malfunction preconditioning cycle in section (i)(4.1.2) below. If a second malfunction preconditioning cycle is permitted in accordance with section (i)(4.1.3) below, the manufacturer may adjust the system or component to be tested before conducting the second malfunction preconditioning cycle. The manufacturer may not replace, modify, or adjust the system or component after the last malfunction preconditioning cycle has taken place.

* * * *

(4.1.2) Optional Malfunction Preconditioning cycle: The manufacturer may request Executive Officer approval to use a malfunction preconditioning cycle prior to conducting ~~each of~~ the ~~above emission~~ tests under section (i)(4.2) below. The Executive Officer shall approve the request upon determining that a manufacturer has provided data and/or engineering evaluation that demonstrate that the malfunction preconditioning cycle is necessary for the emission control system to stabilize ~~the~~ emissions ~~control system~~ (e.g., through control system adaptation or learning) due to the introduction of the malfunction and is not solely intended for the purpose of adding monitoring time to detect a malfunction. The manufacturer may not require the test engine to be cold soaked prior to conducting the malfunction preconditioning cycle in order for the monitoring system testing to be successful.

(4.1.3) Optional second malfunction preconditioning cycle: The manufacturer may ~~also~~ request Executive Officer approval to use an additional identical malfunction preconditioning cycle following a 20 minute hot soak after the ~~initial~~ first malfunction preconditioning cycle under section (i)(4.1.2). The Executive Officer shall approve the request upon determining that a manufacturer has provided data and/or engineering evaluation that demonstrate that the additional malfunction preconditioning cycle is necessary for the emission control system to stabilize ~~the~~ emissions ~~control system~~ (e.g., through control system adaptation or learning) due to the introduction of the malfunction and is not solely intended for the purpose of adding monitoring time to detect a malfunction. ~~The manufacturer may not require the test engine to be cold soaked prior to~~

~~conducting preconditioning cycles in order for the monitoring system testing to be successful. If a second preconditioning cycle is permitted, the manufacturer may adjust the system or component to be tested before conducting the second preconditioning cycle. The manufacturer may not replace, modify, or adjust the system or component after the last preconditioning cycle has taken place.~~

(4.2) Demonstration Test Sequence:

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(4.2.~~2~~1) Malfunction detection cycle: After the manufacturer has met the malfunction preconditioning cycle requirements under section (i)(4.1):

* * * *

(C) For monitors designed to run over alternate monitoring conditions other than the SET cycle and approved under section (d)(3.1.3) (e.g., a monitor that is designed to run on the FTP cycle and requires a regeneration event to enable the monitor~~)~~), the test engine shall be operated over the alternate conditions to allow for initial detection of the tested system or component malfunction (i.e., storage of a pending fault code). The manufacturer shall then operate the test engine over the alternate conditions to allow for the OBD system to store the confirmed/MIL-on fault code and illuminate the MIL.

* * * *

(4.3) Test Data Collection:

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(4.3.2) The manufacturer shall collect the following data:

* * * *

(C) Emission test data: For 2010 through ~~2021~~ 2023 model year engines, the emission test data shall include NMHC, CO, NOx, and PM emission data as applicable (based on the applicable emission threshold malfunction criteria). For all ~~2022~~ 2024 and subsequent model year engines, the emission test data shall include NMHC, CO, NOx, and PM emission data as applicable (based on the applicable emission threshold malfunction criteria), and CO_2 emission data for all monitors. For the CO_2 emission data, the manufacturer may request Executive Officer approval to submit the raw measured (e.g., not fuel-corrected) CO_2 values. The Executive Officer shall approve the request upon determining, based on manufacturer-submitted information, that the raw measured CO_2 values are sufficient to assess the CO_2 impacts of each malfunction.

(4.3.3) For ~~2022~~ 2024 and subsequent model year diesel engines, the manufacturer shall collect the following data stream values at 1 second intervals (i.e., 1 Hertz) and submit the data in a comma separated values file: engine speed, actual engine torque, reference engine maximum torque, engine coolant temperature, engine oil temperature, fuel rate, modeled exhaust flow, intake air/manifold temperature, air flow rate (from mass air flow sensor), fuel injection timing, EGR mass flow rate, commanded EGR valve duty cycle/position, actual EGR valve duty

cycle/position, EGR error between actual and commanded, boost pressure, commanded/target boost pressure, PM filter inlet temperature, PM filter outlet temperature, exhaust gas temperature sensor output, variable geometry turbo position, corrected NOx sensor output, DEF dosing mode, stability of NOx sensor reading, engine friction – percent torque, commanded DEF dosing, DEF usage for current driving cycle, DEF dosing rate, charge air cooler outlet temperature, SCR intake temperature, SCR outlet temperature, modeled actual ammonia storage level on SCR, and target ammonia storage level on SCR. These data shall be collected during any baseline testing and during demonstration testing of the NOx converting catalyst during the exhaust emission test cycle under section (i)(4.2.2).

* * * *

(5) Evaluation Protocol:

(5.1) Full OBD engine ratings subject to sections (d)(7.1.1), (d)(7.2.2), or (d)(7.3) shall be evaluated according to the following protocol.

* * * *

(5.1.2) Except as provided in section (i)(5.1.2)(A) and (B) below, ~~I~~if the MIL illuminates prior to emissions exceeding the applicable emission threshold malfunction criteria specified in sections (e) through (g), no further demonstration is required. With respect to the misfire monitor demonstration test, if a manufacturer has elected to use the minimum misfire malfunction criteria of five or one percent as allowed in sections (e)(2.2.2)~~(A)~~ and (f)(2.2.2)(A), respectively, no further demonstration is required if the MIL illuminates with misfire implanted at the malfunction criteria limit.

(A) If the MIL illuminates prior to emissions exceeding the applicable emission threshold malfunction criteria specified in section (e) through (g) and a default fuel or emission control strategy is used when a malfunction is detected, the test engine shall be retested with the system or component adjusted to the worst acceptable limit (i.e., the applicable monitor indicates the system or component's performance is passing but at the closest possible value relative to the monitor threshold value at which a fault would be detected that would invoke the default strategy and illuminate the MIL). The manufacturer may request the Executive Officer to accept test data when the system or component's performance is at the worst acceptable limit within a margin of error necessary to accommodate testing variability and/or other practical limitations in setting the performance at the absolute worst acceptable limit. The Executive Officer shall accept the test data upon determining that the test data adequately demonstrate that emissions do not exceed the applicable malfunction criteria at the tested worst acceptable limit and that emissions will not exceed the applicable emission threshold malfunction criteria before performance exceeds the monitor threshold for fault detection. Alternatively, the manufacturer may request Executive Officer approval to

use computer modifications to disable the default fuel or emission control strategy when retesting the engine. The Executive Officer shall approve the plan upon determining that the test data and/or engineering evaluation submitted by the manufacturer demonstrate that (1) emissions do not exceed the applicable malfunction criteria with the system or component adjusted to the best performing unacceptable level of performance, and (2) the computer modifications used to disable the default fuel or emission control strategy produce emissions results equivalent to the production-level calibration.

* * * *

(5.1.3) If the MIL does not illuminate when the system or component is set at its limit(s), the criteria limit or the OBD system is not acceptable.

(A) Except as provided for in section (i)(5.1.3)(C), ~~I~~if the MIL first illuminates after emissions exceed the applicable emission threshold malfunction criteria specified in sections (e) through (g), the test engine shall be retested with the tested system or component adjusted so that the MIL will illuminate without emissions exceeding the applicable emission threshold malfunction criteria specified in sections (e) through (g). If the system or component cannot be adjusted to meet this criterion because a default fuel or emission control strategy is used when a malfunction is detected (e.g., open loop fuel control used after an oxygen sensor malfunction is determined), the test engine shall be retested with the system or component adjusted to the worst acceptable limit (i.e., the applicable monitor indicates the system or component's performance is passing but at the closest possible value relative to the monitor threshold value at which a fault would be detected that would invoke the default strategy and illuminate the MIL). The manufacturer may request the Executive Officer to accept test data when the system or component's performance is at the worst acceptable limit within a margin of error necessary to accommodate testing variability and/or other practical limitations in setting the performance at the absolute worst acceptable limit. The Executive Officer shall accept the test data upon determining that the test data adequately demonstrate that emissions do not exceed the applicable malfunction criteria at the tested worst acceptable limit and that emissions will not exceed the applicable emission threshold malfunction criteria before performance exceeds the monitor threshold for fault detection. Alternatively, the manufacturer may request Executive Officer approval to use computer modifications to disable the default fuel or emission control strategy when retesting the engine. The Executive Officer shall approve the plan upon determining that the test data and/or engineering evaluation submitted by the manufacturer demonstrate that (1) emissions do not exceed the applicable malfunction criteria with the system or component adjusted to the best performing unacceptable level of performance, and (2) the computer modifications used to disable the default fuel or emission control strategy produce emissions results equivalent to the production-

level calibration. For the catalyst (i.e., components monitored under sections (e)(5.2.2), (e)(6.2.1), (e)(7.2.1), and (f)(6.2.1)) and PM filter system (i.e., sections (e)(8.2.1) and (e)(8.2.4)(A)), ~~T~~these testing provisions under section (i)(5.1.3)(A) shall ~~only~~ apply ~~to testing of the catalyst (i.e., components monitored under sections (e)(5.2.2), (e)(6.2.1), (e)(7.2.1), and (f)(6.2.1)) or PM filter system (i.e., (e)(8.2.1) and (e)(8.2.4))~~ only if the on-board computer invokes a default fuel or emission control strategy upon detection of the relevant catalyst or PM filter malfunction. Otherwise, the provisions of section (i)(5.1.3)(B) shall apply to testing of the catalyst or PM filter system.

* * * *

(j) Certification Documentation.

* * * *

(2) The following information shall be submitted as part of the certification application. Except as provided below for demonstration data, the Executive Officer will not issue an Executive Order certifying the covered engines without the information having been provided. The information must include:

* * * *

(2.4) ~~Emission test data, a~~A description of the testing sequence (e.g., the number and types of malfunction preconditioning cycles) for each tested monitor, the data required to be collected in section (i)(4.3), and a description of the modified or deteriorated components used for fault simulation with respect to the demonstration tests specified in section (i). The manufacturer shall also include a summary of any issues that were found during testing under section (i), including issues where the engine does not meet one or more of the requirements in section 1971.1 (e.g., a monitor does not detect a malfunction before emissions exceed the emission threshold malfunction criteria in section (e) through (g)). The Executive Officer may approve conditional certification of an engine prior to the submittal of this data for ARB review and approval. Factors to be considered by the Executive Officer in approving the late submission of information identified in section (j)(2.4) shall include the reason for the delay in the data collection, the length of time until data will be available, and the demonstrated previous success of the manufacturer in submitting the data prior to certification.

* * * *

(2.23) For ~~2022~~ 2024 and subsequent model year diesel engines, data demonstrating the net brake torque reported by the engine dynamometer and the "calculated net brake torque" during the FTP and SET cycles. The manufacturer shall use an engine with no malfunctions on the system (engine, engine emission controls, aftertreatment). Manufacturers shall determine the "calculated net brake torque" using data stream parameters "engine reference torque," "engine friction – percent torque," and "actual engine – percent torque," and the following equation:
"Calculated net brake torque" = (engine reference torque) x [(actual engine – percent torque) – (engine friction – percent torque)]

* * * *

(2.25) For ~~2022~~ 2024 and subsequent model year diesel engines, data identifying the NOx sensor status (e.g., if the NOx sensor is actively reporting NOx concentration data, not reporting NOx concentration data due to low exhaust temperature, not reporting NOx concentration data due to sensor instability, etc.) for each NOx sensor during the FTP cycle and the SET cycle. The data shall also identify specifically which parameters and conditions documented in the certification application caused the NOx sensor to transition from one status to another (e.g., from not reporting NOx concentration data to actively reporting and from actively reporting to not reporting). The manufacturer shall use an engine with no malfunctions on the system (engine, engine emission controls, aftertreatment).

(2.26) For 2022 and subsequent model year diesel engines, data showing the instantaneous NOx mass emission rate determined using the test facility's instrumentation and the instantaneous NOx mass emission rate determined by the electronic control unit that is responsible for NOx tracking (as required in section (h)(5.3)) during ~~one hot-start~~ an FTP emissions test as described below. The manufacturer shall use an engine with no malfunctions on the system (engine, engine emission controls, aftertreatment). Data from the electronic control unit must include both engine-out and system-out (i.e., tailpipe) NOx mass emission rates and engine output energy. Data from the test facility must include the engine speed, torque, net brake work, and system-out NOx mass emission rate. The test facility's NOx mass emission rate data must not include a humidity correction. The ~~hot-start~~ FTP test must be immediately preceded by a~~n~~ hot or cold-start FTP cycle (i.e., a preparatory FTP cycle) without cycling the ignition in between the two cycles to warm up the engine and ensure that all sensors are reporting NOx data throughout the entire FTP test. All data must be provided over ~~this~~ the preparatory FTP cycle and ~~hot-start~~ the FTP test~~,~~ at a frequency of at least 1 Hertz in a CSV file~~, and summed to show the total NOx mass and total engine output energy over the cycle~~. The FTP test data (not the preparatory FTP cycle data) must be summed to show the total values determined by the electronic control unit (engine-out NOx mass, system-out NOx mass, and engine output energy) and the total values determined by the test facility (system-out NOx mass and net brake work). The electronic control unit system-out NOx mass and test facility system-out NOx mass emission rate data must be plotted together in a graph versus time over the preparatory FTP cycle and the FTP test. A manufacturer may alternatively provide these data with vehicle-based testing using the EPA Urban Dynamometer Driving Schedule (UDDS) for Heavy-Duty Vehicles specified in 40 CFR Part 86, Appendix I as it existed on July 1, 2012. For this option, the requirements and procedures described above for the engine-dynamometer testing option apply (e.g., the UDDS cycle must be preceded by another UDDS cycle without cycling the ignition in between) with the exception that engine speed, torque, and net brake work data from the

test facility may be omitted (the net brake work shall be calculated using OBD system parameters).

* * * *

(2.28) For ~~2022~~ 2024 and subsequent model year engines, a list of comprehensive components that are not OBD monitored due to meeting the criteria under sections (g)(3.1.1) and (3.1.2), and the engineering evaluation analysis or associated data for each component, including all emission data, a description of how the worst case configuration was determined, and test cycles used to stabilize the system and assess the emission impact.

* * * *

(2.31) For monitors designed to run during the SET cycle under section (d)(3.1.3) on ~~2022~~ 2024 and subsequent model year engines, the information required under section (d)(3.1.3)~~, including the supporting in-use monitor performance ratio data~~.

(2.32) For 2022 and subsequent model year engines in vehicles equipped with active technologies, a written description of each technology utilized by the manufacturer including the identification of each technology relative to the data required to be tracked and reported in the standardized format specified in sections (h)(5.4.~~17~~16) through (h)(5.4.~~22~~21) (e.g., Active Technology #1 is "haptic-feedback accelerator pedal"), the sensor signals and/or calculated values used to activate each technology (e.g., the tip-in rate of accelerator pedal is greater than a certain value), and the driver action (if any) required to activate the technology (e.g., driver tipped out within 1 second of feedback).

(2.33) For 2022 and subsequent model year engines in vehicles equipped with automatic engine shutdown technologies, ~~stop-start~~ start-stop technologies, and waste heat recovery technologies, a written description of the technology, the sensor signals and/or calculated values used to activate the technology (e.g., the temperature of the engine exhaust is greater than a certain value), and the driver action (if any) required to activate the technology (e.g., driver pushes a button).

(2.34) For 2022 and subsequent model year engines, a list of monitors and respective fault codes for malfunctions listed under sections (h)(5.3.6)(B), (h)(5.3.6)(C), (h)(5.7.5), and (h)(5.7.6).

(2.~~21~~~~34~~35) Any other information determined by the Executive Officer to be necessary to demonstrate compliance with the requirements of this regulation. This includes any of the following:

(2.~~34~~35.1) Complete software design description documentation, specifications, and source code of the engine control unit and any other on-board electronic powertrain control unit (e.g., transmission control unit, aftertreatment system control unit). The manufacturer shall provide the descriptions and specifications in English.

(2.~~34~~35.2) A complete list and description of all control unit variables available for real-time display and data logging, as well as all calibration maps, curves, and constants used in the software.

(2.~~34~~35.3) A data acquisition device with real-time display and data logging capability of any and all control unit variables used in calibration. These variables shall be provided in the same engineering units used during calibration (e.g., the units as documented in the AECD documentation provided to the Executive Officer). The data acquisition device shall include, but may not be limited to, an engineering and calibration tool used during control unit software development and calibration.

(2.~~34~~35.4) A method to unlock any production or prototype control unit to allow real-time display and data logging of any and all variables used during calibration.

* * * *

(k) Deficiencies.

* * * *

(3) The fines for engines specified in section (k)(2) above shall be as follows below in sections (k)(3.1) and (3.2). ~~are in the amount of $50 per deficiency per engine for non-compliance with any of the monitoring requirements specified in sections (e), (f), and (g)(4), and $25 per deficiency per engine for non-compliance with any other requirement of section 1971,1. In determining the identified order of deficiencies, deficiencies subject to a $50 fine are identified first. Total fines per engine under section (k) may not exceed $500 per engine and~~ Fines are payable to the State Treasurer for deposit in the Air Pollution Control Fund. Except as provided below, a manufacturer shall submit the fines payment not more than 30 calendar days after the close of a calendar quarter. Within 30 days from the end of the calendar quarter, a manufacturer shall report the number of affected engines produced for sale in California during the quarter and submit the total payment for the engines produced for sale during that quarter. A manufacturer may request Executive Officer approval for an alternate payment schedule in lieu of the schedule described above. Executive Officer approval shall be based on the projected sales volume of the entire manufacturer product line, and the appropriateness and effectiveness of the schedule in paying the total fines in a timely manner.

(3.1) For 2010 through ~~2020~~ 2023 model year engines, the fines are in the amount of $50 per deficiency per engine for non-compliance with any of the monitoring requirements specified in sections (e), (f), and (g)(4), and $25 per deficiency per engine for non-compliance with any other requirement of section 1971.1. In determining the identified order of deficiencies, deficiencies subject to a $50 fine are identified first. Total fines per engine under section (k) may not exceed $500 per engine.

(3.2) For ~~2021~~ 2024 and subsequent model year engines, except as provided below in section (k)(3.2.1), the fines are in the amount of $100 per deficiency per engine for non-compliance with any of the monitoring requirements specified in sections (e), (f), and (g)(4), and $50 per deficiency per engine for non-compliance with any other requirement of section 1971.1. In determining the identified order of deficiencies, deficiencies specified under section (k)(3.2.1) (except for ~~one~~ two Emission Threshold 1 (ET1) deficiencies~~y~~ during the first

model year the deficiencies~~y~~ ~~is~~ are applied and one ET1 deficiency during the second model year the deficiency is applied) shall not be included, and deficiencies subject to $100 are identified first. Total fines per engine under section (k) may not exceed ~~$750~~ $600 per engine for ~~2021~~ 2024 model year engines, $800 per engine for 2025 model year engines, $1000 per engine for ~~2022~~ 2026 model year engines, and ~~$1500~~ $1250 per engine for ~~2023~~ 2027 and subsequent model year engines.

(3.2.1) For deficiencies regarding monitors not detecting a malfunction before emissions exceeded the malfunction criteria defined in sections (e) through (g), the fines are in the amount described in Table 1 below. Except for ~~one~~ two ET1 deficiencies~~y~~ during the first model year the deficiencies~~y~~ ~~is~~ are applied and one ET1 deficiency during the second model year the deficiency is applied, the deficiencies shall not be included in the count of deficiencies used in (k)(2) to determine the number of deficiencies subject to fines.

Table 1

		Applicable Model Year (MY) for Deficiency			
Deficiency Type	**Threshold Exceedance (% of malfunction criteria)**	**1st MY**	**2nd MY (1 MY carryover)**	**3rd MY (2 MY carrover)**	**4th MY (3 MY carryover)**
ET1	100 - 120	Free for ~~1~~ 2 ET1, $100 for all other ET1	Free for 1 ET1, $100 for all other ET1	$150	$200
ET2	121-150	$~~300~~200	$~~300~~200	$~~325~~250	$~~350~~300
ET3	151-200	$~~400~~300	$~~400~~300	$~~425~~350	$~~450~~400

* * * *

(9) For deficiencies related to issues with the tracking requirements in sections (h)(5.3) ~~and (h)(5.4)~~ through (h)(5.7) on 2022 and 2023 model year engines, two of these deficiencies shall be exempt from the specified fines of section (k)(3) and shall not be included in the count of deficiencies in section (k)(2) to determine the number of deficiencies subject to fines.

* * * *

(l) *Production Engine/Vehicle Evaluation Testing.*

* * * *

(2.3) Evaluation requirements:

* * * *

(2.3.1) The evaluation shall demonstrate the ability of the OBD system on the selected production vehicle to detect a malfunction, illuminate the MIL, and, where applicable, store an appropriate fault code (confirmed and permanent fault codes) readable by a scan tool conforming to SAE J1978/J1939 when a malfunction is present and the monitoring conditions

have been satisfied for each individual diagnostic required by title 13, CCR section 1971.1. During testing under section (l)(2), t~~T~~he manufacturer shall also verify the ability of the OBD system to erase permanent fault codes stored during testing for each unique pathway within the software that manages the erasing of permanent fault codes ~~under section (l)(2)~~.

* * * *

(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 for each diagnostic, include the permanent fault code storage/erasure test procedure, and include (if applicable) the 10 additional monitors required to be tested under section (l)(2.3.7) below. ~~If t~~The Executive Officer shall approve the plan upon determining~~es~~ that the requirements of section (l)(2) are satisfied, and that the permanent fault code storage/erasure test procedure meets the following: ~~the proposed test plan shall be approved~~.

(A) The procedure provides comprehensive testing coverage of at least one of each of the different "types" of monitors (fault codes) in each diagnostic or emission critical electronic control unit (e.g., monitors subject to the minimum ratio requirements of section (d)(3.2), monitors not subject to the minimum ratio requirements of section (d)(3.2), monitors that utilize an alternate MIL statistical MIL illumination and fault code storage protocol),

(B) The procedure provides comprehensive testing coverage of every ~~and the~~ different permanent fault code erasure protocol~~s~~ (e.g., "natural" erasure without a clearing of the fault information in the on-board computer, erasure after a battery disconnect, erasure after a scan tool code clear command, erasure after a reprogramming event),

(C) For diagnostics and permanent fault code erasure protocols covered under section (d)(2.3.1)(C)(ii)b. or (d)(2.3.2)(D)(ii)b. (e.g., erasure after a battery disconnect, erasure after a scan tool code clear command), the procedure verifies that the permanent fault code is not erased if the diagnostic determines the respective component/system is not malfunctioning but the criteria described under section (d)(2.3.1)(C)(ii)b.3. or (d)(2.3.2)(D)(ii)b.3. are not met,

(~~B~~D) The procedure verifies that after a scan tool code clear command, all monitors can fully execute and determine that the respective components or systems are not malfunctioning, and

(~~C~~E) The last procedure performed on a vehicle during testing under section (l)(2) verifies that any remaining permanent fault code(s) stored as a result of the previous tests is erased without requiring reprogramming of the diagnostic or emission critical electronic control unit (i.e., erased through "natural" erasure).

* * * *

(2.3.7) For evaluation of test vehicles selected in accordance with section (l)(2.2), except as provided below, manufacturers are not required to demonstrate diagnostics that were previously demonstrated prior to certification as

required in section (i). For evaluation of test vehicles with ~~2022~~ 2024 and subsequent model year engines from the same engine family and rating as the demonstration engines selected under section (i), manufacturers shall additionally test 10 diagnostics in accordance to section (l)(2) that were previously demonstrated prior to certification as required in section (i). The manufacturer shall propose for Executive Officer approval the 10 diagnostics to test. The Executive Officer shall approve the monitors upon determining that the manufacturer has provided data that demonstrate that the selected diagnostics have the lowest in-use monitor performance ratios of all the diagnostics demonstrated under section (i).

* * * *

(3) Verification and Reporting of In-use Monitoring Performance.

* * * *

(3.4) For each group, the data must include all of the in-use performance tracking data reported through SAE J1979/J1939 (i.e., all numerators, denominators, the general denominator, and the ignition cycle counter), the engine model year, the engine manufacturer, the engine family, the engine serial number, the engine HP rating (for diesels), the engine torque rating (for diesels), the date the data were collected, the chassis odometer reading, the vehicle/chassis VIN, the monitoring performance group, ~~and~~ the ECM software calibration identification number, and the distance traveled and be in the standardized format detailed in Attachments D and E of ARB Mail-Out #MSC 09-22. The manufacturer shall also submit a report that includes a summary of any problems identified in the data (e.g., a monitor where the average in-use monitor performance ratio is less than the minimum acceptable ratio under section (d)(3.2.2)).

* * * *

(m) *Running Changes and Field Fixes.*

* * * *

(1) For purposes of section (m), the following terminology shall be defined as follows:

(1.1) "Running change/field fix document" refers to a document indicating notification of a running change and/or field fix for an engine family. The manufacturer may group more than 1 running change and/or field fix notification into one running change/field fix document. Each running change/field fix document shall include the following:

* * * *

(1.1.7) Copies of all service manuals, technical service bulletins and instructions regarding the use, repair, adjustment, maintenance, or testing of such vehicles relevant to the emission control system, OBD system, as applicable, issued by the manufacturer (in written or electronic form) for use by other manufacturers, assembly plants, distributors, dealers, and ultimate purchasers. These shall be submitted to the Executive Officer when they are made available to the public and must be updated as appropriate throughout the useful life of the corresponding vehicles. For

the service manual, the manufacturer shall include only the portions of the manual that were changed due to the running change or field fix, with details highlighting what specifically has been changed. If no changes were made to the service manual due to the running change or field fix, the manufacturer is not required to include the specific service manual as part of the running change/field fix document.

* * * *

(2) Submission Schedule: The manufacturer shall submit either the running change/field fix document or the running change/field fix notification for an engine family prior to or concurrently with implementing the running change or field fix.

(2.1) Running change/field fix document:

(2.1.1) The manufacturer may not submit to the Executive Officer a running change/field fix document for an engine family within 30 calendar days of the issue date of the OBD system approval ~~date~~ for the engine family.

* * * *

§ 1971.5. Enforcement of Malfunction and Diagnostic System Requirements for 2010 and Subsequent Model-Year Heavy-Duty Engines.

* * * *

(b) *Testing Procedures for ARB-Conducted Testing.*

* * * *

(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 system in the identified engine class under the respective tests for the applicable model year(s) as follows:
(A) OBD Emission Testing.

* * * *

(iii) For 2016 through 2018 model year engines (except as provided for alternate-fueled engines in section (b)(6)(A)(v) below):

* * * *

c. Monitors on engines not covered under sections (b)(6)(A)(iii)a. and b. above shall be considered nonconforming if the emission test results indicate that 50 percent or more of the engines in the test sample group do not properly illuminate the MIL when emissions exceed the following:
1. For deficient emission threshold monitors, ~~either~~ any of the applicable following thresholds~~, whichever is smaller~~: (1) 20 percent of the NMHC, CO, or NOx emission standard above the emission level at which a malfunction was detected when the OBD system was approved by the Executive Officer, (2) 20 percent of the PM malfunction criterion (e.g., 0.0060 g/bhp-hr if the PM malfunction criterion is 0.03 g/bhp-hr) above the emission level at which a malfunction was detected when the OBD system was approved by the Executive Officer, or (~~2~~3) the applicable emission level for mandatory recall under section (d)(3)(A)(ii).
2. For all other component/system monitors not mentioned in section (b)(6)(A)(iii)c.1. above, the malfunction criteria on any of the applicable standards (i.e., FTP or SET).

(iv) For 2019 and subsequent model year engines (except as provided for alternate-fueled engines in section (b)(6)(A)(v) below), any engine shall be considered nonconforming if the results of the tests indicate that 50 percent or more of the engines in the test sample do not properly illuminate the MIL when emissions exceed the following:
a. For deficient emission threshold monitors, ~~either~~ any of the applicable following thresholds~~, whichever is smaller~~: (1) 20 percent of the NMHC, CO, or NOx emission standard above the emission level at which a malfunction was detected when the OBD system was approved by the Executive Officer, (2) 20 percent of the PM malfunction criterion (e.g., 0.0060 g/bhp-hr if the PM malfunction criterion is 0.03 g/bhp-hr) above the emission level at which a malfunction was detected when the OBD

system was approved by the Executive Officer, or (~~2~~3) the applicable emission level for mandatory recall under section (d)(3)(A)(ii).

b. For all other component/system monitors not mentioned in section (b)(6)(A)(iv)a. above, the malfunction criteria on any of the applicable standards (i.e., FTP or SET).

(v) For alternate-fueled engines, any engine shall be considered nonconforming if the results of the tests indicate that 50 percent or more of the engines in the test sample do not properly illuminate the MIL when emissions exceed the following:

* * * *

b. For 2022 and subsequent model year engines:

1. For deficient emission threshold monitors, ~~either~~ any of the applicable following thresholds~~, whichever is smaller~~: (1) 20 percent of the NMHC, CO, or NOx emission standard above the emission level at which a malfunction was detected when the OBD system was approved by the Executive Officer, (2) 20 percent of the PM malfunction criterion (e.g., 0.0060 g/bhp-hr if the PM malfunction criterion is 0.03 g/bhp-hr) above the emission level at which a malfunction was detected when the OBD system was approved by the Executive Officer, or (~~2~~3) the applicable emission level for mandatory recall under section (d)(3)(A)(ii).
2. For all other component/system monitors not mentioned in section (b)(6)(A)(v)b.1. above, the malfunction criteria on any of the applicable standards (i.e., FTP or SET).

* * * *

(B) OBD Ratio Testing.

* * * *

(iii) ~~2022~~ 2024 through ~~2025~~ 2027 model year engines with monitors certified to a ratio of 0.300 in accordance with Cal. Code Regs., title 13, section 1971.1(d)(3.2.2) shall be considered nonconforming if the data collected from the engines in the test sample group indicate either that the average in-use monitor performance ratio for one or more of the monitors in the test sample group is less than 0.177 or that 66.0 percent or more of the engines in the test sample group have an in-use monitor performance ratio of less than 0.200 for the same monitor.

(iv) ~~2026~~ 2028 and subsequent model year engines with monitors certified to a ratio of 0.300 in accordance with Cal. Code Regs., title 13, section 1971.1(d)(3.2.2) shall be considered nonconforming if the data collected from the engines in the test sample group indicate either that the average in-use monitor performance ratio for one or more of the monitors in the test sample group is less than 0.265 or that 66.0 percent or more of the engines in the test sample group have an in-use monitor performance ratio of less than 0.300 for the same monitor.

* * * *

(c) *Manufacturer Self-Testing.*

(1) *Purpose*.

To assure that OBD systems on production engines certified on an engine dynamometer are able to detect a fault before emissions exceed the malfunction criteria established in Cal. Code Regs., title 13, sections 1971.1(e) through (g), engine manufacturers shall evaluate engines for each model year, starting with the 2010 model year. The Executive Officer may waive the testing requirements of section (c) for a specific model year if the following are met:

(A) All engines of the specific model year of concern are direct carry-overs of previous model year engines that were tested in accordance with section (c) (i.e., have OBD system calibrations and emission-related software and hardware that are substantially similar to the previous model year engines such that testing of the "direct carry-over" engine under section (c)(3) will provide the same results as testing of the previous model year engine);

(B) All monitors have been tested in accordance with section (c) on the previous model year engines specified in section (c)(1)(A) above;

(C) The manufacturer tested an engine in accordance with section (c) that is one model year before the specific model year of concern; and

(D) The manufacturer did not use the provisions in section (c)(4)(E)(iii) to reduce the number of additional test engines during testing of any of the previous model year engines specified in section (c)(1)(A) above.

(2) *Engine Selection for Manufacturer Self-Testing*.

* * * *

(C) Engines to be included in test sample group.

* * * *

(iii) Upon request of the manufacturer, the Executive Officer may approve an alternate engine selection criterion in lieu of a criterion described in sections (c)(2)(A) and (c)(2)(C)(i) above.

a. The manufacturer may request Executive Officer approval to procure an engine that has mileage that is below 70 percent of the certified full useful life mileage in lieu of the criterion in section (c)(2)(C)(i)c. above. The Executive Officer shall approve the use of the engine upon determining that the manufacturer-submitted plan demonstrates that the engine will produce equivalent results to an engine with mileage that is between 70 to 100 percent of the certified full useful life mileage. The plan may involve the manufacturer operating the ~~engine~~ vehicle to accumulate more mileage on the engine, requesting a extension in the deadline set forth in section (c)(3)(A) below to allow for more mileage accumulation on the engine, and/or providing data showing operating hours-to-mileage equivalency. The plan may not involve the manufacturer operating the engine on a dynamometer to accumulate operating hours for the purposes of showing operating hours-to-mileage equivalency.

b. The manufacturer may request Executive Officer approval to procure an engine that is of the same model year but of a different rating than

the specific rating selected under section (c)(2)(A) above. The Executive Officer shall approve the use of the engine upon determining that the engine is identical to the engine selected under section (c)(2)(A) with respect to the emissions control system hardware, and the manufacturer's plan to re-rate the engine to the rating selected under section (c)(2)(A) will result in worst-case emissions with respect to re-rating up or re-rating down.

c. If a manufacturer is unable to procure the test engine necessary for testing under section (c)(3), the manufacturer may request Executive Officer approval to procure an engine meeting alternate criteria in lieu of the criteria under section (c)(2)(C)(i). The manufacturer shall submit information to the Executive Officer detailing the method(s) used by the manufacturer when trying to procure the engine (including the number of vehicle owners contacted and the procurement incentives, if any), the total California and federal (if applicable) sales volumes of the engine family and specific rating selected for testing, the total California and federal (if applicable) sales volumes for different model year engines that are direct carryovers of this engine family and rating, and the proposed alternate criteria. The Executive Officer shall approve the request upon determining based on the information that the manufacturer has taken all reasonable steps to try to procure an engine meeting the criteria under section (c)(2)(C)(i) and that testing of an engine meeting the alternate criteria will provide the same results as testing of an engine meeting the criteria under section (c)(2)(C)(i).

* * * *

(4) *Additional Testing*.

(A) No further testing is required ~~I~~if the results of the OBD emission tests conducted under section (c)(3) indicate that the OBD system properly illuminates the MIL for all component/system monitors before emissions exceed the following~~malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1(e) through (g), no further testing is required.~~:

(i) For deficient emission threshold monitors, ~~either~~ all of the applicable following thresholds~~, whichever is smaller~~: (1) 20 percent of the NMHC, CO, or NOx emission standard above the emission level at which a malfunction was detected when the OBD system was approved by the Executive Officer, (2) 20 percent of the PM malfunction criterion (e.g., 0.0060 g/bhp-hr if the PM malfunction criterion is 0.03 g/bhp-hr) above the emission level at which a malfunction was detected when the OBD system was approved by the Executive Officer, or (~~2~~3) the applicable emission level for mandatory recall under section (d)(3)(A)(ii).

* * * *

(B) Except as provided for in section (c)(4)(F) below, the engine manufacturer shall conduct further testing on additional engines ~~I~~if the results of the OBD emission tests conducted under section (c)(3) indicate that OBD system does not properly illuminate the MIL for one or more of the component/system

monitor(s) before emissions exceed any of the applicable levels specified in section (c)(4)(A)(i) or (ii) above~~malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1(e) through (g), the engine manufacturer shall conduct further testing on additional engines~~.

(i) Within six months after the completion of testing required in section (c)(3), the engine manufacturer shall emission test an additional four engines from the same engine rating and engine family as the test engine. Upon request of the manufacturer, the Executive Officer may extend the six-month deadline upon finding that the manufacturer has demonstrated good cause for the requested extension.

* * * *

(C) For manufacturers subject to section (c)(4)(B) above, no further testing is required if the results of the OBD emission tests conducted under section (c)(4)(B) indicate that the OBD system properly illuminates the MIL for the tested component/system monitor(s) before emissions exceed all of the ~~malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1(e) through (g)~~applicable levels specified in section (c)(4)(A)(i) or (ii) above on three or more of the additional test engines.

(D) Except as provided for in section (c)(4)(F) below, ~~F~~for manufacturers subject to section (c)(4)(B) above, if the results of the OBD emission tests conducted under section (c)(4)(B) indicate that the OBD system does not properly illuminate the MIL for one or more of the tested component/system monitor(s) before emissions exceed any of the ~~malfunction criteria defined in Cal. Code Regs., title 13, sections 1971.1(e) through (g)~~applicable levels specified in sections (c)(4)(A)(i) and (ii) above on two or more of the additional test engines, the engine manufacturer shall conduct further testing.

(i) Within six months after the completion of testing required in section (c)(4)(B), the engine manufacturer shall test an additional five engines from the same engine rating and engine family as the previously tested engines. Upon request of the manufacturer, the Executive Officer may extend the six-month deadline upon finding that the manufacturer has demonstrated good cause for the requested extension.

* * * *

(E) In any testing of the additional engines under section (c)(4), the engine manufacturer shall follow the engine selection and testing procedures set forth in sections (c)(2) and (c)(3) above except as provided below.

(i) The manufacturer may procure an engine that is a “direct carry-over” of the engine of concern. The manufacturer shall request Executive Officer approval of the “direct carry-over” engine. The Executive Officer shall approve the request based on manufacturer-submitted information and/or engineering evaluation demonstrating that the “direct carry-over” engine (1) is one model year before or after the engine of concern, and (2) has OBD system calibrations and emission-related software and hardware that are substantially similar to the engine of concern such that testing of the

"direct carry-over" engine under section (c)(4) will provide the same results as testing of the engine of concern.

(ii) The manufacturer may request to utilize alternative test procedures (e.g., less frequently calibrated emission analyzers) instead of official test procedures to obtain the emission test data required in section (c)(4). The Executive Officer shall approve the request upon determining that the data from the alternative test procedure are representative of official emission test results. Manufacturers using this option are still responsible for meeting the malfunction criteria established pursuant to Cal. Code Regs., title 13, sections 1971.1(e) through (g) when emission tests are performed in accordance with official test procedures. Additionally, the manufacturer shall report to the Executive Officer any testing issues or failures (e.g., failed calibration checks) that occurred during or immediately after the testing.

(iii) If a manufacturer is unable to procure the required number of test engines specified under section (c)(4)(B)(i) or (c)(4)(D)(i), the manufacturer may request Executive Officer approval to reduce the number of test engines the manufacturer is required to test. The manufacturer shall submit information to the Executive Officer detailing the method(s) used by the manufacturer when trying to procure the engine (including the number of vehicle owners contacted and the procurement incentives, if any), the total California and federal (if applicable) sales volumes of the engine family and specific rating selected for testing, the total California and federal (if applicable) sales volumes for different model year engines that are direct carryovers of this engine family and rating, and the proposed number of test engines. The Executive Officer shall approve the request upon determining that:

a. The manufacturer has taken all reasonable steps to try to procure the required number of additional test engines based on the information above, and

b. The proposed number of test engines provides for a sufficient finding of conformance/nonconformance by the Executive Officer based on the degree of compliance/noncompliance on the tested engines (e.g., how much the emissions exceeded the required malfunction criteria for noncompliant monitors, the number of test engines that passed or failed the tests).

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(d) *Remedial Action.*

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

(A) Except as provided in sections (d)(3)(B) below, the Executive Officer shall order the recall and repair of all engines in an engine class that have been determined to be equipped with a nonconforming OBD system if enforcement testing conducted pursuant to sections (b) or (c) above or information received from the manufacturer indicates that:

(i) For major monitors required to meet the in-use performance ratio pursuant to Cal. Code Regs., title 13, section 1971.1(d)(3.2) ~~and subject to the nonconformance criteria of section (b)(6)(B)(ii), (b)(6)(B)(iii), or (b)(6)(B)(iv)~~ on 2016 and subsequent model year engines~~,~~:

a. For monitors subject to the nonconformance criteria of section (b)(6)(B)(ii) and (b)(6)(B)(iv), the average in-use monitor performance ratio for one or more of the major monitors in the test sample group is less than or equal to 33.0 percent of the applicable required minimum ratio established in Cal. Code Regs., title 13, section 1971.1(d)(3.2.2) (e.g., if the required ratio is 0.100, less than or equal to a ratio of 0.033) or 66.0 percent or more of the vehicles in the test sample group have an in-use monitor performance ratio of less than or equal to 33.0 percent of the applicable required minimum ratio established in Cal. Code Regs., title 13, section 1971.1(d)(3.2.2) for the same major monitor.

b. For monitors subject to the nonconformance criteria of section (b)(6)(B)(iii), 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 0.066 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 0.066.

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(4) *Other Ordered Remedial Action*.

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(B) In making his or her findings regarding remedial action, the Executive Officer shall consider the capability of the OBD system to properly function. This determination shall be based upon consideration of all relevant circumstances including, but not limited to, those set forth below.

* * * *

(xiv) The degree to which a calibration error or other calibration feature adversely impacts the accuracy of the NOx mass values that are calculated by the OBD system under Cal. Code Regs., title 13, section 1971.1(h)(4.2) and (h)(5.3).

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