

**9/24/24 DRAFT**

## Proposed Regulation Order

# **Amendments to Tier 4 Off-Road Compression-Ignition Engine Emission Standards and Test Procedures and Adoption of New Tier 5 Off-Road Compression-Ignition Engine Emission Standards and Test Procedures**

Note: This version of the Proposed Regulation Order complies with Government Code section 11346.2 subdivision (a)(3). The proposed amendments are shown in underline to indicate additions and ~~striketrough~~ to indicate deletions from the existing regulatory text. Subsections for which no changes are proposed in this rulemaking are indicated with “\* \* \* \*”.

Note: Current section 2422 is being deleted in its entirety, and a new section 2422 is being proposed. New sections 2139.1, 2421.1, 2423.1, and 2425.2 are also being proposed. The entire text of new sections 2139.1, 2421.1, 2422, 2423.1, and 2425.2 set forth below is new language and is shown in “normal type” proposed to be added to the California Code of Regulations.

A Table of Contents and page numbers are included in this draft to assist reviewers with navigating the document. These items are not part of the proposed regulation and will not be included in the final Proposed Regulation Order.

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The following sections of the California Code of Regulations, title 13, division 3, chapter 2 are being amended by this regulatory proposal.

Chapter 2. Enforcement of Vehicle Emission Standards and Surveillance Testing

- Section 2116. Repair Label.
- Section 2118. Notification.
- Section 2127. Notification of Owners.
- Section 2128. Repair Label.
- Section 2137. Vehicle, Engine, and Trailer Selection.
- Section 2139. Testing.
- Section 2140. Notification and Use of Test Results.
- Section 2143. Failure Levels Triggering Recall and Corrective Action.

The following sections of the California Code of Regulations, title 13, division 3, chapter 9 are being amended by this regulatory proposal.

Chapter 9. Off-Road Compression-Ignition Engines and Equipment

- Section 2420. Applicability.
- Section 2421. Definitions for Off-Road Compression-Ignition Engines and Equipment that Certify to §2423.
- Section 2423. Exhaust Emission Standards and Test Procedures - Off-Road Compression-Ignition Engines.
- Section 2424. Emission Control Labels—1996 and Later Off-Road Compression-Ignition Engines.
- Section 2425. Defects Warranty Requirements for 1996 and Later Off-Road Compression-Ignition Engines.
- Section 2425.1. Defect Investigation and Reporting Requirements.
- Section 2427. Production Engine Testing, Selection, Evaluation, and Enforcement Action.
- Section 2449. General Requirements for In-Use Off-Road Diesel-Fueled Fleets.

The following section of the California Code of Regulations, title 13, division 3, chapter 9 is being deleted by this regulatory proposal.

Chapter 9. Off-Road Compression-Ignition Engines and Equipment

Section 2422. [Reserved].

The following section of the California Code of Regulations, title 13, division 3, chapter 2 is being proposed for adoption by this regulatory proposal.

Chapter 2. Enforcement of Vehicle Emission Standards and Surveillance Testing

Section 2139.1. CARB Authority to Test for Off-Road Engine and Equipment In-Use Compliance.

The following sections of the California Code of Regulations, title 13, division 3, chapter 9 are being proposed for adoption by this regulatory proposal.

Chapter 9. Off-Road Compression-Ignition Engines and Equipment

Section 2421.1. Definitions for Off-Road Compression-Ignition Engines and Equipment that Certify to §2423.1.

Section 2422. On-Board Diagnostics Requirements - 2029 and Subsequent Model Year Off-Road Diesel Engines Certified to the Tier 5 Emission Standards.

Section 2423.1. Tier 5 Exhaust Emission Standards and Test Procedures - Off-Road Compression-Ignition Engines.

Section 2425.2. Off-Road Compression-Ignition Engine Required Recall and Corrective Action for Failures of Emission-Related Components.

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# Proposed Regulation Order

Title 13 California Code of Regulations (CCR)

Amend Sections 2116, 2118, 2127, 2128, 2137, 2139, 2140, 2143, 2420, 2421, 2423, 2424, 2425, 2425.1, 2427, and 2449; Delete Section 2422; and Adopt new Sections 2139.1, 2421.1, 2422, 2423.1, and 2425.2 of Title 13, CCR, to read as follows:

1. Amend Title 13, CCR, Division 3, Chapter 2, Article 2.1, Section 2116 to read as follows:

## § 2116. Repair Label.

\* \* \* \* \*

(d) For off-road compression-ignition engines that are certified to the exhaust emission standards in title 13, CCR, section 2423.1, manufacturers are exempt from the label requirements of subsections (a), (b), and (c) of this section 2116, if all of the following conditions are met:

(1) The recall shall involve only software or software calibration repairs or changes and does not involve hardware repairs or changes.

(2) Throughout the useful life of the engine, the manufacturer shall keep and retain a record of the engine serial numbers of all pieces of equipment that were inspected or repaired, and

(3) Upon request from the Executive Officer, the manufacturer shall provide information within 14 calendar days about running changes, field fixes, service campaigns, and recalls for any given engine serial numbers from all pieces of equipment affected by the nonconformity.

Note: Authority cited: Sections 38501, 38505, 38510, 38560, 39600, 39601, 43013, 43018, and 43105, Health and Safety Code. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, and 43204, 43205, and -43205.5, Health and Safety Code.

2. Amend Title 13, CCR, Division 3, Chapter 2, Article 2.1, Section 2118 to read as follows:

**§ 2118. Notification.**

The notification of vehicle, engine, or trailer owners shall contain the following:

\* \* \* \* \*

(f) A card to be used by a vehicle, engine, or trailer owner in the event the vehicle, engine, or trailer to be recalled has been sold. Such card should be addressed to the manufacturer, have postage paid, and shall provide a space in which the owner may indicate the name and address of the person to whom the vehicle, engine, or trailer was sold or transferred. For off-road compression-ignition engines that are certified to the exhaust emission standards in title 13, CCR, section 2423.1, manufacturers may obtain new owner information electronically or use of another format other than the post card with postage paid.

\* \* \* \* \*

Note: Authority cited: Sections 38501, 38505, 38510, 38560, 39600, 39601, 43013, 43018, and 43105, Health and Safety Code. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, and 43204, 43205, and -43205.5, Health and Safety Code.



3. Amend Title 13, CCR, Division 3, Chapter 2, Article 2.2, Section 2127 to read as follows:

**§ 2127. Notification of Owners.**

\* \* \* \* \*

(d) The notification of vehicle, engine, or trailer owners shall contain the following:

\* \* \* \* \*

(9) A card to be used by a vehicle, engine, or trailer owner in the event the vehicle, engine, or trailer to be recalled has been sold. Such card should be addressed to the manufacturer, have postage paid, and shall provide a space in which the owner may indicate the name and address of the person to whom the vehicle, engine, or trailer was sold. For off-road compression-ignition engines that are certified to the exhaust emission standards in title 13, CCR, section 2423.1, manufacturers may obtain new owner information electronically or use of another format other than the post card with postage paid.

\* \* \* \* \*

Note: Authority cited: Sections 38501, 38505, 38510, 38560, 39600, 39601, 43013, 43018, and 43105, Health and Safety Code. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, and 43204, 43205, and -43205.5, Health and Safety Code.

4. Amend Title 13, CCR, Division 3, Chapter 2, Article 2.2, Section 2128 to read as follows:

**§ 2128. Repair Label.**

\* \* \* \* \*

(d) For off-road compression-ignition engines that are certified to the exhaust emission standards in title 13, CCR, section 2423.1, manufacturers are exempt from the label requirements of subsections (a), (b), and (c) of this section 2128 if all of the following conditions are met:

(1) The recall shall involve only software or software calibration repairs or changes and does not involve hardware repairs or changes.

(2) Throughout the useful life of the engine, the manufacturer shall keep and retain a record of the engine serial numbers of all pieces of equipment that were inspected or repaired, and

(3) Upon request from the Executive Officer, the manufacturer shall provide information within 14 calendar days about running changes, field fixes, service campaigns, and recalls for any given engine serial numbers from all pieces of equipment affected by the nonconformity.

Note: Authority cited: Sections 38501, 38505, 38510, 38560, 39600, 39601, 43013, 43018, and 43105, Health and Safety Code. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 43000, 43009.5, 43013, 43018, 43101, 43104, 43105, 43106, 43107, and 43204, 43205, and 43205.5, Health and Safety Code.

5. Amend Title 13, CCR, Division 3, Chapter 2, Article 2.3, Section 2137 to read as follows:

**§ 2137. Vehicle, Engine, and Trailer Selection.**

(a) Any vehicle or trailer of an engine family, test group, vehicle family, trailer family, any vehicle of a subgroup of an engine family, test group, vehicle family, or trailer family, or any engine used in a piece of equipment, manufactured for sale in California, shall be subject to these test procedures during its useful life. A minimum of ten (10) in-use vehicles, engines, or trailers determined by the California Air Resources Board (CARB) to be properly maintained and used will be procured and tested by ~~the~~ CARB or its designated laboratory to represent the emission characteristics of the engine family, test group, vehicle family, trailer family, or subgroup. ~~The~~ CARB may test less than ten (10) in-use vehicles, engines, or trailers if the manufacturer notifies the ARB in writing that the manufacturer will accept the results from less than ten (10) vehicles, engines, or trailers as being representative of the engine family, test group, vehicle family, trailer family, or subgroup.

(b) No vehicle, engine, or trailer shall be accepted by ~~the~~ CARB as a representative vehicle, engine, or trailer for enforcement testing unless the following criteria are met:

\* \* \* \* \*

(6) For off-road compression-ignition engines that are certified to the exhaust emission standards in title 13, CCR, section 2423 and are subject to recall testing, engines shall have an hour meter indication and engine age not exceeding the following periods:

(A) For all engines rated under 19 kilowatts, and for constant-speed engines rated under 37 kilowatts with rated speeds greater than or equal to 3,000 revolutions per minute, four years or 2,250 hours of operation, whichever first occurs.

\* \* \* \* \*

(7) For off-road compression-ignition engines that are certified to the exhaust emission standards in title 13, CCR, section 2423.1 and are subject to recall testing, engines shall have an hour meter indication and engine age not exceeding the following periods:

(A) For all engines rated under 19 kilowatts, and for constant-speed engines rated under 37 kilowatts with rated speeds greater than or equal to 3,000 revolutions per minute, six years or 2,250 hours of operation, whichever first occurs.

(B) For all other engines rated at or above 19 kilowatts and under 37 kilowatts, eight years or 3,750 hours of operation, whichever first occurs.

(C) For all engines rated at or above 37 kilowatts, eleven years or 6,000 hours of operation, whichever first occurs.

NOTE: Authority cited: Sections 38501, 38505, 38510, 38560, 39600, 39601, 43013, 43018, and 43105, Health and Safety Code. Reference: Health and Safety Code Sections 38501, 38505, 38510, 38560, 43000, 43009.5, 43013, 43016, 43018, 43101, 43104, 43105, 43106, 43107, 43154, ~~and 43204,~~ 43205, and 43205.5, Health and Safety Code.

6. Amend Title 13, CCR, Division 3, Chapter 2, Article 2.3, Section 2139 to read as follows:

**§ 2139. Testing.**

\* \* \* \* \*

(g) For off-road compression-ignition engines, in-use compliance tests shall be performed pursuant to section 2423, title 13, California Code of Regulations and the "2011-2028 Test Procedures," incorporated by reference in title 13, California Code of Regulations, section 2421, subsection (a)(4)(B) or section 2423.1, title 13, California Code of Regulations and the "2029 and Later Test Procedures," incorporated by reference in title 13, California Code of Regulations section 2423.1, subsection (b)(1)(A), as applicable. The in-use compliance testing shall use the same test procedure utilized for the specific engine's original certification testing.

\* \* \* \* \*

NOTE: Authority cited: Sections 38501, 38505, 38510, 38560, 39600, 39601, 43013, 43018, 43101, 43104, and 43105, Health and Safety Code. Reference: Sections 38501, 38505, 38510, 38560, 39002, 39003, 43000, 43009.5, 43013, 43016, 43018, 43100, 43101, 43101.5, 43102, 43103, 43104, 43105, 43106, 43107, 43154, 43204, 43205, 43205.5, and 43211, 43212, and 43213, Health and Safety Code.

7. Adopt new Title 13, CCR, Division 3, Chapter 2, Article 2.3, Section 2139.1 to read as follows:

Note: The entire text of section 2139.1 set forth below is new language and is shown in “normal type” proposed to be added to the California Code of Regulations.

**§ 2139.1. Testing for Off-Road Engine and Equipment In-Use Compliance.**

In-use compliance testing on off-road engines and equipment shall be conducted using the appropriate procedures in Part I-F of the “California Exhaust Emission Standards and Test Procedures for New 2011-2028 Tier 4 Off-Road Compression-Ignition Engines, Parts I-D, I-E, and I-F,” incorporated by reference in title 13, California Code of Regulations, section 2421, subsection (a)(4)(B), to identify equipment and engines that fail to conform to the applicable emission standards in title 13, California Code of Regulations, section 2423 or Part II of the “California Exhaust Emission Standards and Test Procedures for New 2029 and Later Tier 5 Off-Road Compression-Ignition Engines,” incorporated by reference in title 13, California Code of Regulations, section 2423.1, subsection (b)(1), to identify equipment and engines that fail to conform to the applicable emission standards in title 13, California Code of Regulations, section 2423.1, as applicable, and to take corrective action against the manufacturers of such equipment and engines based on the results of this testing.

NOTE: Authority cited: Sections 38501, 38505, 38510, 38560, 39600, 39601, 43013, 43016, 43018, 43101, 43104, and 43105, Health and Safety Code. Reference: Sections 38501, 38505, 38510, 38560, 39002, 39003, 43000, 43009.5, 43013, 43016, 43018, 43100, 43101, 43101.5, 43102, 43104, 43105, 43106, 43154, 43204, 43205, 43205.5, 43211, 43212, and 43213, Health and Safety Code.

8. Amend Title 13, CCR, Division 3, Chapter 2, Article 2.3, Section 2140 to read as follows:

**§ 2140. Notification and Use of Test Results.**

\* \* \* \* \*

(b) If the results of the in-use vehicle or trailer emission tests conducted pursuant to section 2139 indicate that the average emissions of the test vehicles or trailers for any pollutant exceed the applicable emission standards specified in title 13, California Code of Regulations, sections 1960.1, 1961, 1961.2, 1961.3, 1961.4, 1956.8, 1958, 2412, 2423, 2423.1, or 2442 or in title 17, California Code of Regulations, section 95663, the entire vehicle or trailer population so represented shall be deemed to exceed such standards. The Executive Officer shall notify the manufacturer of the test results and upon receipt of the notification, the manufacturer shall have 45 days to submit an influenced recall plan in accordance with sections 2113 through 2121, title 13, California Code of Regulations. If no such recall plan is submitted, the Executive Officer may order corrective action including recall of the affected vehicles or trailers in accordance with sections 2122 through 2135, title 13, California Code of Regulations.

\* \* \* \* \*

NOTE: Authority cited: Sections 38501, 38505, 38510, 38560, 39600, 39601, 43013, 43018, and 43105, Health and Safety Code. Reference: Sections 38501, 38505, 38510, 38560, 43000, 43009.5, 43013, 43016, 43018, 43101, 43104, 43105, 43106, 43107, 43154, 43204, ~~43205~~, 43205.5, and 43211, ~~43212~~, and 43213, Health and Safety Code.

9. Amend Title 13, CCR, Chapter 2, Article 2.4, Section 2143 to read as follows:

**§ 2143. Failure Levels Triggering Recall and Corrective Action.**

An engine family, test group, a vehicle family, a trailer family or a subgroup shall be subject to a recall when the number of failures of a specific emission-related component exceeds the failure level set forth below, unless the Executive Officer determines from the emission information report that a recall is unnecessary pursuant to the criteria set forth in section 2148, subsections (a) and (b). Vehicles or engines in an engine family or test group shall be recalled at the following failure levels: 4 percent or 50 (whichever is greater) for 1990 through 1991 model year vehicles or engines; 3 percent or 50 (whichever is greater) for 1992 through 1993 model-year vehicles or engines; and 2 percent or 50 (whichever is greater) for 1994 and subsequent model-year vehicles or engines, except off-road compression-ignition engines and equipment that are certified to Tier 5 interim or Tier 5 final exhaust emission standards in title 13, California Code of Regulations (CCR), section 2423.1. Model year 2020 and subsequent model-year trailers are subject to recall at the following rates: 2 percent or 50 units (whichever is greater). The Executive Officer may extend the applicability of the 4 or 3 percent failure levels if he/she determines that proceeding to the next lower level will create an excessive administrative burden on ~~the~~ CARB or the vehicle or trailer manufacturers without a corresponding benefit in the reduction of emissions.

In the case of 2024-2026 model year California-certified heavy-duty diesel and Otto-cycle engines, and heavy-duty vehicles, vehicles or engines in an engine family or test group shall be recalled or subject to other corrective action at the following failure levels: 4 percent or 25 units (whichever is greater). In the case of 2027-2030 model year California-certified heavy-duty diesel and Otto-cycle engines, and heavy-duty vehicles, vehicles or engines in an engine family or test group shall be recalled or subject to other corrective action at the following failure levels: 4 percent or 25 units (whichever is greater) for the first five years of the warranty period, and 5 percent or 35 units (whichever is greater) for years 6 through 7 of the warranty period. In the case of 2031 and subsequent model year California-certified heavy-duty diesel and Otto-cycle engines, and heavy-duty vehicles, vehicles or engines in an engine family or test group shall be recalled or subject to other corrective action at the following failure levels: 4 percent or 25 units (whichever is greater) for the first five years of the warranty period, 5 percent or 35 units (whichever is greater) for years 6 through 7 of the warranty period, and 7 percent or 50 units for years 8 through 10 of the warranty period.

For off-road compression-ignition engines that are certified to Tier 5 interim or Tier 5 final exhaust emission standards in title 13, CCR, section 2423.1, subsection (d)(1)(A)



engines or equipment in an engine family shall be recalled at the following failure level: 4 percent or 12 units (whichever is greater).

NOTE: Authority cited: Sections 38501, 38505, 38510, 38560, 39500, 39600, 39601, 43000.5, 43013, 43105, 43204, 43205.5, and 43214 Health and Safety Code.

Reference: Sections 38501, 38505, 38510, 38560, 43000, 43009.5, 43013, 43016, 43018, 43101, 43104, 43105, 43106, 43107, 43154, and 43204, 43205, and 43205.5, Health and Safety Code.

10. Amend Title 13, CCR, Division 3, Chapter 9, Article 4, Section 2420 to read as follows:

**§ 2420. Applicability.**

(a) General Provisions.

(1) This article shall be applicable to new heavy-duty off-road compression-ignition engines, including all heavy-duty off-road alternate-fueled compression-ignition engines, including those engines derived from existing diesel cycle engines (hereinafter, all such engines shall be referred to as compression-ignition engines), produced on or after January 1, 1996, and all other new 2000 model year and later model year off-road compression-ignition engines and those engines derived from existing diesel-cycle engines; with the exception of all engines and equipment that fall within the scope of the preemption of Section 209(e)(1) of the Federal Clean Air Act (42 U.S.C. § 7543(e)(1)) and as defined by regulation of the U.S. Environmental Protection Agency.

(2) Allowance for Non-Compression-Ignition Engines.

(A) For any engine that is not a distinctly a compression-ignition engine nor derived from such, except as described in subsection (B), below, the Executive Officer shall determine whether the engine shall be subject to these regulations, taking into consideration the relative similarity of the engine's torque-speed characteristics with those of compression-ignition engines. This provision also includes engines that have been designed to operate on alternate fuels, as defined in title 13, CCR, section 2421.1, subsection (b)(2).

(B) Provisions for 2029 and Subsequent Model Year Hydrogen-Fueled Internal Combustion Engines (H2-ICE).

1. Off-road engines designed to operate using hydrogen as a combustion fuel source, H2-ICE, shall automatically be subject to the compression-ignition standards and all the requirements in title 13, CCR, section 2423.1 if any of the following criteria apply except as specified in subsections 4, below:

a. The H2-ICE employs boosted air induction, including turbochargers, superchargers, or any variant thereof, e.g., electric-turbochargers.

b. The H2-ICE is designed to operate in equipment historically powered with an off-road compression-ignition engine.

c. The H2-ICE is derived from existing diesel cycle engines. For example, engines that share the same engine block configuration but utilize different cylinder head designs to convert from compression-ignition diesel-fueled engine to spark-ignition hydrogen-fueled engine would be considered derived from existing diesel cycle engines.

2. An H2-ICE shall not qualify for credits under the zero-emission credit program in title 13, CCR, section 2423.1, subsection (j).

3. An H2-ICE shall not be eligible for earning CO<sub>2</sub> credits under the CA-ABT provisions of title 13, CCR, section 2423.1, subsection (h), including the associated requirements of Part III: 40 CFR PART 1039, Subpart H of the "2029 and Later Test Procedures."

4. Off-road spark-ignition engines subject to phase-out requirements shall not be allowed to circumvent the phase-out requirements by incorporating H2-ICE that have been certified to the compression-ignition standards in title 13, CCR, section 2423.1, subsections (d) and (e), subsequent to the applicable phase-out periods.

(3) Every new off-road compression-ignition engine that is manufactured for sale, sold, offered for sale, introduced or delivered for introduction into commerce, or imported into California and that is subject to any of the standards prescribed in this article and documents incorporated by reference therein, is required to be certified for use and sale by the manufacturer through the California Air Resources Board (CARB) and covered by an Executive Order, issued pursuant to Chapter 9, Article 4, section 2423 or section 2423.1, as applicable.

\* \* \* \* \*

(d) *Military Tactical Vehicles or Equipment.*

\* \* \* \* \*

(3) On January 1, 1997, the U.S. Department of Defense shall submit to ~~the~~ CARB a list of all vehicle and equipment types that are exempted under the above provisions and which are located in the State of California. If any additional vehicle and equipment types are added to the list during the previous 12 months, the U.S. Department of Defense shall update the list and submit it to ~~the~~ CARB by January 1 of the following year.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102, 43104, and 43105, Health and Safety Code. Reference: Sections 43013, 43016, 43017, 43018, 43101, 43102, 43104, 43105, 43150, 43151, 43152, 43153, 43154, 43205.5, and 43210, 43210.5, 43211, and 43212, Health and Safety Code.

11. Amend Title 13, CCR, Chapter 9, Article 4, Section 2421 to read as follows:

**§ 2421. Definitions for Off-Road Compression-Ignition Engines and Equipment that Certify to Section 2423.**

(a) The definitions in Section 1900 (b), Chapter 3, Title 13 of the California Code of Regulations (CCR) shall apply to title 13, CCR, Division 3, Chapter 9, Article 4 with the following additions:

\* \* \* \* \*

(4)(B) "~~2011-2028 and Later Test Procedures~~" means the collection of documents titled "California Exhaust Emission Standards and Test Procedures for New ~~2011-2028 and Later~~ Tier 4 Off-Road Compression-Ignition Engines, Parts I-D, I-E, and I-F," which include, respectively, the emission standards, general compliance provisions, and engine testing procedures applicable to ~~2011-2028~~ model year ~~and later~~ off-road compression engines, as adopted October 25, 2012, as amended [INSERT DATE OF AMENDMENT]. These documents are incorporated by reference herein.

\* \* \* \* \*

(15) "Constant-speed engine" means

\* \* \* \* \*

(C) for engines subject to the ~~2011-2028 and Later~~ Test Procedures, an off-road compression-ignition engine certified to operate only at constant speed, where constant-speed operation means engine operation with a governor that automatically controls the operator demand to maintain engine speed, even under changing load. Governors do not always maintain speed exactly constant. Typically speed can decrease (0.1 to 10) % below the speed at zero load, such that the minimum speed occurs near the engine's point of maximum power.

\* \* \* \* \*

(35) "Maximum Engine Power" means the maximum brake power point on the nominal power curve for a specific engine configuration, rounded to the nearest whole kilowatt. The "nominal power curve" of an engine configuration means the relationship between maximum available engine brake power and engine speed for a specific engine configuration, as determined using the mapping procedures specified in Part 1065 of the 2008-2010 Test Procedures or Part I-F of the ~~2011-2028 and Later~~ Test Procedures as applicable, based on the manufacturer's design and production specifications for that engine. This relationship may also be expressed by a torque curve that relates maximum available engine torque with engine speed. The

nominal power curve shall be within the normal production variability of actual power curves for production engines of the same engine configuration. This definition of Maximum Engine Power shall be applicable for all references to a specific power value or range of power values with respect to engines subject to the 2008-2010 or 2011-~~2028~~ and ~~Later~~ Test Procedures as applicable, except as otherwise noted or permitted by the Executive Officer. Maximum Engine Power shall be used as the basis for categorizing engine families into appropriate Tier 4 power categories.

\* \* \* \* \*

(37) "Maximum Test Speed" has the same meaning as defined in Part 1065.1001 of the 2008-2010 and 2011-~~2028~~ and ~~Later~~ Test Procedures.

(38) "Model year" means the manufacturer's annual production period which includes January 1 of a calendar year or, if the manufacturer has no annual production period, the calendar year. Other examples for the determination of model year are identified in § 1039.801 of the 2008-2010 and the 2011-~~2028~~ and ~~Later~~ Test Procedures, as applicable.

\* \* \* \* \*

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102, and 43104, Health and Safety Code. Reference: Sections 43013, 43016, 43018, 43101, 43102, 43104, 43105, 43150, 43151, 43152, 43153, 43154, 43205.5, and 43210, 43210.5, 43211, and 43212, Health and Safety Code.

12. Adopt new Title 13, CCR, Division 3, Chapter 9, Article 4, Section 2421.1 to read as follows:

Note: The entire text of section 2421.1 set forth below is new language and is shown in "normal type" proposed to be added to the California Code of Regulations.

**§ 2421.1. Definitions for Off-Road Compression-Ignition Engines and Equipment that Certify to Section 2423.1.**

(a) The definitions in title 13, California Code of Regulations (CCR), section 1900, subsection (b) and in the "California 2029 and Later Model Year Test Procedures for Tier 5 Off-Road Compression-Ignition Engines," which is incorporated by reference in title 13, CCR, section 2423.1, subsection (b)(1) shall apply to title 13, CCR, Division 3, Chapter 9, Article 4, except that the definitions that apply to title 13, CCR, section 2422 are contained therein.

(b) In addition to the definitions incorporated under subsection (a), the following definitions shall govern the provisions of this Article;

(1) *Test Procedures.*

"2029 and Later Test Procedures" means the "California 2029 and Later Model Year Test Procedures for Tier 5 Off-Road Compression-Ignition Engines," which is incorporated by reference in title 13, CCR, section 2423.1, subsection (b)(1).

(2) *Definition of Terms.*

"*Applicable standard*" means an emission standard to which an engine is subject; or a family emission limit to which an engine is certified under an emission credit program in title 13, CCR, section 2423.1.

"*Alternate fuel*" means any fuel that will reduce non-methane hydrocarbons (on a reactivity-adjusted basis), oxides of nitrogen (NO<sub>x</sub>), carbon monoxide (CO), and the potential risk associated with toxic air contaminants as compared to gasoline or diesel fuel and would not result in increased deterioration of the engine. Alternate fuels include, but are not limited to: methanol, ethanol, liquefied petroleum gas, compressed natural gas, hydrogen, and electricity.

"*Applicable steady-state duty cycle*" means the manufacturer's choice of Steady-State Duty Cycle (either the discrete-mode testing duty cycle or the ramped modal testing duty cycle).

"*Assembly-line tests*" are those tests or inspections that are performed on or at the end of the assembly-line.

*"Auxiliary emission-control device"* means any element of design that senses temperature, motive speed, engine speed, transmission gear, or any other parameter for the purpose of activating, modulating, delaying, or deactivating the operation of any part of the emission-control system.

*"Blue Sky Series engine"* means an off-road compression-ignition engine meeting the requirements of title 13, CCR, section 2423.1, subsection (d)(7).

*"Calendar year"* is defined as the twelve-month period commencing on January 1 through December 31.

*"California averaging, banking, and trading program"* (CA-ABT) means the voluntary program that allows a manufacturer to average, bank, and trade emission credits for purposes of certification to show compliance with the standards in title 13, CCR, section 2423.1. CA-ABT only applies to engines and equipment produced and delivered for sale in California.

*"California small-volume engine manufacturer"* means an engine manufacturer that meets all of the following criteria:

(A) The manufacturer sells a total of 200 or fewer engines in California annually (including engines that are exempt from California regulation under section 209(e)(1) of the Federal Clean Air Act (42 U.S.C. § 7543(e)(1)) and that also sells a total of 60 or fewer engines in California annually that are subject to California emission standards. These totals include:

1. All new engines sold in a model year including those certified to the California Transition Program for Equipment Manufacturers requirements in title 13, CCR, section 2423.1, subsection (k) and those that do not meet the Tier 5 emission standards in title 13, CCR, section 2423.1, but are certified in California using the California Averaging, Banking, and Trading Program provisions in title 13, CCR, section 2423.1, subsection (h);

2. All new replacement engines produced under Part V: 40 CFR PART 1068, Subpart C, section 1068.240 of the "2029 and Later Test Procedures;" and

3. For manufacturers owned by a parent company, the total production volumes of the parent company and all its subsidiaries.

(B) The manufacturer has not previously certified Tier 5 engines as a non-California small-volume engine manufacturer.

*"CARB Enforcement Officer"* means any officer or employee of the California Air Resources Board so designated by the Executive Officer (or by their designee).

*"Certified configuration" or "certified emissions configuration"* means the assembled state of an engine that is equipped with a complete set of emission-related components and systems that are equivalent from an emissions standpoint (i.e., tolerances, calibrations, and specifications) to those components and systems that:

- (A) were originally installed on the engine when it was issued an Executive Order,
- (B) have been approved by the engine manufacturer to supersede any of the original emission-related components and systems for that engine, or
- (C) are direct replacement parts equaling or exceeding the emissions-related performance of the original or superseded components and systems.

*"Compression-ignition engine"* means a type of engine with operating characteristics significantly similar to the theoretical Diesel combustion cycle. The non-use of a throttle to regulate intake flow for controlling power during normal operation is indicative of a compression-ignition engine. A compression-ignition engine may be petroleum-fueled (i.e., diesel-fueled) or alternate-fueled. All engines and equipment that fall within the scope of the preemption of Section 209(e)(1) of the Federal Clean Air Act (42 U.S.C. 7543(e)(1)) and as defined by regulation of the United States Environmental Protection Agency, are specifically not included within this category.

*"Conformity factor"* means the ratio of the in-use emission test result to the applicable regulatory standard.

*"Constant-speed engine"* means an off-road compression-ignition engine certified to operate only at constant speed, where constant-speed operation means engine operation with a governor that automatically controls the operator demand to maintain engine speed, even under changing load. Governors do not always maintain speed exactly constant. Typically, speed can decrease 0.1 percent to 10 percent below the speed at zero load, such that the minimum speed occurs near the engine's point of maximum power.

*"Compliance testing"* means CARB-directed emissions tests and inspections of production engines and equipment that are offered for sale, or manufactured for sale, in California in order to verify compliance with the applicable certification emission standards. The emissions tests may be conducted at CARB or contracted out facilities or at the manufacturer's facility. The testing will be done at the



expense of the manufacturer. Compliance testing shall be conducted in accordance with Part II, Subpart C of the "2029 and Later Test Procedures."

*"Confirmatory testing"* means CARB directed emissions tests and inspections of the test engines and/or test vehicles used by the manufacturer to obtain test data for submittal with the certification application. The emissions tests may be conducted at CARB facilities, contracted out facilities, or at the manufacturer's facility. The testing will be done at the expense of the manufacturer.

*"Dealer"* means that person or entity engaged in the selling of new off-road compression-ignition engines, vehicles or equipment to ultimate purchasers.

*"Diesel Aftertreatment Rapid Aging Protocol (DARAP)"* means the method for generating durability cycles based on operational data inputs described in Part IV: 40 CFR PART 1065, Subpart L, sections 1065.1131 through 1065.1145, of the "2029 and Later Test Procedures."

*"Diesel cycle engine"* means a type of engine that operates according to the theoretical diesel combustion cycle. The primary means of controlling power output in a diesel cycle engine is by limiting the amount of fuel that is injected into the combustion chambers of the engine. A diesel cycle engine may be petroleum-fueled (i.e., diesel-fueled) or alternate-fueled.

*"Direct replacement part"* means a component that is identical in level of duty, function and design to the component it replaces, and can be fitted without making any additional modifications to the engine or to the equipment.

*"Emission-related component"* means an "emission-related part," as defined in title 13, CCR, section 1900, subsection (b)(3).

*"End of assembly line"* is defined as that place where the final inspection test or quality-audit test is performed.

*"Executive Officer"* means the Executive Officer of the California Air Resources Board.

*"Exhaust emissions"* means substances emitted into the atmosphere from any opening downstream from the exhaust port of an off-road engine.

*"Exhaust port"* means the passage in the cylinder head which connects the exhaust valve and the exhaust manifold. The emissions from the exhaust port are commonly referred to as "engine-out" emissions.

*"Extended Warranty"* means either of the following: 1) corrective action required by the Executive Officer that extends the warranty time periods in both hours and years for a specific emissions-related component pursuant to this article. The

extended warranty shall be at a minimum equal to or more than the applicable certified useful life period of that vehicle or engine. Direct notification of corrective action to vehicle or engine owners shall be required, or 2) additional coverage provided by an engine manufacturer, equipment manufacturer, or dealer, typically at additional cost to the purchaser, for repairs and maintenance beyond the original factory or regulatory base emissions warranty period(s). Extended warranties vary from the most comprehensive bumper-to-bumper coverage to more focused coverage including powertrains or aftermarket components.

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

*"Family emission limit"* (FEL) means an emission level that is declared by the manufacturer to serve in lieu of an emission standard for certification purposes (other than CO<sub>2</sub> standards) and for the California averaging, banking, and trading program, established in title 13, CCR, section 2423.1. For greenhouse gas standards, FEL means an emission level that serves as the standard that applies for testing individual certified engines. The CO<sub>2</sub> FEL is equal to the CO<sub>2</sub> FCL multiplied by 1.03. A FEL must be expressed to the same number of decimal places as the applicable emission standard.

*"Final calendar quarter production"* means the calendar quarter in which the production of an engine family ends.

*"First calendar quarter production"* means the calendar quarter in which the production of an engine family begins.

*"40 CFR"* means Title 40, Code of Federal Regulations.

*"Fuel-fired heater"* means a fuel burning device that creates heat for the purpose of warming the passenger compartment of a piece of equipment but does not contribute to the propulsion of the piece of equipment.

*"Gross engine malfunction"* is defined as one yielding an emission value greater than the sum of the mean plus three (3) times the standard deviation. This definition shall apply only for determination of control limits.

*"Historically Powered"* means the engine was produced and delivered for sale in California between calendar years 2010 and 2029.

*"Hybrid electric equipment"* means equipment that can draw energy from both of the following on-vehicle sources of stored energy: 1) a consumable fuel and 2) an energy storage device such as a battery, capacitor, or flywheel.

*"Incomplete rebuilt replacement engine"* means a rebuilt replacement engine that is sold or offered for sale in California without all the necessary components to enable engine operation including, but not necessarily limited to, the fuel system and the air system.

*"Manufacturer"* means any person who is engaged in the manufacturing or assembling of new off-road engines, vehicles, or equipment or the importing of new off-road engines, vehicles, or equipment for resale and who has been granted certification, or any person who acts for and is under the control of a manufacturer in connection with the distribution of new off-road engines, vehicles, or equipment. This includes "Engine manufacturers," "Off-road equipment manufacturers," and "Vehicle manufacturers." "Manufacturer" does not include a dealer who receives new off-road engines, vehicles, or equipment for sale in commerce, nor any person engaging in the manufacturing or assembling of new off-road engines, vehicles, or equipment who does not install an engine as part of that manufacturing or assembling process. All off-road vehicle or equipment manufacturing entities that are under the control of the same person are considered to be a single off-road vehicle manufacturer or off-road equipment manufacturer.

*"Nonroad Compression-Ignition Composite Transient Cycle"* is defined in Part III: 40 CFR PART 1039, Appendix VI to Part 1039 - Nonroad Compression-Ignition Composite Transient Cycle of the "2029 and Later Test Procedures."

*"Normal production and inventory practices"* means those practices typically employed for similar engine families in years in which emission standards do not change.

*"Off-road compression-ignition engine"* means an engine that meets the definition of a "nonroad engine" in Part V: 40 CFR PART 1068, Subpart A, section 1068.30 of the "2029 and Later Test Procedures."

*"Off-road engine manufacturer"* means a manufacturer in connection with the distribution of new off-road engines.

*"Off-road equipment manufacturer"* means a manufacturer of new off-road equipment or importer of new off-road equipment.

*"Off-road vehicle"* or "Off-road equipment" means a vehicle or equipment that is powered by an off-road compression-ignition engine.

*"Off-road vehicle manufacturer"* means a manufacturer of new off-road vehicles or equipment or importer of new off-road vehicles.

*"Otto cycle engine"* means a type of engine with operating characteristics that operates according to the theoretical Otto combustion cycle. The primary means of controlling power output in an Otto cycle engine is by limiting the amount of air and fuel that can enter the combustion chambers of the engine. Gasoline-fueled engines are Otto cycle engines.

*"Power category"* means a specific range of maximum power that defines the applicability of standards. For example, references to the 56-130 kW power category and  $56 \leq \text{kW} < 130$  include all engines with maximum power at or above 56 kW but below 130 kW. Also references to 56-560 kW power categories or  $56 \leq \text{kW} \leq 560$  include all engines with maximum power at or above 56 kW, but at or below 560 kW, even though these engines span multiple power categories. Note that in some cases, FEL caps are based on a subset of a power category. The Tier 5 applicable power categories are defined as follows:

- (A) Engines with maximum engine power below 8 kW.
- (B) Engines with maximum engine power at or above 8 kW but below 19 kW.
- (C) Engines with maximum engine power at or above 19 kW but below 56 kW.
- (D) Engines with maximum engine power at or above 56 kW but below 130 kW.
- (E) Engines with maximum engine power at or above 130 kW but at or below 560 kW.
- (F) Engines with maximum engine power above 560 kW.

*"Quality-audit test"* is defined as the test performed on a sample of production engines produced for sale in California.

*"Rebuilder"* means any person who rebuilds engines for which the practices in title 13, CCR, section 2423.1, subsection (q)(1)(A) apply.

*"Replacement engine"* means a new compression-ignition off-road engine that is used to replace an engine that has already been placed into service (whether the previous engine is replaced in whole or in part with a new engine).

*"Representative engine sample"* means that the sample is typical of the engine family or engine family group as a whole (as defined in applicable test procedures).

*"Small off-road engine"* has the meaning specified in title 13, CCR, section 2401.

*"Small-volume engine manufacturer"* has the same meaning as a "California small-volume engine manufacturer," unless otherwise stated in the regulation.

*"Steady-state duty cycles"* are defined as follows:

(A) "Discrete-mode testing duty cycles" are contained in subparagraphs (a)(1), (b)(1), and (c)(1) of Appendix II to 40 CFR, Part 1039 of the "2029 and Later Test Procedures."

(B) "Ramped modal testing duty cycles" (RMC) are contained in subparagraphs (a)(2), (b)(2), and (c)(2) of Appendix II to 40 CFR, Part 1039 of the "2029 and Later Test Procedures."

*"Tested engine configuration"* means an engine configuration selected for testing. Different configurations may be used for criteria pollutant emission testing and for greenhouse gas emission testing. For criteria pollutant emission testing, the configuration with the highest volume of fuel injected per cylinder per combustion cycle at the point of maximum torque must be selected – unless good engineering judgment indicates that a different engine configuration is more likely to exceed (or have emissions nearer to) an applicable emission standard or FEL. For greenhouse gas emission testing, one or more configurations that meet the Family Certification Level must be chosen as specified in title 13, CCR, section 2423.1, subsection (e)(4).

*"Tier 4 engine"* means an engine that is certified to the Tier 4 interim or Tier 4 final emission standards in title 13, CCR, section 2423, subsection (b)(1)(B).

*"Tier 5 engine"* means an engine that is certified to the Tier 5 interim or Tier 5 final emission standards in title 13, CCR, section 2423.1.

*"Transport refrigeration unit (TRU)"* is defined in title 13, CCR, section 2477.4.

*"Unscheduled maintenance"* means any inspection, adjustment, repair, removal, disassembly, cleaning, or replacement of components or systems that is performed to correct or diagnose a part failure that was not anticipated.

*"Useful life"* means:

(A) For all Tier 5 engines rated under 19 kilowatts, and for constant-speed engines rated under 37 kilowatts with rated speeds greater than or equal to 3,000 revolutions per minute, a period of use of eight years or 3,000 hours of operation, whichever first occurs.

(B) For all other Tier 5 engines rated at or above 19 kilowatts and under 37 kilowatts, a period of use of eleven years or 5,000 hours of operation, whichever first occurs.

(C) For all Tier 5 engines rated at or above 37 kilowatts, a period of use of 15 years or 8,000 hours, whichever first occurs.

*"Variant engine configuration"* means an engine in the same engine family as the tested engine configuration, but which is calibrated differently such that greenhouse gas exhaust emissions may exceed the tested engine family's emissions levels.

*"Warrantable condition"* means any condition of an engine that triggers the responsibility of the manufacturer to take corrective action pursuant to title 13, CCR, section 2425.

*"Warranted part"* means any emissions-related component installed on an engine by the equipment or engine manufacturer, or installed in a warranty repair, which is listed on the warranty parts list.

*"Warranty period"* means the period of time, either in years or hours of operation, that the engine or part is covered by the warranty provisions.

*"Warranty station"* means a service facility authorized by the equipment or engine manufacturer to perform warranty repairs. This shall include all manufacturer distribution centers that are franchised to service the subject equipment or engines.

*"Zero-emission equipment"* means off-road vehicles or equipment with a powertrain that produces zero emissions of any regulated criteria pollutant, precursor pollutant, air toxics, or greenhouse gas under any possible operational modes or conditions. Equipment that uses a fuel-fired heater does not qualify as "zero-emission equipment."

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102, and 43104, Health and Safety Code. Reference: Sections 43013, 43016, 43018, 43101, 43102, 43104, 43105, 43150, 43151, 43152, 43153, 43154, 43205.5, and 43210, 43210.5, 43211, and 43212, Health and Safety Code.

4. Amend Title 13, CCR, Chapter 9, Article 4, Section 2422 to read as follows:

Note: Section 2422 does not currently contain any text. The current section number 2422 and title “[Reserved]” are being deleted in their entirety.

**~~§ 2422. —[Reserved].~~**

5. Adopt new Title 13, CCR, Chapter 9, Article 4, Section 2422 to read as follows:

Note: The entire text of section 2422 set forth below is new language and is shown in “normal type” proposed to be added to the California Code of Regulations.

**§ 2422. On-Board Diagnostics Requirements - 2029 and Subsequent Model Year Off-Road Diesel Engines Certified to the Tier 5 Emission Standards.**

(a) *Purpose.*

The purpose of this regulation is to reduce off-road diesel engine emissions by establishing requirements for off-road on-board diagnostic (OR OBD) systems on diesel engines certified for sale in off-road applications in California. The OR OBD systems, through the use of an on-board computer(s), shall monitor emission systems in-use for the actual life of the engine and shall be capable of detecting malfunctions of the monitored emission systems, illuminating a malfunction indicator light (MIL) to notify the equipment operator of detected malfunctions, and storing fault codes identifying the detected malfunctions. Unless otherwise noted, all section references in this regulation refer to section 2422 of title 13, California Code of Regulations (CCR).

(b) *Applicability.*

Manufacturers shall not sell, offer for sale, import, distribute, or enter into commerce in California any electronically-controlled off-road diesel engines unless they meet all requirements of this section.

All electronically-controlled off-road diesel engines certified to the Tier 5 emission standards in title 13, CCR section 2423.1 shall be equipped with an OR OBD system that has been certified by the Executive Officer as meeting all applicable requirements of this regulation (title 13, CCR section 2422).

(c) *Definitions.*

For the purposes of section 2422, the following definitions apply.

“*3B-MAW*” means 3-bin moving average window.

“*Actual life*” means the entire period that an engine is operated in California up to the time the engine is retired from use.

*"Applicable standards"* means the specific Tier 5 emission standards (transient test standard or steady-state test standard) to which the engine is certified.

*"Auxiliary emission-control device (AECD)"* is defined in title 13, CCR section 2421.1(b)(2).

*"Calibration verification number"* means a calculated number that is used to verify the integrity of the computer software and calibration information on an on-board electronic control unit.

*"Closed crankcase ventilation (CV) system"* means as a form of crankcase ventilation system that vents to the intake or the exhaust, but not to the atmosphere.

*"CO"* means carbon monoxide.

*"CV valve"* means as any form of valve, orifice, and/or filter/separator used to restrict, control, or alter the composition (e.g., remove oil vapor or particulate matter) of the crankcase vapor flow.

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

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

*"Diagnostic or emission critical electronic control unit (DEC ECU)"* means an on-board electronic control unit (e.g., the engine control module) that is field reprogrammable and satisfies any of the following:

- (1) Controls fuel injection timing or quantity, fuel pressure level, cylinder deactivation, exhaust gas recirculation (EGR) valve position, variable geometry turbocharger position, turbocharger boost level, diesel exhaust fluid (DEF) injection quantity, aftertreatment thermal management strategies, AECD operation, particulate matter (PM) filter regeneration, oxides of nitrogen (NO<sub>x</sub>) sensor functions, or PM sensor functions;



- (2) Has primary control over a monitor/diagnostic required by section (f) except sections (f)(1)(G) and (f)(2)(G); or
- (3) Has primary control over a rationality fault diagnostic or functional check for any input or output component required to be monitored by section (f)(1)(G) or (f)(2)(G).

For purposes of this definition, "primary control" over a monitor/diagnostic means the control unit does any of the following: (a) determines if any enable conditions are satisfied; (b) calculates all or part of the diagnostic decision statistic or metric by which pass or fail decisions are made (e.g., the comparison of a component's measured or calculated level of performance to a malfunction threshold); or (c) makes or processes pass or fail decisions (e.g., debounces diagnostic decision statistics or commands MIL illumination or fault code storage).

*"Diesel engine"* means a "Diesel cycle engine" as defined in title 13, CCR section 2421.1, subsection (b)(2).

*"Engine rating"* means a unique combination of displacement, rated power, and rated torque within an engine family. An engine rating may include multiple engine configurations with different software and/or calibrations.

*"OR OBD parent rating"* means the engine rating with the highest projected California sales of all engine ratings within an engine family in the model year for which that engine family must first comply with Stage 2 requirements according to section (d). The manufacturer shall determine the engine rating with the highest projected California sales based on sales data from the previous 3 model years and projected market demand. For engines without 3 years of sales data history, the manufacturer shall estimate the highest projected sales based on available market data.

*"OR OBD child rating"* means an engine rating within an engine family that is not the OR OBD parent rating.

*"Engine start"* means the point when the engine reaches a speed 150 revolutions-per-minute (rpm) below the normal, warmed-up idle speed.

*"Field reprogrammable"* means capable of supporting a manufacturer service procedure intended to be executed in a dealership or other equipment service environment (e.g., by over-the-air reprogramming) that results in the downloading of new software and/or calibration data into the control unit or device.

*"Final inducement"* means the final derating of engine operation to idle only or engine shutdown that shall occur if an engine's SCR (selective catalytic reduction) system is not working properly consistent with the requirements of "Part VI: Additional California Tier 5 Requirements, Subpart A - Inducements Related to Selective Catalytic Reduction (SCR)", of the "2029 and Later Test Procedures," incorporated by reference herein.

*"Functional check"* for an output component or system means a diagnostic that verifies proper response of the component and system to a computer command.

*"General denominator"* means a measure of the number of times an engine has been operated as defined in section (e)(2)(D)4.b.

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

*"Ignition cycle counter"* means a counter that indicates the number of ignition cycles an engine has experienced as defined in section (e)(2)(D)3.b.

*"Inducement"* means any strategy used on an engine to satisfy the requirements of "Part VI: Additional California Tier 5 Requirements, Subpart A - Inducements Related to Selective Catalytic Reduction (SCR)", of the "2029 and Later Test Procedures," incorporated by reference in title 13, CCR, section 2423.1, subsection (b)(1)(A).

*"Infrequent,"* with regards to regeneration, means having an expected frequency of on average less than once over a transient or ramped-modal duty cycle, or on average less than once per mode in a discrete-mode test.

*"Malfunction"* means any deterioration or failure of a component or system that causes the performance to be outside of the applicable limits in section (f).

*"Malfunction preconditioning cycle"* means a test cycle that meets the requirements of section (g)(4)(D)1.b. or c.

*"Manufacturer"* means the holder of the Executive Order for the engine family.

*"MIL"* means malfunction indicator light.

*"MIL-on fault code,"* means the diagnostic trouble code stored when an OBD system has confirmed that a malfunction exists (e.g., during the second operating cycle that the malfunction is detected) and has commanded the MIL on in accordance with the requirements of sections (e)(3) and (f).

*"NMHC"* means non-methane hydrocarbon.

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

*"NO<sub>x</sub>"* means oxides of nitrogen.

*"Operating cycle"* means a period of engine operation that consists of engine start and engine shutoff. For monitors/diagnostics that run during engine-off conditions, the period of engine off time following engine shutoff and up to the next engine start shall be considered part of the operating cycle. For equipment that employ engine shutoff strategies (e.g., engine shutoff at idle), the manufacturer may request Executive Officer approval to use an alternate definition for operating cycle (e.g., key on and key off). Executive Officer approval of the alternate definition shall be based on equivalence to engine start and engine shutoff signaling the beginning and ending of a single driving event for conventional equipment.

*"OR OBD data snapshot"* means all of the applicable data described in sections (e)(2)(C) through (e)(2)(F) and sections (e)(3)(B) through (e)(3)(F), obtained by a tool (e.g., scan tool) at one point in time.

*"Pending fault code"* means the diagnostic trouble code stored upon the initial detection of a malfunction (e.g., during the first operating cycle the malfunction is detected) prior to illumination of the MIL in accordance with the requirements of sections (e)(3) and (f).

*"PM"* means particulate matter.

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

*"Regeneration"* means an event during which emissions levels change while the emission control performance is being restored by design. Regeneration events include, for example, PM filter soot oxidation, catalyst desulfurization, and decrystallization events.

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

For example, for NO<sub>x</sub> sensors, response rate is the delay from when the sensor is exposed to a different NO<sub>x</sub> exhaust gas level until it indicates the different NO<sub>x</sub> exhaust gas level.

*"Start of engine production"* means the time when the manufacturer has produced two percent of the projected volume for the engine. In section (i), the start of engine production shall be based on the engine rating subject to the specific regulatory provision.

*"Start of equipment production"* means the time when the manufacturer has produced two percent of the projected volume for the equipment. In section (i), the start of equipment production shall be based on the engine rating and equipment combination for the engine rating subject to the specific regulatory provision.

*"Steady-state test"* means an exhaust emission test conducted according to the test procedures incorporated by reference in title 13, CCR section 2423(c) that is used to determine compliance with the steady-state test standard to which an engine is certified.

*"Discrete-Mode Cycle"* means the discrete-mode variant of the engine dynamometer schedules in 40 CFR appendix II of part 1039, entitled, "Steady-State Duty Cycles," as defined in title 13, CCR, section 2421.1, subsection (b)(2).

*"Ramped-Modal Cycle (RMC)"* means the ramped-modal variant of the engine dynamometer schedules in 40 CFR appendix II of part 1039, entitled, "Steady-State Duty Cycles," as defined in title 13, CCR, section 2421.1, subsection (b)(2).

*"Steady-state test standard"* means the certification exhaust emission standards and test procedures applicable to the RMC or discrete-mode cycle incorporated by reference in title 13, CCR section 2423.1(d)(1) to which the engine is certified.

*"Tailpipe NO<sub>x</sub> sensor"* means an exhaust gas sensor that measures oxides of nitrogen (NO<sub>x</sub>) concentration at a location in an engine's exhaust system where the NO<sub>x</sub> concentration of the exhaust gas is equivalent to the NO<sub>x</sub> concentration of the exhaust gas just before it leaves the exhaust system and enters the atmosphere.

*"Tier 5 emission standards"* means the Tier 5 interim and Tier 5 final emission standards in title 13, CCR section 2423.1.

"Tier 5 engine" means an engine that is certified to the Tier 5 emission standards.

"Transient test" means an exhaust emission test conducted according to the test procedures incorporated by reference in title 13, CCR section 2423(c) that is used to determine compliance with the transient test standard to which an engine is certified.

"Low Load Cycle (LLC)" means the engine dynamometer schedule in Part VI, Subpart B of the "2029 and Later Test Procedures."

"Nonroad Transient Test Cycle (NRTC)" means the engine dynamometer schedule in Part III: 40 CFR PART 1039, Appendix VI to Part 1039 - Nonroad Compression-ignition Composite Transient Cycle of the "2029 and Later Test Procedures."

"Transient test standard" means the certification exhaust emission standards and test procedures applicable to the NRTC incorporated by reference in title 13, CCR section 2423(b) to which the engine is certified.

(d) *Implementation Requirements.*

Tier 5 engines that are electronically-controlled shall meet the Stage 1 and Stage 2 requirements in sections (d)(1) and (d)(2), respectively, in accordance with the implementation schedule in section (d)(3).

(1) *Stage 1 Requirements.*

- (A) Phase 1 standardization requirements in sections (e)(1) and (e)(2),
- (B) Certification documentation requirements in sections (h)(1), (h)(2)(A), and (h)(3),
- (C) Deficiencies requirements in section (j), and
- (D) Enforcement requirements in section (k).

(2) *Stage 2 Requirements.*

(A) *On-Board Monitoring and Diagnostics (OBMD) Engines.* For Tier 5 engines equipped with a selective catalytic reduction (SCR) system(s) or a tailpipe NOx sensor, Stage 2 requirements consist of the following:

1. Phase 1 standardization requirements in sections (e)(1) and (e)(2),
2. Phase 2 standardization requirements in section (e)(3),
3. OBMD diagnostic requirements in sections (f)(1) and (f)(3) through (f)(6),

4. Demonstration testing requirements in section (g),
5. Certification documentation requirements in sections (h)(1), (h)(2)(B), and (h)(3),
6. Post-certification verification requirements in section (i),
7. Deficiencies requirements in section (j), and
8. Enforcement requirements in section (k).

(B) *On-Board Diagnostic (OBD) Engines.* For Tier 5 engines that are not equipped with an SCR system(s) or a tailpipe NOx sensor, Stage 2 requirements consist of the following:

1. Phase 1 standardization requirements in sections (e)(1) and (e)(2),
2. Phase 2 standardization requirements in section (e)(3),
3. OBD diagnostic requirements in section (f)(2) through (f)(6),
4. Demonstration testing requirements in section (g),
5. Certification documentation requirements in sections (h)(1), (h)(2)(B), and (h)(3),
6. Post-certification verification requirements in section (i),
7. Deficiencies requirements in section (j), and
8. Enforcement requirements in section (k).

(3) *Implementation Schedule.*

(A) The implementation schedule by engine model year (MY) and power category (kilowatt (kW)) for OR OBD parent ratings is shown in Table 1 below.

(B) The implementation schedule by engine model year and power category for OR OBD child ratings is shown in Table 2 below.

*Table 1. Implementation Schedule for OR OBD Parent Ratings*

Power Category	Stage 1	Stage 2
< 19 kW	2031-2033 MY	2034+ MY
$19 \leq \text{kW} < 56$	2031-2033 MY	2034+ MY
$56 \leq \text{kW} < 130$	2031-2033 MY	2034+ MY
$130 \leq \text{kW} \leq 560$	2029-2032 MY	2033+ MY
> 560 kW	2030-2033 MY	2034+ MY

*Table 2. Implementation Schedule for OR OBD Child Ratings*

Power Category	Stage 1	Stage 2
< 19 kW	2031-2036 MY	2037+ MY
$19 \leq \text{kW} < 56$	2031-2036 MY	2037+ MY
$56 \leq \text{kW} < 130$	2031-2036 MY	2037+ MY
$130 \leq \text{kW} \leq 560$	2029-2035 MY	2036+ MY
> 560 kW	2030-2036 MY	2037+ MY

(e) *Standardization Requirements.*

(1) *Documents Incorporated by Reference.*

The following SAE International (SAE) and International Organization for Standardization (ISO) documents are incorporated by reference into this regulation:

**<documents/dates TBD>**

(A) SAE J1930 "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms - Equivalent to ISO/TR 15031-2," March 2017 (SAE J1930).

(B) SAE J1930-DA "Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms Web Tool Spreadsheet," March 2017.

(C) SAE J1939, which consists of:

1. SAE J1939 "Serial Control and Communications Heavy Duty Vehicle Network - Top Level Document," August 2013.

2. SAE J1939-DA "Digital Annex of Serial Control and Communication Heavy Duty Vehicle Network Data," April 2019.

3. SAE J1939-1 "On-Highway Equipment Control and Communication Network," November 2012.

4. SAE J1939-11 "Physical Layer, 250 Kbps, Twisted Shielded Pair," December 2016.

5. SAE J1939-13, "Off-Board Diagnostic Connector," October 2016 (SAE J1939-13).

6. SAE J1939-15 "Physical Layer, 250 Kbps, Un-Shielded Twisted Pair (UTP)," August 2015.

7. SAE J1939-21 "Data Link Layer," March 2016.

8. SAE J1939-31 "Network Layer," April 2014.

9. SAE J1939-71 "Vehicle Application Layer," October 2016.

10. SAE J1939-73 "Application Layer-Diagnostics," May 2017.

11. SAE J1939-81 "Network Management," March 2017.

12. SAE J1939-84 "OBD Communications Compliance Test Cases for Heavy Duty Components and Vehicles," October 2017.

(D) SAE J2403 "Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature," August 2020 (SAE J2403).

(E) ISO 2575:2021 "Road vehicles - Symbols for controls, indicators and tell-tales," September 2021 (ISO 2757).

(2) *Phase 1 Standardization Requirements.* The requirements of this section apply to engines required to meet the Phase 1 standardization requirements in accordance with section (d).

(A) *Communication Protocol.* The manufacturer shall use SAE J1939 for communication of all required OR OBD-related messages from on-board to off-board network communications to a scan tool designed to communicate with an SAE J1939 network. All required OR OBD-related messages using this protocol shall use the 500 kilobits per second baud rate.

(B) *Diagnostic Link Connector.*

1. The off-road equipment shall incorporate a standard data link connector that conforms to the "Type 2" specifications of SAE J1939-13.



2. Except as provided in section (e)(2)(B)5., the connector shall be located near the operator controls or the engine's power switch. The location of the connector shall be in plain, unobstructed view of a person facing the operator controls or engine power switch.

3. Except as provided in section (e)(2)(B)5., the connector shall not be covered with or located behind any form of panel, access door, or storage device (e.g., fuse panel cover, hinged door, ashtray, coinbox) that requires opening or removal to access the connector.

4. The connector shall be mounted in a manner that allows operation of the equipment (e.g., does not interfere with use of the operator controls) while a scan tool is connected to the connector. The connector may be equipped with a dust cap in the shape and size of the diagnostic connector for environmental protection purposes, but the dust cap shall be removable by hand without the use of any tools and be labeled "OBD" to aid technicians in identifying the connector.

5. If it is not technically feasible for the connector to meet the requirements of section (e)(2)(B)2. or 3., the connector may be located in an alternate location or may be covered if the manufacturer applies a durable label to the exterior of the equipment that indicates the location of the connector and the connector location is accessible by hand without requiring the use of tools or removal of parts. The manufacturer shall provide details on the connector location and the label in the certification application pursuant to section (h)(2).

6. **<reserve section for possible language about "embedded service tool" concept>**

(C) *Data Stream Parameters.* The OR OBD system shall make available the following signals on demand through the diagnostic link connector in accordance with SAE J1939 specifications. The signals shall be accessible to a scan tool designed to communicate with an SAE J1939 network. The OR OBD system shall always use the actual signal value instead of a default or limp home value.

1. For all engines:
  - a. Certification-Critical Parameters.
    - i. Engine speed,
    - ii. Actual indicated engine torque (as a percentage of reference engine maximum torque),

- iii. Nominal engine friction torque (as a percentage of reference engine maximum torque),
  - iv. Reference engine maximum torque,
  - v. Engine percent load at current speed,
  - vi. Engine fuel rate,
  - vii. Engine coolant temperature,
  - viii. PM filter regeneration status,
  - ix. Ambient air temperature,
  - x. Barometric pressure,
  - xi. Engine intake manifold temperature,
  - xii. Engine intake manifold pressure,
  - xiii. Engine out exhaust temperature (upstream of all aftertreatment components; e.g., diesel oxidation catalyst inlet temperature is acceptable if the diesel oxidation catalyst is the first component in the aftertreatment system),
  - xiv. SCR outlet temperature (for engines with SCR),
  - xv. Engine family name,
  - xvi. Engine serial number,
  - xvii. Engine rated power,
  - xviii. Engine rated speed, *and*
  - xix. OR OBD requirements to which the engine is certified.
- b. Additional Standard Parameters.
- i. Engine oil temperature,
  - ii. Engine control module system voltage, *and*
  - iii. Modeled exhaust flow rate (mass/time).
2. For all engines so equipped:
- a. Primary Parameters.
    - i. Normalized trigger for PM filter regeneration,
    - ii. Fuel pressure,

- iii. Fuel injection timing,
- iv. Engine intercooler temperature,
- v. Air flow rate from mass air flow sensor,
- vi. Commanded EGR valve duty cycle/position,
- vii. Actual EGR valve duty cycle/position,
- viii. EGR error between actual and commanded,
- ix. Absolute pedal position,
- x. Boost pressure,
- xi. Commanded/target boost pressure,
- xii. Turbocharger inlet air temperature,
- xiii. Fuel rail pressure,
- xiv. Commanded fuel rail pressure,
- xv. PM filter inlet temperature,
- xvi. PM filter outlet temperature,
- xvii. PM filter delta pressure,
- xviii. Exhaust gas temperature sensor output,
- xix. Variable geometry turbocharger position,
- xx. Commanded variable geometry turbocharger position,
- xxi. Turbocharger compressor inlet temperature,
- xxii. Turbocharger compressor inlet pressure,
- xxiii. Turbocharger turbine inlet temperature,
- xxiv. Turbocharger turbine outlet temperature,
- xxv. Wastegate valve position,
- xxvi. Glow plug lamp status,
- xxvii. EGR temperature,
- xxviii. Variable geometry turbocharger control status (e.g., open loop, closed loop),
- xxix. Reductant level (e.g., DEF tank fill level),

- xxx. Oxygen sensor output,
- xxxi. Air/fuel ratio sensor output,
- xxxii. NOx sensor output,
- xxxiii. Corrected NOx sensor output (the corrected NOx concentration used by the applicable ECU),
- xxxiv. PM sensor output,
- xxxv. Engine hours of operation while low/empty SCR reductant operator warning/inducement active,
- xxxvi. Reductant quality sensor output,
- xxxvii. NOx mass emission rate - engine out,
- xxxviii. NOx mass emission rate - tailpipe,
- xxxix. Commanded DEF dosing,
  - xl. DEF dosing mode (A, B, C, etc.),
  - xli. DEF dosing rate,
  - xl. Target ammonia storage level on SCR,
  - xl. Modeled actual ammonia storage level on SCR,
  - xliv. SCR intake temperature,
  - xl. SCR outlet temperature,
  - xlvi. Stability of NOx sensor reading,
  - xl. EGR mass flow rate,
  - xl. Engine fuel rate,
  - xl. Equipment fuel rate,
    - I. Hydrocarbon doser flow rate,
    - li. Charge air cooler outlet temperature,
    - lii. Crankcase pressure sensor output,
    - liii. Crankcase oil separator rotational speed,
    - liv. Fuel pressure from the high-pressure and low-pressure fuel system,

- iv. Vehicle speed,
- lvi. NOx adsorber regeneration status, and
- lvii. NOx adsorber desulfurization status.

b. For engines that have inducement and/or engine derate strategies, all parameters in 40 CFR section 1036.110(b)(9) for which the associated components must satisfy the diagnostic requirements in sections (f)(1) or (f)(2).

3. Any physical inputs and outputs used by OR OBD system diagnostics which are not listed above.

4. Any physical inputs and outputs used by AECDs which are not listed above.

5. Any physical inputs and outputs used by OR-REAL calculations which are not listed above.

6. Any physical inputs and outputs used by inducements which are not listed above.

7. Any physical inputs and outputs used by the engine cooling system which are not listed above.

8. Any physical inputs and outputs used by the lubrication system which are not listed above.

(D) *Tracking Data.*

1. *Off-Road Real Emissions Assessment Logging (OR-REAL) Data.* For engines equipped with an SCR system or a tailpipe NOx sensor, the OR OBD system shall comply with the OR-REAL tracking requirements described below:

a. The manufacturer shall implement software algorithms to track and report in a standardized format the following parameters in the units specified in the parentheses:

- i. NOx mass - engine out (grams (g)),
- ii. NOx mass - tailpipe (g),
- iii. Engine output energy (kilowatt-hours (kWh)),
- iv. Engine run time (hours), and
- v. Equipment fuel consumption (liters).

b. The OR OBD system shall store the parameters in section (e)(2)(D)1.a. into the four data arrays described below. The OR OBD system shall update the data in each array every second using signals that are sampled at a frequency of at least 1 Hertz.

i. Active 50 Hour Array.

I. When the NO<sub>x</sub> sensors used to determine the NO<sub>x</sub> mass parameters listed in section (e)(2)(D)1.a. are all reporting valid NO<sub>x</sub> concentration data, the OR OBD system shall store data for all parameters in section (e)(2)(D)1.a. into the Active 50 Hour Array.

II. When the total engine run time value that is stored in Bin 1 (defined in section (e)(2)(D)1.c.i. below) of the Active 50 Hour Array reaches 50 hours, the OR OBD system shall transfer all stored data to the Stored 50 Hour Array described in section (e)(2)(D)1.b.ii. The OR OBD system shall reset all data in the Active 50 Hour Array to zero and begin incrementing anew.

ii. Stored 50 Hour Array.

I. The Stored 50 Hour Array is a static repository for data stored by the Active 50 Hour Array. The OR OBD system shall overwrite the stored 50 Hour Array data with the data stored in the Active 50 Hour Array only when the total engine run time stored in Bin 1 (defined in section (e)(2)(D)1.c.i. below) of the Active 50 Hour Array reaches 50 hours.

iii. Lifetime Array.

I. When the NO<sub>x</sub> sensors used to determine the NO<sub>x</sub> mass parameters listed in section (e)(2)(D)1.a. are all reporting valid NO<sub>x</sub> concentration data, the OR OBD system shall store data for all parameters in section (e)(2)(D)1.a. into the Lifetime Array.

II. The Lifetime Array shall maintain a running total of parameter data for the actual life of the engine.

iv. Lifetime Engine Activity Array.

I. The OR OBD system shall store the parameters in section (e)(2)(D)1.a.iii. through v. into the Lifetime Engine Activity Array whenever the engine is running regardless of NO<sub>x</sub> sensor status.

II. The Lifetime Engine Activity Array shall maintain a running total of parameter data for the actual life of the engine.

c. The OR OBD system shall store each parameter in each array in section (e)(2)(D)1.b. into a series of bins that are defined as indicated below. Table 3 indicates the bins that are assigned to each array and to each parameter. References to "rated power" mean the engine's rated net brake power.

i. "Bin 1" shall store the total value of the parameter in a given array. The values in Bins 2 through 13 shall sum to equal the value in Bin 1.

ii. Bins that store data when the engine power output is less than or equal to 25 percent of rated power:

I. "Bin 2" is for SCR outlet temperatures less than or equal to 200 degrees Celsius;

II. "Bin 3" is for SCR outlet temperatures greater than 200 degrees Celsius and less than or equal to 250 degrees Celsius;

III. "Bin 4" is for SCR outlet temperatures greater than 250 degrees Celsius and less than or equal to 400 degrees Celsius;

IV. "Bin 5" is for SCR outlet temperatures greater than 400 degrees Celsius.

iii. Bins that store data when the engine power output is greater than 25 percent of rated power and less than or equal to 50 percent of rated power:

I. "Bin 6" is for SCR outlet temperatures less than or equal to 200 degrees Celsius;

II. "Bin 7" is for SCR outlet temperatures greater than 200 degrees Celsius and less than or equal to 250 degrees Celsius;

III. "Bin 8" is for SCR outlet temperatures greater than 250 degrees Celsius and less than or equal to 400 degrees Celsius;

IV. "Bin 9" is for SCR outlet temperatures greater than 400 degrees Celsius.

iv. Bins that store data when the engine power output is greater than 50 percent of rated power:

- I. "Bin 10" is for SCR outlet temperatures less than or equal to 200 degrees Celsius;
- II. "Bin 11" is for SCR outlet temperatures greater than 200 degrees Celsius and less than or equal to 250 degrees Celsius;
- III. "Bin 12" is for SCR outlet temperatures greater than 250 degrees Celsius and less than or equal to 400 degrees Celsius;
- IV. "Bin 13" is for SCR outlet temperatures greater than 400 degrees Celsius.
- v. "Bin 14" shall store data only when a regeneration event is being commanded. Storage of data into Bins 1 through 13 shall occur independently of data storage into Bin 14, and shall not be interrupted or otherwise affected by activity related to Bin 14.
- vi. "Bin 15" shall store the total value of the parameter in a given array only when the Stage 2 pause conditions of section (e)(2)(D)1.g.i. are met. The OR OBD system shall not store data into Bin 15 under any conditions for Stage 1 engines.
- vii. "Bin A," "Bin B," and "Bin C" shall store data according to the requirements of section (e)(2)(D)1.d., below.

*Table 3. OR-REAL Bin Assignments.*

Parameter	Active 50-Hour Array (Bins)	Stored 50-Hour Array (Bins)	Lifetime Array (Bins)	Lifetime Engine Activity Array (Bins)
NOx mass - engine out (g)	1-15	1-15	1-15	None
NOx mass - tailpipe (g)	1-15 and A,B,C	1-15 and A,B,C	1-15 and A,B,C	None
Engine output energy (kWh)	1-15 and B,C	1-15 and B,C	1-15 and B,C	1-15 and B,C
Engine run time (hours)	1-15 and A,B,C	1-15 and A,B,C	1-15 and A,B,C	1-15 and A,B,C
Total fuel consumption (liters)	1-15	1-15	1-15	1-15



d. The 3-bin moving average window (3B-MAW) bins described below shall store data comprised of overlapping 300-second windows of engine operation. Storage of data shall begin after engine start when 300 seconds of engine operation have elapsed for which no exclusions apply (see section (e)(2)(D)1.d.iv.). Each second thereafter, the OR OBD system shall save the last 300 seconds of exclusion-free data into the appropriate bin. The OR OBD system shall discard any partial window of valid data (i.e., a window that contains less than 300 seconds of valid data) at the end of the operating cycle.

i. "Bin A" shall store data when the window average power output is 8 percent or less of the engine's rated power.

ii. "Bin B" shall store data when the window average power output is greater than 8 percent the engine's rated power and less than or equal to 25 percent of the engine's rated power.

iii. "Bin C" shall store data when the window average power output is greater than 25 percent of the engine's rated power.

iv. Excluded Data. The OR OBD system shall exclude data from a window for any period meeting one or more of the following conditions:

I. OR-REAL tracking is paused.

II. For engines required to meet Stage 2 requirements, the MIL is commanded on.

III. For 3B-MAW bins in the Active 50-hour and Lifetime Arrays, one of the NO<sub>x</sub> sensors used to determine the NO<sub>x</sub> mass parameters listed in section (e)(2)(D)1.a. is not reporting valid NO<sub>x</sub> concentration data.

IV. The engine is performing an infrequent regeneration.

V. The barometric pressure is less than 82.5 kilopascals (kPa).

VI. The ambient air temperature is less than 0 degrees Celsius.

VII. The ambient air temperature is greater than  $-0.0014 \times h + 37.78$  degrees Celsius, where the height "h" shall be

approximated by  $(101.3 - \text{barometric pressure}) \text{ kPa} \times 328 \text{ feet} / 1.2 \text{ kPa}$ .

v. The OR OBD system shall handle time intervals which include alternating periods of both valid data that are less than 300 seconds and periods of excluded data according to the following requirements:

I. The OR OBD system shall combine non-continuous periods of valid data into a 300-second window and store them in the appropriate bin provided that no period of excluded data exceeds 599 seconds.

II. The OR OBD system shall discard a partial window of valid data (i.e., a window that contains less than 300 seconds of valid data) if it includes a period of excluded data that is 600 or more seconds long. If data are discarded, a new window shall begin with the first two consecutive seconds for which none of the conditions for excluded data are satisfied.

e. Numerical Value Specifications. For each parameter specified in section (e)(2)(D)1.a.:

i. For parameters in arrays described in sections (e)(2)(D)1.b., the OR OBD system shall reset each number to zero only when an NVRAM reset occurs (e.g., reprogramming event). The OR OBD system shall not reset the numbers to zero under any other circumstances including when a scan tool (generic or enhanced) command to clear fault codes is received.

ii. The OR OBD system shall store each number within 120 seconds after the end of an operating cycle.

f. Pause Conditions for Engines Required to Meet Stage 1 Requirements.

i. Except for the conditions described in section (e)(2)(D)1.f.ii. below, the OR OBD system shall continue tracking all parameters listed in section (e)(2)(D)1.a. in Bins 1-14 and Bins A-C according to Table 3.

ii. The OR OBD system shall pause tracking of all parameters listed in section (e)(2)(D)1.a. within 10 seconds if any of the conditions in sections (e)(2)(D)1.f.ii.I. through IV. below occur. When the condition no longer occurs (e.g., the engine stop lamp is not commanded on),

tracking of all parameters in section (e)(2)(D)1.a. shall resume within 10 seconds:

I. The engine has a diagnostic system (not required by this regulation) which detects a malfunction of any component used to determine SCR outlet temperature and the engine manufacturer's designated warning or notification lamp is commanded on for that malfunction;

II. The engine has a diagnostic system (not required by this regulation) which detects a malfunction of a NO<sub>x</sub> sensor that is used to calculate engine-out or tailpipe NO<sub>x</sub> mass and the engine manufacturer's designated warning or notification lamp is commanded on for that malfunction;

III. The SCR inducement system has activated a torque reduction or final inducement; or

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

iii. The manufacturer may request Executive Officer approval to pause tracking of all parameters listed in section (e)(2)(D)1.a. if a malfunction occurs that is not covered under sections (e)(2)(D)1.f.ii.l. through IV. above (e.g., a malfunction that results in a light being commanded on for equipment with no engine stop lamp such that the operator is likely to turn off the engine, 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 (e)(2)(D)1.a.

g. Pause Conditions for Engines Required to Meet Stage 2 Requirements.

i. Except for malfunctions described in section (e)(2)(D)1.g.ii. below, the OR OBD system shall continue tracking all parameters listed in section (e)(2)(D)1.a. if a malfunction has been detected and the MIL is commanded on. Within 10 seconds of the MIL being commanded on, the OR OBD system shall store tracked data only in Bin 15 as described in section (e)(2)(D)1.c.vi. and shall pause storage of data in all other bins (Bins 1-14 and Bins A-C). When the malfunction is no longer detected and the MIL is no longer commanded on, tracking of all parameters in

section (e)(2)(D)1.a. shall resume in Bins 1-14 and Bins A-C and shall pause in Bin 15 within 10 seconds.

ii. The OR OBD system shall pause tracking of all parameters listed in section (e)(2)(D)1.a. within 10 seconds if any of the conditions in sections (e)(2)(D)1.g.ii.l. through IV. below occur. When the condition no longer occurs (e.g., the engine stop lamp is not commanded on), tracking of all parameters in section (e)(2)(D)1.a. shall resume within 10 seconds:

I. A malfunction of any component used to determine SCR outlet temperature has been detected and the MIL is commanded on for that malfunction;

II. A malfunction of a NO<sub>x</sub> sensor that is used to calculate engine-out or tailpipe NO<sub>x</sub> mass has been detected and the MIL is commanded on for that malfunction;

III. The SCR inducement system has activated a torque reduction or final inducement; or

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

iii. The manufacturer may request Executive Officer approval to pause tracking of all parameters listed in section (e)(2)(D)1.a. if a malfunction occurs that is not covered under sections (e)(2)(D)1.g.ii.l. through IV. above (e.g., a malfunction that results in a light being commanded on for equipment with no engine stop lamp such that the operator is likely to turn off the engine, 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 (e)(2)(D)1.a.

h. NO<sub>x</sub> Mass Accuracy Requirements.

i. The engine-out and tailpipe NO<sub>x</sub> mass parameters that are calculated by the OR OBD system to fulfill the requirements in section (e)(2)(D)1. and data stream requirements in section (e)(2)(C)2.a. shall not have an error of more than **+/- TBD percent**, or alternatively at the manufacturer's discretion, **+/- TBD g/bhp-hr** when divided by the net brake work of the engine. This requirement applies only to the NO<sub>x</sub> mass parameters in sections (e)(2)(D)1. and (e)(2)(C)2.a.

ii. The OR OBD system shall report the most accurate values that are calculated within the applicable electronic control unit (e.g., the engine control module). The NO<sub>x</sub> mass values shall be calculated using the most accurate NO<sub>x</sub> concentration and exhaust flow rate values that are calculated within the applicable electronic control unit.

iii. Any negative concentrations reported by a NO<sub>x</sub> sensor shall be set to zero when used in a NO<sub>x</sub> mass calculation.

iv. The manufacturer shall not include a humidity correction factor when calculating NO<sub>x</sub> mass.

v. The Executive Officer shall determine compliance with the accuracy requirement in section (e)(2)(D)1.h.i. by comparing data from the OR OBD system and the test facility that are submitted by the manufacturer as described in section (h)(2)(C)d. The Executive Officer shall compare the total tailpipe NO<sub>x</sub> mass calculated by the OR OBD system for the test cycle with the total NO<sub>x</sub> mass measured by the test facility and give consideration to the consistency of the behavior of the two sets of instantaneous NO<sub>x</sub> mass values over the test cycle.

vi. Notwithstanding the compliance determination based on the data submitted as described in section (h)(2)(C)d., manufacturers shall not include any calibration/software feature which adversely impacts the accuracy of the calculated NO<sub>x</sub> mass values relative to the accuracy demonstrated at the time of certification when the engine operates in conditions outside of the certification testing environment.

## 2. Total Engine Run Time.

a. Manufacturers shall implement software algorithms to track and report the total engine run time in the standardized format specified in SAE J1939.

b. Numerical Value Specifications. The total engine run time value shall never be reset to zero under any circumstances including when an NVRAM reset occurs (e.g., reprogramming event) or a scan tool (generic or enhanced) command to clear fault codes is received.

## 3. Ignition Cycle Counter.

a. Definition. The ignition cycle counter is defined as a counter that indicates the number of ignition cycles an engine has experienced as defined in section (e)(2)(D)3.b. The OR OBD system shall report one ignition cycle counter in accordance with the specifications in section (e)(2)(D)3.d.

b. Specifications for Incrementing.

i. When the OR OBD system increments the ignition cycle counter in accordance with section (e)(2)(D)3.b.ii. below, the OR OBD system shall increment the ignition cycle counter by an integer of one. The OR OBD system shall not increment the ignition cycle counter more than once per ignition cycle.

ii. The OR OBD system shall increment the ignition cycle counter within 10 seconds if and only if the engine exceeds an engine speed of 150 rpm below the normal, warmed-up idle speed for at least two seconds plus or minus one second.

c. Specifications for Disabling Incrementation.

i. For an engine required to meet Stage 1 requirements, the OR OBD system shall disable further incrementing of the ignition cycle counter if (1) the engine has a diagnostic system (not required by this regulation) which detects a malfunction of any component used to determine if the criteria in section (e)(2)(D)3.b.ii. are satisfied (e.g., engine speed or time of operation) and (2) the engine manufacturer's designated warning or notification lamp is commanded on for that malfunction.

ii. For an engine required to meet Stage 2 requirements, the OR OBD system shall disable further incrementing of the ignition cycle counter if (1) a malfunction has been detected for any component used to determine if the criteria in section (e)(2)(D)3.b.ii. are satisfied (e.g., engine speed or time of operation) and (2) the corresponding pending fault code or MIL-on fault code is stored.

iii. The OR OBD system shall not disable incrementing of the ignition cycle counter for any condition other than those specified in sections (e)(2)(D)3.c.i. and ii. above. Incrementing of the ignition cycle counter shall resume within 10 seconds when the malfunction is no longer present (e.g., pending fault code erased through self-clearing or by a scan tool command).

d. Numerical Value Specifications.

i. The ignition cycle counter shall have a minimum value of zero and a maximum value of 65,535 with a resolution of one.

ii. The ignition cycle counter shall be reset to zero only when a NVRAM reset occurs (e.g., reprogramming event) and may not be reset

to zero under any other circumstances including when a scan tool command to clear fault codes is received.

iii. If the ignition cycle counter reaches the maximum value of 65,535, the ignition cycle counter shall rollover and increment to zero on the next ignition cycle to avoid overflow problems.

#### 4. General Denominator.

a. Definition. The general denominator is defined as a measure of the number of times an engine has been operated as defined in section (e)(2)(D)4.b. The OR OBD system shall report the general denominator in accordance with the specifications in section (e)(2)(D)4.d.

##### b. Specifications for Incrementing.

i. When the OR OBD system increments the general denominator in accordance with section (e)(2)(D)4.b.ii. below, the OR OBD system shall increment the general denominator by an integer of one. The OR OBD system shall not increment the general denominator more than once per operating cycle.

ii. The OR OBD system shall increment the general denominator within 10 seconds if and only if the criteria identified below are satisfied on a single operating cycle:

I. Cumulative time since engine start of operating cycle is greater than or equal to 600 seconds while at an elevation of less than 8,000 feet (2,438 meters) above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit (or -6.7 degrees Celsius);

II. Cumulative engine operation at or above 8 percent of rated power which occurs for greater than or equal to 300 seconds while at an elevation of less than 8,000 feet (2,438 meters) above sea level and at an ambient temperature of greater than or equal to 20 degrees Fahrenheit (or -6.7 degrees Celsius);

##### c. Specifications for Disabling Incrementation.

i. For an engine required to meet Stage 1 requirements, the OR OBD system shall disable further incrementing of the general denominator if (1) the engine has a diagnostic system (not required by this regulation) which detects a malfunction of any component used to determine if the criteria in section (e)(2)(D)4.b.ii. are satisfied (e.g., power output, ambient temperature, or time of operation) and (2) the

engine manufacturer's designated warning lamp is commanded on for that malfunction.

ii. For an engine required to meet Stage 2 requirements, the OR OBD system shall disable further incrementing of the general denominator if (1) a malfunction has been detected for any component used to determine if the criteria in section (e)(2)(D)4.b.ii. are satisfied (e.g., power output, ambient temperature, or time of operation) and (2) the corresponding pending or MIL-on fault code is stored.

iii. The OR OBD system shall not disable incrementing of the general denominator for any condition other than those specified in section (e)(2)(D)4.c.i. and ii. above. Incrementing of the general denominator shall resume within 10 seconds when the malfunction is no longer present (e.g., pending fault code erased through self-clearing or by a scan tool command).

d. Numerical Value Specifications.

i. The general denominator shall have a minimum value of zero and a maximum value of 65,535 with a resolution of one.

ii. The general denominator shall be reset to zero only when a NVRAM reset occurs (e.g., reprogramming event) and may not be reset to zero under any other circumstances including when a scan tool command to clear fault codes is received.

iii. If the general denominator reaches the maximum value of 65,535, the general denominator shall rollover and increment to zero on the next operating cycle that meets the general denominator definition to avoid overflow problems.

(E) *Software Calibration Identification.*

1. The OR OBD system shall report a single software calibration identification number (CAL ID) for each DEC ECU through the standardized data link connector in accordance with the SAE J1939 specifications.

2. The OR OBD system shall use a unique CAL ID for every emission-related calibration and/or software set having at least one bit of different data from any other emission-related calibration and/or software set.

a. Control units coded with multiple emission or diagnostic calibrations and/or software sets shall indicate a unique CAL ID for each variant in a manner that enables an off-board device to determine which variant is being used by the equipment.



b. Control units that utilize a strategy that will result in MIL illumination if the incorrect variant is used (e.g., control units that contain variants for manual and automatic transmissions but will illuminate the MIL if the variant selected does not match the type of transmission on the vehicle) are not required to use unique CAL IDs.

(F) *Software Calibration Verification Number.*

1. The OR OBD system shall report a single calibration verification number (CVN) for each CAL ID. The CVN shall be capable of being used to determine if the emission-related software and/or calibration data are valid and applicable for that application and CAL ID.

2. The OR OBD system shall make available the CVN through the standardized data link connector in accordance with the SAE J1939 specifications. The OR OBD system shall report each CVN to a generic scan tool in the same order as the CAL IDs are reported to the scan tool to allow the scan tool to match each CVN to the corresponding CAL ID.

3. The OR OBD system shall use the CRC-16 or CRC-32 algorithm to calculate a single CVN for each CAL ID.

4. The OR OBD system shall calculate the CVN at least once per ignition cycle and store the CVN value until the CVN is subsequently updated.

5. The OR OBD system shall not erase the stored CVN value under the following conditions:

a. When fault memory is erased by a generic scan tool in accordance with SAE J1939 specifications, or

b. During normal equipment shut down (i.e., key off, engine off).

6. When a CVN request message is received by the on-board computer, the OR OBD system shall make available the stored CVN value through the data link connector to a generic scan tool.

a. Except as provided for below in sections (e)(2)(F)6.b. through d., when a CVN request is received, the OR OBD system shall not use delayed timing in sending the CVN and shall not respond with a message indicating that the CVN value is not currently available (e.g., shall not respond with a negative response code, acknowledgement (00E80016) parameter group number: Control Byte = 3, or a negative acknowledgement), and shall not respond with a default value (i.e., a value or space holder that is not a valid CVN value).

b. If the CVN request message is received within the first 120 seconds of engine operation after a reprogramming event or an NVRAM reset or within the first 120 seconds of engine operation after a volatile memory reset or battery disconnect, the on-board computer may respond with one or more messages directing the scan tool to wait or resend the request message after the delay (e.g., a negative response code, acknowledgement (00E80016) parameter group number: Control Byte = 3, or a negative acknowledgement). Such messages and delays shall conform to the specifications for transmitting CVN data contained in SAE J1939.

c. When a CVN request is received, engines using SAE J1939 may respond with one or more messages directing the scan tool to wait or resend the request message after the delay (e.g., a negative response code, acknowledgement (00E80016) parameter group number: Control Byte = 3, or a negative acknowledgement) when the on-board computer is already sending a different multi-packet message using TP.BAM. Such messages shall conform to the specifications for transmitting CVN data contained in SAE J1939.

d. If a communication malfunction is preventing access to a CVN value for reporting in response to a scan tool request, the OR OBD system may report a default CVN value in lieu of a valid CVN value if:

i. A pending fault code or a MIL-on fault code is stored with the MIL commanded on pinpointing a communication malfunction for the module that is unable to report a valid CVN, and

ii. The default CVN value used cannot be mistaken for a valid CVN (e.g., all zeros or all question marks for the default value cannot be mistaken for a valid CVN).

7. Manufacturers shall make the CVN and CAL ID combination information available for all engines in an electronic format that allows for off-board verification that the CVN is valid and appropriate for a specific engine and CAL ID.

a. Manufacturers shall submit the CVN and CAL ID information to the Executive Officer twice per year not more than 30 calendar days after June 30 and December 31.

b. Manufacturers shall submit information about all CVN and CAL ID combinations applicable for every engine, including CVN and CAL ID combinations from running changes and field fixes after the production period has ended.

c. The manufacturer shall submit the information through [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov).

(3) *Phase 2 Standardization Requirements.* The requirements of this section apply to engines required to meet the Phase 2 standardization requirements in accordance with section (d).

(A) Malfunction Indicator Light (MIL).

1. Equipment With an Instrument Panel.

a. The equipment shall be equipped with a MIL that, when illuminated, displays the ISO engine symbol (i.e., symbol number F.01 as described in ISO 2575, incorporated by reference (e)(1)).

b. For equipment that have more than one instrument panel, the MIL shall be located on the instrument panel in closest proximity to the operator.

2. Equipment Without an Instrument Panel.

a. The equipment shall be equipped with a MIL that consists of an amber LED light with a minimum diameter or width of 5 millimeters.

b. The MIL shall be permanently embedded or affixed to the equipment in a location that is in the unobstructed field of view of the operator.

i. For equipment with one or more control panels, the MIL shall be located on the control panel in closest proximity to the operator.

ii. For equipment with no control panel, the MIL shall be located in plain, unobstructed view of the operator while the operator is using the steering controls or other frequently used equipment controls.

c. The word "OBD" shall be permanently engraved or printed immediately below the MIL in all capital letters using at least 14-point font size.

3. The MIL shall be of sufficient illumination to be readily visible under all lighting conditions and shall be amber in color when illuminated.

4. The MIL shall illuminate in the key on, engine off position before engine cranking to indicate that the MIL is functional.

a. The MIL shall continuously illuminate during this functional check for a minimum of 15 seconds.

b. During this functional check of the MIL, the data stream value for MIL status (see section (e)(3)(E)1.) shall indicate commanded off unless the MIL has also been commanded on for a detected malfunction.

c. This functional check of the MIL is not required during equipment operation in the key on, engine off position subsequent to the initial engine cranking of an ignition cycle.

5. There shall be only one MIL used to indicate all malfunctions detected by the OR OBD system on a single piece of equipment (i.e., the manufacturer shall not implement more than one MIL on a single piece of equipment that meets the MIL requirements of the regulation). The MIL shall not be used for any purpose other than specified in this regulation.

(B) Fault Codes.

1. For engines using the SAE J1939 protocol for the standardized functions required in section (e):

a. For all monitors/diagnostics, the OR OBD system shall make stored pending and MIL-on fault codes available through the diagnostic link connector in a standardized format in accordance with SAE J1939 specifications (i.e., Diagnostic Message (DM) 6 and DM12).

b. The OR OBD system shall employ standardized fault codes conforming to SAE J1939.

c. Except as otherwise specified in section (f), the stored fault code shall, to the fullest extent possible, pinpoint the likely cause of the malfunction. To the extent feasible, manufacturers shall use separate fault codes for every diagnostic where the diagnostic and repair procedure or likely cause of the failure is different.

d. Manufacturers shall use appropriate SAE-defined fault codes of SAE J1939 whenever possible.

i. This requirement applies both to monitors/diagnostics required in section (f) and any other manufacturer-specific diagnostics that are designed to identify malfunctions in emissions-related components.

ii. With Executive Officer approval, manufacturers may use manufacturer-defined fault codes in accordance with SAE J1939 specifications. Factors to be considered by the Executive Officer for approval shall include the lack of available SAE-defined fault codes, uniqueness of the monitor/diagnostic or monitored component,

expected future usage of the diagnostic or component, and estimated usefulness in providing additional diagnostic and repair information to service technicians. Manufacturer-defined fault codes shall be used consistently (i.e., the same fault code shall not be used to represent two different failure modes) across a manufacturer's entire product line.

e. The OR OBD system shall store a pending or MIL-on fault code (as required in section (f)) and make the fault code available to an SAE J1939 scan tool within 10 seconds after a diagnostic has determined that a malfunction has occurred.

(C) Freeze Frames.

1. For engines using SAE J1939:

a. The OR OBD system shall make "freeze frame" information required to be stored pursuant to sections (f)(1)(A) and (f)(4) available on demand through the standardized data link connector in accordance with SAE J1939-73 specifications.

b. Freeze frame information shall include:

i. The fault code which caused the freeze frame data to be stored.

ii. All the signals required in sections (XXX) and (XXX).

iii. All the signals required in sections (XXX) and (XXX) that are used for diagnostic or control purposes in the specific DEC ECU that stored the fault code.

c. The OR OBD system shall store freeze frame conditions on at least one data frame for at least one fault code.

(D) Test Results.

1. Except as provided in section (e)(3)(D)7. below, for all monitors/diagnostics identified in sections (f)(1)(A) through (E) and (f)(2)(A) through (E), the OR OBD system shall:

a. Store the results of the most recent monitoring decisions of the respective monitor/diagnostic.

b. Store the test limits established for monitoring the respective monitor/diagnostic.

c. Make the test results and test limits available through the data link in accordance with the standardized format specified in SAE J1939-73 for the SAE J1939 protocol.

2. The OR OBD system shall report test results such that properly functioning components and systems (i.e., "passing" systems) do not store test values outside of the established test limits. Test limits shall include both minimum and maximum acceptable values and shall be defined so that a test result equal to any of the test limit is a "passing" value, not a "failing" value.

3. The test results shall be standardized such that the name of the monitored component (e.g., aftertreatment diesel particulate filter system) can be identified by a generic scan tool and the test results and limits can be scaled and reported with the appropriate engineering units by a generic scan tool.

4. The OR OBD system shall store test results until updated by a more recent valid test result or the fault memory of the OR OBD system computer is cleared.

5. If the OR OBD system fault memory is cleared, the OR OBD system shall report values corresponding to 'test not complete' for all test results in accordance with SAE J1939-73 specifications. The OR OBD system shall update the test results once the applicable monitor/diagnostic has run and has valid test results and limits to report.

6. The OR OBD system shall always report all test results and test limits. The OR OBD system shall store and report unique test results for each separate monitor/diagnostic.

7. The requirements of section (e)(3)(D) do not apply to the following diagnostics:

a. PM sensor and heater circuit/out-of-range diagnostics specified under sections (f)(1)(C)2.a., (f)(1)(C)2.c.ii., (f)(2)(B)2.a., and (f)(2)(B)2.c.ii.,

b. Tailpipe NO<sub>x</sub> sensor and heater circuit/out-of-range diagnostics specified under sections (f)(1)(D)2.a. and (f)(1)(D)2.d.ii., and

c. Fuel system feedback control diagnostics specified under section (f)(2)(E)2.d.

(E) Additional Data Stream Parameters. The OR OBD system shall make available the following signals on demand through the diagnostic link connector in accordance with SAE J1939 specifications. The signals shall be accessible to a scan tool designed to communicate with an SAE J1939 network. The OR OBD

system shall always use the actual signal value instead of a default or limp home value.

1. MIL status.
2. Engine run time since code clear.
3. Engine run time while MIL activated.
4. For engines required to meet OBMD requirements in accordance with section (d)(2)(A):
  - a. OBM NO<sub>x</sub> 3B-MAW window counters (Bin B and C)
  - b. OBM NO<sub>x</sub> and work data

(F) Additional Tracking Data. The manufacturer shall implement software algorithms to track and report in a standardized format the following parameters:

1. PM Filter Fault Code History. For all engines equipped with a PM filter, the OR OBD system shall track the following information each time the OR OBD system detects a PM filtration efficiency malfunction or a PM sensor malfunction:
  - a. Fault Codes. The OR OBD system shall track the most recent 5 pending and MIL-on fault codes. If a pending fault code matures to a MIL-on fault code, the OR OBD system shall replace the pending fault code's information with the MIL-on fault code's information.
  - b. Total Engine Run Time. For each of the tracked fault codes, the OR OBD system shall track the total engine run time at the time the fault code was stored.
  - c. Numerical Value Specifications. The OR OBD system shall never reset the PM filter fault code history data to zero under any circumstances including when an NVRAM reset occurs (e.g., reprogramming event) or a scan tool (generic or enhanced) command to clear fault codes is received.
2. Monitor Activity Data. The OR OBD system shall track and report the following data in accordance with SAE J1939 specifications.
  - a. Mini-Numerator
    - i. Definition. The mini-numerator is defined as a counter that indicates the number of operating cycles over which a monitor/diagnostic ran and completed since the last time the mini-denominator (defined below in section (e)(3)(F)2.b.) was reset to zero.

The OR OBD system shall track and report a mini-numerator for each supported fault code that can illuminate the MIL.

ii. Specifications for Incrementing.

I. When the OR OBD system increments the mini-numerator, it shall be incremented by an integer of one. The mini-numerator shall not be incremented more than once per operating cycle.

II. The OR OBD system shall increment the mini-numerator at the end of an operating cycle if and only if the associated monitor/diagnostic ran and completed on the operating cycle.

III. The OR OBD system shall pause further incrementing of the mini-numerator on an operating cycle if a malfunction has been detected which can illuminate the MIL as described in section (e), and the DEC ECU that tracks and reports the mini-numerator stores a pending fault code or MIL-on fault code for the malfunction. The OR OBD system shall resume incrementing the mini-numerator on the next operating cycle in which no such fault code is present.

IV. The OR OBD system shall cease further incrementing of the mini-numerator if the mini-numerator has reached a value of 255.

iii. Specifications for Resetting. The OR OBD system shall reset the mini-numerator to zero at the same time the OR OBD system resets the mini-denominator to zero as described below in section (e)(3)(F)2.b.

b. Mini-Denominator

i. Definition. The mini-denominator is defined as a counter that indicates the number of general denominator incrementations that have accumulated since the last time the mini-denominator was reset to zero. The OR OBD system shall track and report a mini-denominator for each DEC ECU that is capable of storing a fault code.

ii. Specifications for Incrementing.

I. When the OR OBD system increments the mini-denominator, it shall be incremented by an integer of one. The mini-denominator shall not be incremented more than once per operating cycle.

II. The OR OBD system shall increment the mini-denominator at the end of an operating cycle if and only if the general



denominator increments during the operating cycle as described in section (e)(2)(D)4.

III. The OR OBD system shall pause further incrementing of the mini-denominator on an operating cycle if a malfunction has been detected which can illuminate the MIL as described in section (f) and the DEC ECU that tracks and reports the mini-denominator stores a pending fault code or MIL-on fault code for the malfunction. The OR OBD system shall resume incrementing the mini-denominator on the next operating cycle in which no such fault code is present.

IV. The OR OBD system shall cease further incrementing of the mini-denominator if the mini-denominator has reached a value of 255.

iii. Specifications for Resetting. The OR OBD system shall reset the mini-denominator to zero after the mini-denominator has reached a value of 255 and the OR OBD system has updated the monitor activity ratio described below in section (e)(3)(F)2.c. The reset shall occur before the beginning of the next operating cycle.

c. Monitor Activity Ratio

i. Definition. The monitor activity ratio, or MAR, is defined as the ratio of the mini-numerator to the mini-denominator when the mini-denominator reaches its maximum value of 255. The MAR has a minimum value of zero and a maximum value of one. The OR OBD system shall track and report a MAR for each supported fault code that can illuminate the MIL.

ii. Specifications for Updating. The MAR shall be updated only at the end of the same operating cycle in which the mini-denominator reaches a value of 255. The current value for the MAR shall be replaced with the new value.

iii. Specifications for Resetting. The OR OBD system shall not reset the MAR to zero except under the conditions described below in section (e)(3)(F)2.d.

d. In addition to the specifications for resetting described above in sections (e)(3)(F)2.a.iii., (e)(3)(F)2.b.iii., and (e)(3)(F)2.c.iii., the mini-numerator, mini-denominator, and MAR may be reset to zero only when a NVRAM reset occurs (e.g., reprogramming event). Numbers shall not be

reset to zero under any other circumstances including when a scan tool command to clear fault codes is received.

(G) Erasure of Emission-Related Diagnostic Information.

1. For purposes of section (e)(3)(G), "emission-related diagnostic information" includes the following:

- a. Fault codes (i.e., pending and MIL-on fault codes) (section (e)(3)(B))
- b. Freeze frames (section (e)(3)(C))
- c. Test results (section (e)(3)(D))
- d. The following data stream parameters: engine run time while MIL activated, engine run time since code clear, and MIL status (section (e)(3)(E))

2. The OR OBD system shall erase the emission-related diagnostic information if any of the following occurs:

- a. The OR OBD system receives a command from a scan tool (generic or enhanced) to erase the information,
- b. An on-board computer reprogramming event, or
- c. Power to the on-board computer is disconnected and the OR OBD system does not store the emission-related diagnostic information in NVRAM.

3. If any of the emission-related diagnostic information is erased as a result of a command by a scan tool or during an on-board reprogramming event, the OR OBD system shall erase all the emission-related diagnostic information from all DEC ECUs and shall not erase a subset of the emission-related diagnostic information (e.g., the OR OBD system shall not erase only one of three stored fault codes or only information from one control unit without erasing information from the other control unit(s)).

(f) *Diagnostic Requirements.*

Section (f) applies to engines required to meet the Stage 2 requirements in accordance with section (d)(2). Sections (f)(1) and (f)(2) set forth the monitoring and diagnostic requirements. Section (f)(3) sets forth the monitoring conditions requirements for the applicable diagnostics described in sections (f)(1) and (f)(2). Section (f)(4) sets forth the MIL, fault code, and freeze frame requirements for the applicable diagnostics described in sections (f)(1) and (f)(2). Section

(f)(5) sets forth the malfunction criteria determination requirements. Section (f)(6) sets forth the exceptions to the diagnostic requirements.

(1) *OBMD Diagnostic Requirements.* The monitor/diagnostic requirements of this section apply to engines that are required to meet the OBMD requirements in accordance with section (d)(2)(A).

(A) OBM NO<sub>x</sub> Emission Threshold Monitor.

1. Requirement. The OR OBD system shall monitor the engine for proper control of tailpipe NO<sub>x</sub> emissions.

2. Malfunction Criteria.

a. The OR OBD system shall detect a malfunction when the engine's NO<sub>x</sub> control capability decreases to the point that would cause an engine's tailpipe NO<sub>x</sub> emissions (as measured by the tailpipe NO<sub>x</sub> sensor) to exceed:

i. For engines in power categories less than 56 kW or greater than 560 kW: 1.2 g/kW-hr or 1.5 times the applicable standard, whichever is higher, as calculated from 2,400 windows of data in Bin C in accordance with section (f)(1)(A)2.b. below.

ii. For engines in power categories greater than or equal to 56 kW and less than or equal to 560 kW: 0.60 g/kW-hr as calculated from 2,400 windows of data in Bin B or 2,400 windows of data in Bin C in accordance with sections (f)(1)(A)2.b. and c. below.

b. The OR OBD system shall make a diagnostic decision each time 2,400 windows have accumulated in the applicable 3B-MAW bin according to section (e)(2)(D)1.d.

i. The diagnostic decision shall be based on 2,400 windows of data that do not overlap with data from other 2,400-window blocks (i.e., a diagnostic decision shall not include data from a window used in another diagnostic decision).

ii. The OR OBD system shall make a diagnostic decision from a 2,400-window block of data that is comprised of windows from one operating cycle or more than one operating cycle.

l. The OR OBD system shall not discard partial blocks of data (i.e., blocks that contain less than 2,400 windows of data) at the end of an operating cycle.

II. The OR OBD system shall discard partial windows of data (i.e., windows that contain less than 300 seconds of data) at the end of an operating cycle.

iii. If more than one 2,400-window block of data occurs in the operating cycle, the OR OBD system shall make a diagnostic decision for each 2,400-window block of data in the operating cycle.

c. For engines in power categories greater than or equal to 56 kW and less than or equal to 560 kW, the OR OBD system shall separately detect malfunctions determined from data in Bin B and malfunctions determined from data in Bin C.

### 3. Monitoring Conditions.

a. Except as provided for in section (f)(1)(A)3.b. below, the OR OBD system shall monitor for malfunctions identified in section (f)(1)(A)2. under all operating conditions.

b. The OR OBD system shall pause monitoring if the OR-REAL tracking is paused in accordance with section (e)(2)(D)1.g.

### 4. MIL, Fault Code, and Freeze Frame Requirements.

#### a. MIL Illumination and Fault Code Storage Protocol.

i. For engines using the SAE J1939 protocol for the standardized functions required in section (e):

I. Pending Fault Code Storage. Upon detection of a malfunction, the OR OBD system shall store a pending fault code within 10 seconds.

II. Pending Fault Code Erasure. After storage of a pending fault code under section (f)(1)(A)4.a.i.i., if a malfunction is not detected in the next 2,400-window block of data in the same 3B-MAW bin (i.e., there is no indication of the malfunction at any time during the next 2,400-window block of data in the same 3B-MAW bin), the corresponding pending fault code shall be erased.

III. MIL-on Fault Code Storage, Pending Fault Code Erasure, and MIL Illumination. After storage of a pending fault code under section (f)(1)(A)4.a.i.i., except as provided below in section (f)(1)(A)4.a.iii., if the identified malfunction is again detected in the next 2,400 window block of data in the same 3B-MAW bin, the OR

OBD system shall illuminate the MIL continuously, erase the pending fault code, and store a MIL-on fault code within 10 seconds.

ii. The OR OBD system shall store different fault codes for malfunctions determined from data from Bin B and malfunctions determined from data from Bin C.

iii. In lieu of illuminating the MIL in section (f)(1)(A)4.a.i.III., the OR OBD system shall not illuminate the MIL if the OR OBD system detects a malfunction when the engine has exceeded its emission warranty period specified in title 13, CCR section 2425. The fault code and freeze frame requirements set forth still apply.

b. MIL Extinguishing and Fault Code Erasure Protocol.

i. For engines using the SAE J1939 protocol for the standardized functions required in section (e):

I. Extinguishing the MIL. Once the MIL has been illuminated in accordance with section (f)(1)(A)4.a.i.III., the OR OBD system shall extinguish the MIL after three subsequent sequential 2,400-window blocks of data in the same 3B-MAW bin during which the diagnostic responsible for illuminating the MIL executes and the previously detected malfunction is no longer present, provided no other malfunction has been detected that would independently illuminate the MIL.

II. Erasing a MIL-on Fault Code. The OR OBD system shall erase a MIL-on fault code in accordance with the conditions to extinguish the MIL described under section (f)(1)(A)4.b.i.I.

c. Freeze Frame Conditions Storage and Erasure Protocol. The OR OBD system shall store and erase "freeze frame" conditions (as described in section (e)(3)(C)) present at the time a malfunction is detected as follows:

i. For engines using the SAE J1939 protocol for the standardized functions required in section (e), the OR OBD system shall store freeze frame conditions in conjunction with the storage of a pending fault code.

I. If the pending fault code is erased in the next 2,400-window block of data during which a malfunction is not detected (as described in section (f)(1)(A)4.a.i.II.), the OR OBD system may erase the corresponding freeze frame conditions.

II. If the pending fault code matures to a MIL-on fault code (as described under section (f)(1)(A)4.a.i.III.), the OR OBD system shall replace the stored freeze frame conditions with freeze frame conditions associated with the MIL-on fault code.

III. The OR OBD system shall erase the freeze frame information in conjunction with the erasure of the MIL-on fault code as described in section (f)(1)(A)4.a.i.II.

ii. If a fault code is stored when the maximum number of frames of freeze frame conditions is already stored, the OR OBD system shall not replace any currently stored freeze frame conditions with freeze frame conditions for the newly stored fault code except as allowed for MIL-on fault codes in section (f)(1)(A)4.c.i.II.

d. For engines in power categories greater than or equal to 56 kW and less than or equal to 560 kW, the monitors that detect malfunctions determined from data in Bin B shall have separate MIL illumination/extinguishing, fault code storage/erasure, and freeze frame storage/erasure protocols from monitors that detect malfunctions determined from data in Bin C.

(B) Particulate Matter (PM) Filter Diagnostic.

1. Requirements.

a. The OR OBD system shall monitor the PM filter on engines so equipped for filtering performance and regeneration malfunctions.

b. For engines equipped with active regeneration systems that utilize an active/intrusive injection (e.g., in-exhaust fuel injection, in-exhaust fuel/air burner):

i. The OR OBD system shall monitor the active/intrusive injection system for performance malfunctions.

ii. The OR OBD system shall monitor the individual electronic components (e.g., injectors, valves, sensors) that are used in the active/intrusive injection system in accordance with the comprehensive component diagnostic requirements in section (f)(1)(G).

2. Malfunction Criteria.

a. Filtering Performance.

i. The OR OBD system shall detect a malfunction if a decrease in the filtering capability of the PM filter causes an engine's PM emissions

to exceed either of the following thresholds, whichever is higher: 0.040 g/kW-hr as measured from the applicable emission test cycle (i.e., NRTC or steady state cycle), or the applicable standard plus 0.020 g/kW-hr (e.g., 0.060 g/kW-hr if the exhaust emission standard is 0.040 g/kW-hr).

ii. If no failure or deterioration of the PM filtering performance could result in an engine's PM emissions exceeding the malfunction criteria specified in section (f)(1)(B)2.a.i. above, the OR OBD system shall detect a malfunction when no detectable amount of PM filtering occurs.

b. Frequent Regeneration. The OR OBD system shall detect a malfunction when the PM filter regeneration frequency exceeds the manufacturer's specified design limits for allowable regeneration frequency.

c. Active/Intrusive Injection. For systems that utilize active/intrusive injection (e.g., in-cylinder post fuel injection, in-exhaust air-assisted fuel injection) to achieve regeneration of the PM filter, the OR OBD system shall detect a malfunction if any failure or deterioration of the injection system's ability to properly regulate injection causes the system to be unable to achieve regeneration of the PM filter.

### 3. Monitoring Conditions.

a. The manufacturer shall define the monitoring conditions for malfunctions identified in sections (f)(1)(B)2.a. and b. (i.e., PM filter filtering performance and frequent regeneration malfunctions) in accordance with section (f)(3).

b. The OR OBD system shall monitor for malfunctions identified in section (f)(1)(B)2.c. (i.e., PM filter active/intrusive injection malfunctions) whenever an ECU commands a PM filter regeneration event to occur. The manufacturer may disable monitoring during conditions when the OR OBD system cannot robustly distinguish between a malfunctioning injection system and a properly operating injection system. The manufacturer shall limit the disablement interval only to that necessary for avoiding false detection.

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

(C) PM Sensor and Heater Diagnostic.

1. Requirements.

a. The OR OBD system shall monitor the PM sensor on engines so equipped for circuit and performance malfunctions.

b. For engines equipped with heated PM sensors, the OR OBD system shall monitor the PM sensor heater for circuit and performance malfunctions.

2. Malfunction Criteria.

a. Circuit. The OR OBD system shall detect circuit malfunctions (e.g., open circuit, short to ground or high voltage) and malfunctions of the PM sensor caused by out-of-range values.

b. Monitoring Capability. To the extent feasible, the OR OBD system shall detect a malfunction of the PM sensor when the PM sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OR OBD system monitoring device (i.e., for use by other diagnostics to detect malfunctions). For this requirement, "sufficient" is defined as the capability of the worst performing acceptable PM sensor to detect the best performing unacceptable other monitored system or component (e.g., PM filter).

c. PM Sensor Heater.

i. Heater Performance. The OR OBD system shall detect a malfunction of the PM sensor heater performance when the current or voltage drop in the heater circuit is no longer within the manufacturer's specified limits for normal operation (i.e., within the criteria required to be met by the component vendor for heater circuit performance at high mileage).

ii. Circuit. The OR OBD system shall detect malfunctions of the PM sensor heater circuit (e.g., open circuit, short circuits) that conflict with the commanded state of the PM sensor heater (e.g., shorted to 12 Volts when commanded to 0 Volts (ground)).

3. Monitoring Conditions.

a. The manufacturer shall define the monitoring conditions for malfunctions identified in sections (f)(1)(C)2.b. and (f)(1)(C)2.c.i. (PM sensor monitoring capability and heater performance malfunctions) in accordance with section (f)(3).



b. Except as provided in section (f)(1)(C)3.c. below, the OR OBD system shall monitor continuously for malfunctions identified in sections (f)(1)(C)2.a. and (f)(1)(C)2.c.ii. (i.e., PM sensor circuit malfunctions and PM sensor heater circuit malfunctions). The monitoring conditions shall ensure that the diagnostic yields a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

c. For malfunctions identified in sections (f)(1)(C)2.a. and (f)(1)(C)2.c.ii. (i.e., PM sensor circuit malfunctions and PM sensor heater circuit malfunctions), the manufacturer may temporarily disable continuous monitoring during conditions where a properly functioning PM sensor or PM sensor heater cannot be distinguished from a malfunctioning PM sensor or PM sensor heater. The manufacturer shall limit the disablement interval only to that necessary for avoiding false detection.

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

(D) Tailpipe NO<sub>x</sub> Sensor and Heater Diagnostic.

1. Requirements.

a. The OR OBD system shall monitor the tailpipe NO<sub>x</sub> sensor used by the OBM NO<sub>x</sub> emission threshold monitor (described in section (f)(1)(C)) or data stream or tracking parameters required in section (e) for circuit, performance, and activity malfunctions.

b. For engines equipped with heated tailpipe NO<sub>x</sub> sensors, the OR OBD system shall monitor the heater for circuit and performance malfunctions.

2. Malfunction Criteria.

a. Circuit. The OR OBD system shall detect circuit malfunctions (e.g., open circuit, short to ground or high voltage) and malfunctions of the tailpipe NO<sub>x</sub> sensor caused by out-of-range values.

b. Performance. The OR OBD system shall detect a malfunction if a failure or deterioration of the sensor voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s) causes the error in the OR OBD system's NO<sub>x</sub> mass calculation to exceed **+/- TBD g/kW-hr** as measured from the applicable emission test cycle (i.e., NRTC or steady state cycle).

c. Activity. The OR OBD system shall detect a malfunction of the tailpipe NOx sensor (e.g., internal sensor temperature not properly achieved/maintained, stabilization criteria not properly achieved/maintained) when the tailpipe 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 tailpipe NOx sensor to be actively reporting NOx concentration data.

i. The malfunctions include malfunctions that delay the time it takes for the tailpipe NOx sensor to become active after start (e.g., time after start to satisfy tailpipe NOx sensor stabilization criteria takes longer than normal) and malfunctions that cause the tailpipe 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).

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

d. Tailpipe NOx Sensor Heater.

i. Heater Performance. The OR OBD system shall detect a malfunction of the tailpipe NOx sensor heater performance when the current or voltage drop in the heater circuit is no longer within the manufacturer's specified limits for normal operation (i.e., within the criteria required to be met by the component vendor for heater circuit performance at high mileage).

ii. Circuit. The OR OBD system shall detect malfunctions of the tailpipe NOx heater circuit (e.g., open circuit, short circuits) that conflict with the commanded state of the tailpipe NOx sensor heater (e.g., shorted to 12 Volts when commanded to 0 Volts (ground)).

3. Monitoring Conditions.

a. The manufacturer shall define the monitoring conditions for malfunctions identified in sections (f)(1)(D)2.b., (f)(1)(D)2.c., and (f)(1)(D)2.d.i. (i.e., tailpipe NOx sensor performance, activity, and sensor heater performance malfunctions) in accordance with section (f)(3).

b. Except as provided in section (f)(1)(D)3.c. below, the OR OBD system shall monitor continuously for malfunctions identified in sections

(f)(1)(D)2.a. and (f)(1)(D)2.d.ii. (i.e., tailpipe NO<sub>x</sub> sensor circuit malfunctions and sensor heater circuit malfunctions). The monitoring conditions shall ensure that the diagnostic yields a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

c. For malfunctions identified in sections (f)(1)(D)2.a. and (f)(1)(D)2.d.ii. (i.e., tailpipe NO<sub>x</sub> sensor circuit malfunctions and sensor heater circuit malfunctions), the manufacturer may temporarily disable continuous monitoring during conditions where a properly functioning NO<sub>x</sub> sensor/NO<sub>x</sub> sensor heater cannot be distinguished from a malfunctioning NO<sub>x</sub> sensor/NO<sub>x</sub> sensor heater. The manufacturer shall limit the disablement interval only to that necessary for avoiding false detection.

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

(E) Diesel Oxidation Catalyst (DOC) Diagnostic.

1. Requirement. For DOCs used to generate an exotherm to assist PM filter regeneration, the OR OBD system shall monitor the DOC on engines so equipped for insufficient exotherm malfunctions.

2. Malfunction Criteria. The OR OBD system shall detect a malfunction when the DOC is unable to generate a sufficient exotherm to achieve regeneration of the PM filter.

3. Monitoring Conditions. The OR OBD system shall monitor for malfunctions identified in section (f)(1)(E)2. (i.e., DOC exotherm malfunctions) whenever an ECU commands a PM filter regeneration event to occur. The manufacturer may disable monitoring during conditions when the OR OBD system cannot robustly distinguish between a malfunctioning DOC and a properly operating DOC. The manufacturer shall limit the disablement interval only to that necessary for avoiding false detection.

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

(F) Closed Crankcase Ventilation (CV) System Diagnostic.

1. Requirement. The OR OBD system shall monitor the closed CV system on engines so equipped for system integrity malfunctions.

## 2. Malfunction Criteria.

### a. For the purposes of section (f)(1)(F):

i. Any additional external CV system tubing or hoses used to equalize crankcase pressure or to provide a ventilation path between various areas of the engine (e.g., crankcase and valve cover) are considered part of the closed CV system "between the crankcase and the CV valve."

ii. Any fittings that are used for connection such as nipples or barbs that the hoses must be placed over for proper attachment are considered part of the "hose, tube, or line."

### b. The OR OBD system shall detect a malfunction of the closed CV system as follows:

i. Except as provided in section (f)(1)(F)2.b.iii. below, the OR OBD system shall detect a malfunction of the closed CV system when a disconnection of the system occurs between the crankcase and the CV valve, or between the CV valve and intake ducting.

ii. Except as provided in section (f)(1)(F)2.b.iii. below, for any hose, tube, or line that transports crankcase vapors, the OBD system shall detect a closed CV system malfunction when the system contains a disconnection or break equal to or greater than the smallest internal cross-sectional area of that hose, tube, or line.

iii. Manufacturers are not required to detect disconnections or breaks of any CV system hose, tube, or line if the disconnection or break:

I. Causes the engine to stall immediately during idle operation,

II. Is unlikely to occur due to a CV system design that is integral to the induction system (e.g., machined passages rather than tubing or hoses),

III. Results in a rapid loss of oil or other overt indication of a closed CV system malfunction such that the equipment operator is certain to respond and have the equipment repaired, or

IV. Occurs downstream of where the crankcase vapors are delivered to the air intake system.

3. Monitoring Conditions. The manufacturer shall define the monitoring conditions for malfunctions identified in sections (f)(1)(F)2.b.i. and ii. in accordance with section (f)(3).

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

(G) Comprehensive Component Diagnostic.

1. Requirements.

a. The OR OBD system shall monitor for malfunction any electronic powertrain component/system not otherwise described in sections (f)(1)(A) through (F) above that provides input to (directly or indirectly) or receives commands from an on-board computer and meets any of the following:

i. Is used as part of the diagnostic strategy for a monitored system or component described in sections (f)(1)(A) through (F),

ii. Is an input to (directly or indirectly) or output from an AECD strategy, or

iii. Is used as an input for OR-REAL tracking described in section (e)(2)(D)1.

b. The OR OBD system shall monitor for malfunction any electronic powertrain component/system not otherwise described in sections (f)(1)(A) through (F) and (f)(1)(G)1.a. that provides input to (directly or indirectly) or receives commands from an on-board computer, and is used as part of the diagnostic strategy for another monitored system or component described in section (f)(1)(G).

c. The OR OBD system shall monitor for malfunction the ability of an on-board computer to send and receive information to and from other on-board computers if it affects the performance of the OR OBD system.

d. The OR OBD system shall monitor for malfunction the individual electronic components described in section (f)(1)(B) that are required to be monitored in accordance with the comprehensive component diagnostic requirements in section (f)(1)(G).

## 2. Malfunction Criteria.

### a. Input Components.

i. For input components described in sections (f)(1)(G)1.a. and (f)(1)(G)1.d. above, the OR OBD system shall detect malfunctions caused by any of the following:

I. Circuit malfunctions for non-digital inputs and lack of communication to the on-board computer for digital inputs;

II. Out-of-range values; and

III. For rationality fault diagnostics, malfunctions where the sensor output is inappropriately high and malfunctions where the sensor output is inappropriately low, to the extent feasible.

ii. For input components described in section (f)(1)(G)1.b., the OR OBD system shall detect malfunctions caused by any of the following:

I. Circuit malfunctions for non-digital inputs and lack of communication to the on-board computer for digital inputs;

II. Out-of-range values; and

III. For rationality fault diagnostics, malfunctions where one of the following occurs, whichever the manufacturer chooses: the sensor output is inappropriately high, the sensor output is inappropriately low, or the sensor output is stuck at the same value.

### b. Output Components/Systems.

i. Functional Check. The OR OBD system shall detect a malfunction of an output component/system when proper functional response of the component and system to computer commands does not occur.

ii. If a functional check is not feasible, the OR OBD system shall detect a malfunction of an output component/system caused by a circuit malfunction (e.g., open circuit, short to ground or high voltage) if the signal to the output component/system is non-digital, and communication errors or the lack of communication if the signal to the output component/system is digital.

c. For malfunctions described in section (f)(1)(G)1.c., the OR OBD system shall detect a malfunction of an on-board computer if any of the following occurs:

- i. The computer cannot send information to another on-board computer, or
- ii. The computer cannot receive information from another on-board computer.

### 3. Monitoring Conditions.

#### a. Input Components.

i. Except as provided in section (f)(1)(G)3.d. below, the OR OBD system shall monitor continuously for malfunctions identified in sections (f)(1)(G)2.a.i.I., (f)(1)(G)2.a.i.II., (f)(1)(G)2.a.ii.I., and (f)(1)(G)2.a.ii.III. (i.e., circuit malfunctions, communication malfunctions, and out of range values). The monitoring conditions shall ensure that the diagnostic yields a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

ii. The manufacturer shall define the monitoring conditions for malfunctions identified in sections (f)(1)(G)2.a.i.III. and (f)(1)(G)2.a.ii.III. (i.e., rationality malfunctions) in accordance with section (f)(3), with the following exceptions:

I. In lieu of the requirement in section (f)(3)(B), the rationality fault diagnostics shall occur every time the monitoring conditions are met during the operation cycle; and

II. For rationality fault diagnostics that require a regeneration event, the diagnostic is not subject to the monitor activity ratio requirement in section (f)(3)(C) if the regeneration event is infrequent, is an approved AECD, and is needed for robust monitoring.

#### b. Output Components/Systems.

i. The manufacturer shall define the monitoring conditions for malfunctions identified in section (f)(1)(G)2.b.i. (i.e., functional malfunctions) in accordance with section (f)(3) except as provided in section (f)(1)(G)3.b.i.I. below.

I. For functional checks that require a regeneration event, the diagnostic is not subject to the monitor activity ratio requirement in

section (f)(3)(C) if the regeneration event is infrequent, is an approved AECD, and is needed for robust monitoring.

II. For all functional checks, the OR OBD system is not required to activate an output component/system when it would not normally be active for the purposes of performing a functional check of the output component/system.

ii. Except as provided in section (f)(1)(G)3.d. below, the OR OBD system shall monitor continuously for malfunctions identified in section (f)(1)(G)2.b.ii. (i.e., circuit malfunctions and communication malfunctions). The monitoring conditions shall ensure that the diagnostic yields a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

c. Except as provided in section (f)(1)(G)3.d. below, the manufacturer shall monitor for malfunctions identified in section (f)(1)(G)2.c. (i.e., on-board computer communication malfunctions) under all operating conditions. The monitoring conditions shall ensure that the diagnostic yields a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

d. For malfunctions identified in sections (f)(1)(G)2.a.i.l., (f)(1)(G)2.a.i.ii., (f)(1)(G)2.a.ii.l., (f)(1)(G)2.a.ii.ii., (f)(1)(G)2.b.ii., and (f)(1)(G)2.c. (i.e., circuit malfunctions, communication malfunctions, and out of range values), the manufacturer may temporarily disable monitoring during conditions when a properly functioning component cannot be distinguished from a malfunctioning component. The manufacturer shall limit the disablement interval only to that necessary for avoiding false detection.

4. MIL, Fault Code, and Freeze Frame Requirements. Except as provided below, the requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

a. For output component/system malfunctions identified in section (f)(1)(G)2.b.ii. (i.e., circuit malfunctions), manufacturers are not required to store different fault codes for each distinct malfunction (e.g., open circuit, shorted low).

(2) *OBD Diagnostic Requirements.* The diagnostic requirements of this section apply to engines that are required to meet the OBD requirements in accordance with section (d)(2)(B).



(A) PM Filter Diagnostic.

1. Requirements.

a. The OR OBD system shall monitor the PM filter on engines so equipped for filtering performance and regeneration malfunctions.

b. For engines equipped with active regeneration systems that utilize an active/intrusive injection (e.g., in-exhaust fuel injection, in-exhaust fuel/air burner):

i. The OR OBD system shall monitor the active/intrusive injection system for performance malfunctions.

ii. The OR OBD system shall monitor the individual electronic components (e.g., injectors, valves, sensors) that are used in the active/intrusive injection system in accordance with the comprehensive component diagnostic requirements in section (f)(2)(G).

2. Malfunction Criteria.

a. Filtering Performance.

i. The OR OBD system shall detect a malfunction if a decrease in the filtering capability of the PM filter causes an engine's PM emissions to exceed either of the following thresholds, whichever is higher: 0.040 g/kW-hr as measured from the applicable emission test cycle (i.e., NRTC or steady state cycle), or the applicable standard plus 0.020 g/kW-hr (e.g., 0.060 g/kW-hr if the exhaust emission standard is 0.040 g/kW-hr).

ii. If no failure or deterioration of the PM filtering performance could result in an engine's PM emissions exceeding the malfunction criteria specified in section (f)(2)(A)2.a.i. above, the OR OBD system shall detect a malfunction when no detectable amount of PM filtering occurs.

b. Frequent Regeneration. The OR OBD system shall detect a malfunction when the PM filter regeneration frequency exceeds the manufacturer's specified design limits for allowable regeneration frequency.

c. Active/Intrusive Injection. For systems that utilize active/intrusive injection (e.g., in-cylinder post fuel injection, in-exhaust air-assisted fuel injection) to achieve regeneration of the PM filter, the OR OBD system shall detect a malfunction if any failure or deterioration of the injection system's ability to properly regulate injection causes the system to be unable to achieve regeneration of the PM filter.

### 3. Monitoring Conditions.

a. Manufacturers shall define the monitoring conditions for malfunctions identified in sections (f)(2)(A)2.a. and b. (i.e., PM filter filtering performance and frequent regeneration malfunctions) in accordance with section (f)(3).

b. The OR OBD system shall monitor for malfunctions identified in section (f)(2)(A)2.c. (i.e., PM filter active/intrusive injection malfunctions) whenever an ECU commands a PM filter regeneration event to occur. The manufacturer may disable monitoring during conditions when the OR OBD system cannot robustly distinguish between a malfunctioning injection system and a properly operating injection system. The manufacturer shall limit the disablement interval only to that necessary for avoiding false detection.

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

#### (B) PM Sensor and Heater Diagnostic.

##### 1. Requirements.

a. The OR OBD system shall monitor the PM sensor on engines so equipped for circuit and performance malfunctions.

b. For engines equipped with heated PM sensors, the OR OBD system shall monitor the PM sensor heater for circuit and performance malfunctions.

##### 2. Malfunction Criteria.

a. Circuit. The OR OBD system shall detect circuit malfunctions (e.g., open circuit, short to ground or high voltage) and malfunctions of the PM sensor caused by out-of-range values.

b. Monitoring Capability. To the extent feasible, the OR OBD system shall detect a malfunction of the PM sensor when the PM sensor output voltage, resistance, impedance, current, amplitude, activity, offset, or other characteristics are no longer sufficient for use as an OR OBD system monitoring device (i.e., for use by other diagnostics to detect malfunctions). For this requirement, "sufficient" is defined as the capability of the worst performing acceptable PM sensor to detect the best performing unacceptable other monitored system or component (e.g., PM filter).

c. PM Sensor Heater.

i. Heater Performance. The OR OBD system shall detect a malfunction of the PM sensor heater performance when the current or voltage drop in the heater circuit is no longer within the manufacturer's specified limits for normal operation (i.e., within the criteria required to be met by the component vendor for heater circuit performance at high mileage).

ii. Circuit. The OR OBD system shall detect malfunctions of the PM sensor heater circuit (e.g., open circuit, short circuits) that conflict with the commanded state of the PM sensor heater (e.g., shorted to 12 Volts when commanded to 0 Volts (ground)).

3. Monitoring Conditions.

a. Manufacturers shall define the monitoring conditions for malfunctions identified in sections (f)(2)(B)2.b. and (f)(2)(B)2.c.i. (PM sensor monitoring capability and heater performance malfunctions) in accordance with section (f)(3).

b. Except as provided in section (f)(2)(B)3.c. below, the OR OBD system shall monitor continuously for malfunctions identified in sections (f)(2)(B)2.a. and (f)(2)(B)2.c.ii. (i.e., PM sensor circuit malfunctions and PM sensor heater circuit malfunctions). The monitoring conditions shall ensure that the diagnostic yields a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

c. For malfunctions identified in sections (f)(2)(B)2.a. and (f)(2)(B)2.c.ii. (i.e., PM sensor circuit malfunctions and PM sensor heater circuit malfunctions), the manufacturer may temporarily disable continuous monitoring during conditions where a properly functioning PM sensor or PM sensor heater cannot be distinguished from a malfunctioning PM sensor or PM sensor heater. The manufacturer shall limit the disablement interval only to that necessary for avoiding false detection.

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

(C) Exhaust Gas Recirculation (EGR) System Diagnostic.

1. Requirements.

a. The OR OBD system shall monitor the EGR system on engines so equipped for low flow rate, high flow rate, and slow response malfunctions.

b. For engines equipped with EGR coolers (e.g., heat exchangers), the OR OBD system shall monitor the cooler system for insufficient cooling malfunctions.

c. The individual electronic components (e.g., actuators, valves, sensors) that are used in the EGR system shall be monitored in accordance with the comprehensive component diagnostic requirements in section (f)(2)(G).

## 2. Malfunction Criteria.

### a. Low Flow.

i. The OR OBD system shall detect a malfunction of the EGR system if a decrease from the manufacturer's specified EGR flow rate causes an engine's NMHC, CO, NO<sub>x</sub>, or PM emissions to exceed the following:

I. For engines in power categories greater than or equal to 19 kW and less than 56 kW, 0.04 g/kW-h PM as measured from the applicable emission test cycle (i.e., NRTC or steady state cycle) or 2.0 times applicable standards for NMHC, CO, or NO<sub>x</sub>.

II. For engines in all other power categories, 2.0 times the applicable standards for NMHC, CO, NO<sub>x</sub>, or PM.

ii. For engines in which no failure or deterioration of the EGR system that causes a decrease in flow could result in an engine's emissions exceeding the malfunction criteria specified in section (f)(2)(C)2.a.i. above, the OR OBD system shall detect a malfunction when the EGR system has reached its control limits such that it cannot increase EGR flow to achieve the commanded flow rate or, for non-feedback controlled EGR systems, the EGR system has no detectable amount of EGR flow when EGR flow is expected.

b. High Flow. The OR OBD system shall detect a malfunction when the EGR system has reached its control limits such that it cannot reduce EGR flow to achieve the commanded flow rate or, for non-feedback controlled EGR systems, the EGR system has maximum detectable EGR flow when little or no EGR flow is expected.

c. Slow Response. The OBD system shall detect a malfunction of the EGR system when no detectable response to a change in commanded or expected flow rate occurs.

d. EGR Cooler Performance. The OR OBD system shall detect a malfunction when the system has no detectable amount of EGR cooling.

3. Monitoring Conditions. The manufacturer shall define the monitoring conditions for malfunctions identified in sections (f)(2)(C)2.a. through d. (i.e., EGR system low flow, high flow, slow response, and EGR cooler performance malfunctions) in accordance with section (f)(3).

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

(D) DOC Diagnostic.

1. Requirement. For DOCs used to generate an exotherm to assist PM filter regeneration, the OR OBD system shall monitor the DOC on engines so equipped for insufficient exotherm malfunctions.

2. Malfunction Criteria. The OR OBD system shall detect a malfunction when the DOC is unable to generate a sufficient exotherm to achieve regeneration of the PM filter.

3. Monitoring Conditions. The OR OBD system shall monitor for malfunctions identified in section (f)(2)(D)2. (i.e., DOC exotherm malfunctions) whenever an ECU commands a PM filter regeneration event to occur. The manufacturer may disable monitoring during conditions when the OR OBD system cannot robustly distinguish between a malfunctioning DOC and a properly operating DOC. The manufacturer shall limit the disablement interval only to that necessary for avoiding false detection.

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

(E) Fuel System Diagnostic.

1. Requirements.

a. The OR OBD system shall monitor the fuel delivery system for pressure control, injection quantity, injection timing, and feedback control malfunctions.

b. The individual electronic components (e.g., actuators, valves, sensors, pumps) that are used in the fuel system and not specifically addressed in this section shall be monitored in accordance with the comprehensive component diagnostic requirements in section (f)(2)(G).

## 2. Malfunction Criteria.

### a. Fuel System Pressure Control.

i. The OR OBD system shall detect a malfunction of the fuel system pressure control system (e.g., fuel, hydraulic fluid) if a failure or deterioration causes an engine's NMHC, CO, NO<sub>x</sub>, or PM emissions to exceed:

I. For engines in power categories greater than or equal to 19 kW and less than 56 kW, 0.04 g/kW-h PM as measured from the applicable emission test cycle (i.e., NRTC or steady state cycle) or 2.0 times applicable standards for NMHC, CO, or NO<sub>x</sub>.

II. For engines in all other power categories, 2.0 times the applicable standards for NMHC, CO, NO<sub>x</sub>, or PM.

ii. For engines in which no failure or deterioration of the fuel system pressure control could result in an engine's emissions exceeding the applicable malfunction criteria specified in section (f)(2)(E)2.a.i., the OR OBD system shall detect a malfunction when the system has reached its control limits such that the commanded fuel system pressure cannot be delivered.

### b. Injection Quantity.

i. The OR OBD system shall detect a malfunction of the fuel injection system when the system is unable to deliver the commanded quantity of fuel such that an engine's NMHC, CO, NO<sub>x</sub>, or PM emissions exceed:

I. For engines in power categories greater than or equal to 19 kW and less than 56 kW, 0.04 g/kW-h PM as measured from the applicable emission test cycle (i.e., NRTC or steady state cycle) or 2.0 times applicable standards for NMHC, CO, or NO<sub>x</sub>.

II. For engines in all other power categories, 2.0 times the applicable standards for NMHC, CO, NO<sub>x</sub>, or PM.

ii. For engines in which no failure or deterioration of the fuel injection quantity could result in an engine's emissions exceeding the applicable malfunction criteria specified in section (f)(2)(E)2.b.i. above, the OR OBD system shall detect a malfunction when the system has reached its control limits such that the commanded fuel quantity cannot be delivered.

c. Injection Timing.

i. The OR OBD system shall detect a malfunction of the fuel injection system when the system is unable to deliver fuel at the proper crank angle/timing (e.g., injection timing too advanced or too retarded) such that an engine's NMHC, CO, NO<sub>x</sub>, or PM emissions exceed:

I. For engines in power categories greater than or equal to 19 kW and less than 56 kW, 0.04 g/kW-h PM as measured from the applicable emission test cycle (i.e., NRTC or steady state cycle) or 2.0 times applicable standards for NMHC, CO, or NO<sub>x</sub>.

II. For engines in all other power categories, 2.0 times the applicable standards for NMHC, CO, NO<sub>x</sub>, or PM.

ii. For engines in which no failure or deterioration of the fuel injection timing could result in an engine's emissions exceeding the applicable malfunction criteria specified in section (f)(2)(E)2.c.i. above, the OR OBD system shall detect a malfunction when the system has reached its control limits such that the commanded fuel injection timing cannot be achieved.

d. Feedback Control. If the engine is equipped with feedback control of the fuel system (e.g., feedback control of pressure or pilot injection quantity), the OR OBD system shall detect a malfunction:

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

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

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

3. Monitoring Conditions.

a. Except as provided in sections (f)(2)(E)3.b. and d. below, the OR OBD system shall monitor for malfunctions identified in sections (f)(2)(E)2.a. and d. (i.e., fuel system fuel pressure control and feedback control malfunctions) under all operating conditions. The monitoring conditions shall ensure that the diagnostic yields a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

b. For fuel systems that achieve injection fuel pressure within the injector or increase pressure within the injector (e.g. in the injector of an amplified common rail system), manufacturers may request Executive Officer approval to define the monitoring conditions for malfunctions identified in section (f)(2)(E)2.a in accordance with section (f)(3). The Executive Officer shall approve the monitoring conditions upon the manufacturer submitting data and/or analysis identifying all possible failure modes and the effect each has (e.g., failure modes and effects analysis) on fuel pressure across the entire range of engine operating conditions, and upon the Executive Officer determining based on the data and/or analysis that the monitoring conditions allow for robust detection of all causes of fuel pressure malfunctions.

c. The manufacturer shall define the monitoring conditions for malfunctions identified in sections (f)(2)(E)2.b. and c. (i.e., fuel system injection quantity and timing malfunctions) in accordance with section (f)(3).

d. For the malfunction criteria specified in section (f)(2)(E)2.d.iii. (i.e., fuel system feedback control used up all adjustment malfunction), the manufacturer may temporarily disable monitoring during conditions when the OR OBD system cannot robustly distinguish between a malfunctioning system and a properly operating system if the control system, when operating as designed on an engine with all emission controls working properly, routinely operates during these conditions with all of the adjustment allowed by the manufacturer used up.

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

(F) Closed Crankcase Ventilation (CV) System Diagnostic.

1. Requirement. The OR OBD system shall monitor the closed CV system on engines so equipped for system integrity malfunctions.

2. Malfunction Criteria.

a. For the purposes of section (f)(2)(F):

i. Any additional external CV system tubing or hoses used to equalize crankcase pressure or to provide a ventilation path between various areas of the engine (e.g., crankcase and valve cover) are considered part of the closed CV system "between the crankcase and the CV valve."



ii. Any fittings that are used for connection such as nipples or barbs that the hoses must be placed over for proper attachment are considered part of the "hose, tube, or line."

b. The OR OBD system shall detect a malfunction of the closed CV system as follows:

i. Except as provided in section (f)(2)(F)2.b.iii. below, the OR OBD system shall detect a malfunction of the closed CV system when a disconnection of the system occurs between the crankcase and the CV valve, or between the CV valve and intake ducting.

ii. Except as provided in section (f)(2)(F)2.b.iii. below, for any hose, tube, or line that transports crankcase vapors, the OBD system shall detect a closed CV system malfunction when the system contains a disconnection or break equal to or greater than the smallest internal cross-sectional area of that hose, tube, or line.

iii. Manufacturers are not required to detect disconnections or breaks of any CV system hose, tube, or line if the disconnection or break:

I. Causes the engine to stall immediately during idle operation,

II. Is unlikely to occur due to a CV system design that is integral to the induction system (e.g., machined passages rather than tubing or hoses),

III. Results in a rapid loss of oil or other overt indication of a closed CV system malfunction such that the equipment operator is certain to respond and have the equipment repaired, or

IV. Occurs downstream of where the crankcase vapors are delivered to the air intake system.

3. Monitoring Conditions. Manufacturers shall define the monitoring conditions for malfunctions identified in sections (f)(2)(F)2.b.i. and ii. in accordance with section (f)(3).

4. MIL, Fault Code, and Freeze Frame Requirements. The requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

(G) Comprehensive Component Diagnostic.

1. Requirements.

a. The OR OBD system shall monitor for malfunction any electronic powertrain component/system not otherwise described in sections (f)(2)(A) through (F) above that provides input to (directly or indirectly) or receives commands from an on-board computer and meets any of the following:

- i. Is used as part of the diagnostic strategy for a monitored system or component described in sections (f)(2)(A) through (F), or
- ii. Is an input to (directly or indirectly) or output from an AECD strategy.

b. The OR OBD system shall monitor for malfunction any electronic powertrain component/system not otherwise described in sections (f)(2)(A) through (F) and (f)(2)(G)1.a. that provides input to (directly or indirectly) or receives commands from an on-board computer, and is used as part of the diagnostic strategy for another monitored system or component described in section (f)(2)(G).

c. The OR OBD system shall monitor for malfunction the ability of an on-board computer to send and receive information to and from other on-board computers if it affects the performance of the OR OBD system.

d. The OR OBD system shall monitor for malfunction the individual electronic components described in sections (f)(2)(A), (f)(2)(C), and (f)(2)(E) that are required to be monitored in accordance with the comprehensive component diagnostic requirements in section (f)(2)(G).

2. Malfunction Criteria.

a. Input Components.

i. For input components described in sections (f)(2)(G)1.a. and (f)(2)(G)1.d. above, the OR OBD system shall detect malfunctions caused by any of the following:

I. Circuit malfunctions for non-digital inputs and lack of communication to the on-board computer for digital inputs;

II. Out-of-range values; and

III. For rationality fault diagnostics, malfunctions where the sensor output is inappropriately high and malfunctions where the sensor is inappropriately low, to the extent feasible.

ii. For input components described in section (f)(2)(G)1.b., the OR OBD system shall detect malfunctions caused by any of the following:

I. Circuit malfunctions for non-digital inputs and lack of communication to the on-board computer for digital inputs;

II. Out-of-range values; and

III. For rationality fault diagnostics, malfunctions where one of the following occurs, whichever the manufacturer chooses: the sensor output is inappropriately high, the sensor output is inappropriately low, or the sensor output is stuck at the same value.

b. Output Components/Systems.

i. Functional Check. The OR OBD system shall detect a malfunction of an output component/system when proper functional response of the component and system to computer commands does not occur.

ii. If a functional check is not feasible, the OR OBD system shall detect a malfunction of an output component/system caused by a circuit malfunction (e.g., open circuit, short to ground or high voltage) if the signal to the output component/system is non-digital, and communication errors or the lack of communication if the signal to the output component/system is digital.

c. For malfunctions described in section (f)(2)(G)1.c., the OR OBD system shall detect a malfunction of an on-board computer if any of the following occurs:

i. The computer cannot send information to another on-board computer, or

ii. The computer cannot receive information from another on-board computer.

3. Monitoring Conditions.

a. Input Components.

i. Except as provided in section (f)(2)(G)3.d. below, the OR OBD system shall monitor continuously for malfunctions identified in sections (f)(2)(G)2.a.i.I., (f)(2)(G)2.a.i.II., (f)(2)(G)2.a.ii.I., and (f)(2)(G)2.a.ii.II. (i.e., circuit malfunctions, communication malfunctions, and out of range values). The monitoring conditions shall ensure that the diagnostic yields

a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

ii. The manufacturer shall define the monitoring conditions for malfunctions identified in sections (f)(2)(G)2.a.i.III. and (f)(2)(G)2.a.ii.III. (i.e., rationality malfunctions) in accordance with section (f)(3), with the following exceptions:

I. In lieu of the requirement in section (f)(3)(B), the rationality fault diagnostics shall occur every time the monitoring conditions are met during the operation cycle; and

II. For rationality fault diagnostics that require a regeneration event, the diagnostic is not subject to the monitor activity ratio requirement in section (f)(3)(C) if the regeneration event is infrequent, is an approved AECD, and is needed for robust monitoring.

b. Output Components/Systems.

i. The manufacturer shall define the monitoring conditions for malfunctions identified in section (f)(2)(G)2.b.i. (i.e., functional malfunctions) in accordance with section (f)(3) except as provided in section (f)(2)(G)3.b.i.I. below.

I. For functional checks that require a regeneration event, the diagnostic is not subject to the monitor activity ratio requirement in section (f)(3)(C) if the regeneration event is infrequent, is an approved AECD, and is needed for robust monitoring.

II. For all functional checks, the OR OBD system is not required to activate an output component/system when it would not normally be active for the purposes of performing a functional check of the output component/system.

ii. Except as provided in section (f)(2)(G)3.d. below, the OR OBD system shall monitor continuously for malfunctions identified in section (f)(2)(G)2.b.ii. (i.e., circuit malfunctions and communication malfunctions). The monitoring conditions shall ensure that the diagnostic yields a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

c. Except as provided in section (f)(2)(G)3.d. below, the manufacturer shall monitor for malfunctions identified in section (f)(2)(G)2.c. (i.e., on-board computer communication malfunctions) under all operating

conditions. The monitoring conditions shall ensure that the diagnostic yields a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

d. For malfunctions identified in sections (f)(2)(G)2.a.i.i., (f)(2)(G)2.a.i.ii., (f)(2)(G)2.a.ii.i., (f)(2)(G)2.a.ii.ii., (f)(2)(G)2.b.ii., and (f)(2)(G)2.c. (i.e., circuit malfunctions, communication malfunctions, and out of range values), the manufacturer may temporarily disable monitoring during conditions when a properly functioning component cannot be distinguished from a malfunctioning component. The manufacturer shall limit the disablement interval only to that necessary for avoiding false detection.

4. MIL, Fault Code, and Freeze Frame Requirements. Except as provided below, the requirements for MIL illumination/extinguishment, fault code storage/erasure, and freeze frame storage/erasure are set forth in section (f)(4).

a. For output component/system malfunctions identified in section (f)(2)(G)2.b.ii. (i.e., circuit malfunctions), manufacturers are not required to store different fault codes for each distinct malfunction (e.g., open circuit, shorted low).

(3) *Monitoring Conditions Requirements.* For monitoring conditions of diagnostics in sections (f)(1) and (f)(2) that are required to meet the requirements of section (f)(3):

(A) Except as provided below in section (f)(3)(D) and elsewhere in sections (f)(1) and (f)(2), the manufacturer shall define monitoring conditions that meet all the following criteria:

1. Are technically necessary to ensure robust detection of malfunctions (e.g., avoid false passes and false indications of malfunctions),
2. Are designed to ensure monitoring will occur under conditions which may reasonably be expected to be encountered in normal equipment operation and use, and
3. Are designed to ensure monitoring will occur during the following test cycles:
  - a. For engines certified to transient test standards, during the NRTC.
  - b. For engines certified to steady-state test standards, during the applicable steady-state cycle.

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

(C) The monitoring conditions shall ensure that the diagnostic yields a monitor activity ratio (as defined in section (e)(3)(F)2.c.) that meets or exceeds 0.05 on in-use engines.

(D) In lieu of the criterion in section (f)(3)(A)3., manufacturers may request Executive Officer approval to define monitoring conditions that are not encountered during the NRTC (for engines certified to the transient test standards) or the applicable steady-state cycle (for engines certified to the steady-state test standards). The Executive Officer shall approve the request upon finding the following:

1. The conditions encountered during the NRTC or the applicable steady-state cycle restrict robust detection of malfunctions;

2. The monitoring conditions are technically necessary to ensure robust detection of malfunction; and

3. Data or an engineering evaluation submitted by the manufacturer demonstrate that the component/system does not normally function, or monitoring is otherwise not feasible, during the NRTC or the applicable steady-state cycle.

(4) *MIL, Fault Code, and Freeze Frame Requirements.* For the MIL, fault code, and freeze frame protocols of diagnostics in sections (f)(1) and (f)(2) that are required to meet the requirements of section (f)(4):

(A) MIL Illumination and Fault Code Storage Protocol.

1. For engines using the SAE J1939 protocol for the standardized functions required in section (e):

a. Pending Fault Code Storage. Upon detection of a malfunction, the OR OBD system shall store a pending fault code within 10 seconds.

b. Pending Fault Code Erasure. After storage of a pending fault code under section (f)(4)(A)1.a., if a malfunction is not detected before the end of the next operating cycle in which monitoring occurs (i.e., there is no indication of the malfunction at any time during the operating cycle), the OR OBD system shall erase the corresponding pending fault code at the end of the operating cycle.

c. MIL-on Fault Code Storage and MIL Illumination. After storage of a pending fault code under section (f)(4)(A)1.a., if the malfunction is again

detected before the end of the next operating cycle in which monitoring occurs, the OR OBD system shall illuminate the MIL continuously, erase the corresponding pending fault code, and store a MIL-on fault code within 10 seconds.

d. Requesting Alternative Protocols. A manufacturer may request Executive Officer approval to employ alternate statistical MIL illumination and fault code storage protocols to those specified in sections (f)(4)(A)1.a. through c. above. The Executive Officer shall grant approval upon determining that the manufacturer has provided data and/or an engineering evaluation that demonstrate that the alternative protocol can evaluate the monitored component's performance and detect malfunctions in a manner that is equally effective and timely. The Executive Officer shall not accept strategies requiring on average more than 6 operating cycles for MIL illumination.

e. MIL Illumination and Fault Code Storage for Default Actions. Except as provided for in section (f)(4)(D), the OR OBD system shall store fault codes and illuminate the MIL when the engine enters a default mode of operation that can affect emissions or the performance of the OR OBD system or in the event of a malfunction of any on board computer that can affect the performance of the OR OBD system.

i. Except as provided for in section (f)(4)(A)1.e.ii., the OR OBD system shall illuminate the MIL and store a MIL-on fault code within 10 seconds of detection of the condition that causes the engine to enter the default mode of operation.

ii. If the default mode of operation is recoverable (i.e., the diagnostic or control strategy that caused the default mode of operation can run on the next operating cycle and confirm the presence of the condition that caused the default operation), in lieu of illuminating the MIL and storing a MIL-on fault code within 10 seconds on the first operating cycle where the default mode of operation is entered, the OR OBD system may meet the following requirements:

I. If the engine enters the default mode of operation in the first operating cycle, the OR OBD system shall store a pending fault code within 10 seconds of detection; and

II. If the condition causing the default mode of operation is again detected before the end of the next operating cycle, the OR OBD system shall erase the pending fault code, store a MIL-on fault code, and illuminate the MIL within 10 seconds of detection.

(B) MIL Extinguishing and Fault Code Erasure Protocol.

1. For engines using the SAE J1939 protocol for the standardized functions required in section (e):

a. MIL Extinguishing. Once the MIL has been illuminated, the OR OBD system shall extinguish the MIL after three subsequent sequential operating cycles during which the diagnostic responsible for illuminating the MIL executes and the previously detected malfunction is no longer present, provided no other malfunction has been detected that would independently illuminate the MIL.

b. MIL-on Fault Code Erasure. The OR OBD system shall erase the corresponding MIL-on fault code in conjunction with extinguishing the MIL as described under section (f)(4)(B)1.a.

c. MIL Extinguishing and Fault Code Erasure for Default Actions. For default modes of operation that are recoverable during each subsequent operating cycle after the MIL is illuminated (i.e., where the diagnostic or control strategy that caused the default mode of operation can run on every subsequent operating cycle and confirm the presence of the condition that caused the default operation on each cycle):

i. Once the MIL has been illuminated in accordance with section (f)(4)(A)1.e., the OR OBD system shall extinguish the MIL after three subsequent sequential operating cycles during which the diagnostic responsible for illuminating the MIL executes and the previously detected condition causing the default mode of operation is no longer present, provided no other malfunction has been detected that would independently illuminate the MIL.

ii. The OR OBD system shall erase the corresponding MIL-on fault code in conjunction with extinguishing the MIL as described under section (f)(4)(B)1.c.i. above.

(C) Freeze Frame Conditions Storage and Erasure Protocol. The OR OBD system shall store and erase "freeze frame" conditions (as described in section (e)(3)(C)) present at the time a malfunction is detected as follows.

1. For engines using the SAE J1939 protocol for the standardized functions required in section (e):

a. The OR OBD system shall store freeze frame conditions in conjunction with the storage of a pending fault code.



i. If the pending fault code is erased in the next operating cycle in which monitoring occurs and a malfunction is not detected (as described under section (f)(4)(A)1.b.), the OR OBD system shall erase the corresponding freeze frame conditions.

ii. If the pending fault code matures to a MIL-on fault code (as described under section (f)(4)(A)1.c.), the OR OBD system shall replace the stored freeze frame conditions with freeze frame conditions regarding the MIL-on fault code.

iii. The OR OBD system shall erase the freeze frame information in conjunction with the erasure of the MIL-on fault code (as described under section (f)(4)(B)1.b.).

b. For alternate strategies that do not store pending fault codes (i.e., diagnostics using alternate statistical strategies described in section (f)(4)(A)1.d. such as diagnostics that store a MIL-on fault code and illuminate the MIL upon the first detection of a malfunction), the OR OBD system shall store and erase freeze frame conditions in conjunction with the storage and erasure of the MIL-on fault code.

c. If a fault code is stored when the maximum number of frames of freeze frame conditions is already stored, the OR OBD system shall not replace any currently stored freeze frame conditions with freeze frame conditions for the newly stored fault code except as allowed for MIL-on fault codes in section (f)(4)(C)1.a.ii.

(D) Exceptions to MIL and Fault Code Requirements.

1. If the engine enters a default mode of operation that can affect emissions or the performance of the OR OBD system, a manufacturer shall be exempt from the requirements of section and (f)(4)(A)1.e. (i.e., exempt from illuminating the MIL and storing fault codes) if any of the following are met:

a. The default strategy (1) causes an overt indication (e.g., illumination of a red engine shut-down warning light) such that the equipment operator is certain to respond and have the problem corrected, (2) is not otherwise caused by a component required to be monitored by the OR OBD system under sections (f)(1) and (f)(2), and (3) is not invoked to protect a component required to be monitored by the OR OBD system under sections (f)(1) and (f)(2); or

b. The default strategy is an AECD that is properly activated due to the occurrence of conditions that have been approved by the Executive Officer.

(5) *Malfunction Criteria Determination.*

(A) General Malfunction Criteria Determination Requirements. For purposes of determining the malfunction criteria for diagnostics in sections (f)(1) and (f)(2):

1. For diagnostics described in sections (f)(1)(B) through (F) and (f)(2)(A) through (F), the manufacturer shall use a component/system deteriorated to the malfunction criteria using methods established by the manufacturer to represent real world deterioration and failure modes under normal and malfunctioning engine and emission control system operating conditions.

2. For comprehensive component diagnostics described in sections (f)(1)(G) and (f)(2)(G), the manufacturer is not required to deteriorate the component/system using methods established by the manufacturer to represent real world deterioration and failure modes for purposes of determining the malfunction criteria, but is required to design the diagnostic to detect real world deterioration and failure modes under normal and malfunctioning engine and emission control system operating conditions.

3. For engines that are certified to transient test standards, in determining the malfunction criteria for diagnostics in sections (f)(1) and (f)(2) that are required to indicate a malfunction when emissions exceed an emission threshold (e.g., 0.040 g/kW-hr as measured from an applicable emission test cycle, 2.0 times any of the applicable standards), the manufacturer shall use the emission test cycle and standard (i.e., NRTC and transient test standard or applicable steady-state cycle and steady-state test standard) determined by the manufacturer to be more stringent (i.e., to result in higher emissions with the same level of component malfunction) as the "applicable emission test cycle" and "applicable standard."

a. The manufacturer shall use data and/or engineering analysis to determine the test cycle and standard that are more stringent.

b. The manufacturer shall identify in the certification documentation (required under section (h)) the test cycle and standard determined by the manufacturer to be more stringent for each applicable diagnostic.

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

4. For engines that are certified to steady-state test standards and not to transient test standards, in determining the malfunction criteria for diagnostics in sections (f)(1) and (f)(2) that are required to indicate a malfunction when emissions exceed an emission threshold (e.g., 0.040 g/kW-hr as measured from an applicable emission test cycle, 2.0 times any of the applicable standards), the manufacturer shall use the applicable steady-state cycle and steady-state test standard.

(B) Adjusted Emissions for Infrequent Regeneration Events.

1. For diagnostics in sections (f)(1) and (f)(2) that are required to indicate a malfunction when emissions exceed a certain emission threshold (e.g., 2.0 times the applicable standards) on engines equipped with emission controls that experience infrequent regeneration events, a manufacturer shall adjust the emission test results that are used to determine the malfunction criterion. Except as provided in section (f)(5)(B)2.b. below, the manufacturer shall adjust the emission result for each diagnostic using the procedure described in 40 CFR part 1039.525 (last amended October 25, 2016), and hereby incorporated by reference) with the component for which the malfunction criteria is being established deteriorated to the malfunction threshold. The adjusted emission value shall be used for purposes of determining whether or not the specified emission threshold is exceeded (e.g., a malfunction shall be detected when the adjusted emission value exceeds 2.0 times any applicable standard).

2. For calculating the adjustment factors:

a. Except as provided below, 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.

b. In lieu of using the procedures described in 40 CFR part 1039.525, the manufacturer may submit an alternate plan to calculate the adjustment factors for determining the adjusted emission values to the Executive Officer for review and approval. The Executive Officer shall approve the plan upon the manufacturer providing data or an engineering evaluation that is complete, accurate, and demonstrates the procedure is consistent with good engineering judgment in determining appropriate modifications to the tailpipe certification adjustment factors, and that the frequency factor derivation plan appropriately incorporates the impact of the malfunction on the regeneration event frequency.

(6) *Exceptions to Diagnostic Requirements.*

(A) **Low Temperature Exemption.** The manufacturer may request Executive Officer approval to exempt a specific component from the comprehensive component diagnostic requirements of section (f)(1)(G) or (f)(2)(G), whichever is applicable, if all malfunctions of the component affect the diagnostic strategy for any other monitored component or system only when the ambient temperature is below 20 degrees Fahrenheit (i.e., -6.7 degrees Celsius). 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 ambient temperature is above 20 degrees Fahrenheit (i.e., -6.7 degrees Celsius): (1) a malfunction of the component does not affect the diagnostic strategy for any other monitored component or system, and (2) the ambient temperature is determined based on a temperature sensor monitored by the OR OBD system (e.g., IAT sensor).

(g) *Demonstration Testing Requirements.*

(1) **Requirement.** The manufacturer shall test and submit emissions and diagnostic test data from one or more durability demonstration test engines (test engines).

(A) The manufacturer shall perform the testing each model year and submit the test data as part of the certification documentation described under section (h).

(B) The manufacturer is not required to test and submit the test data for a test engine in accordance with section (g) if:

1. The manufacturer has previously submitted the data for all engine ratings and power categories in all engine families, and
2. The engine, emission control system, and calibrations of all the monitors/diagnostics required to be tested (in accordance with section (g)(3)) in all the previously tested engines have not changed to the extent that the emissions test data are affected since the engine was tested.

(2) *Test Engine Selection.*

(A) Prior to submitting any applications for certification for a model year, the manufacturer shall notify the Executive Officer of the engine families and engine ratings within each family planned for that model year. The Executive Officer will then select the engine family(ies) and the specific engine rating within the engine family(ies) that the manufacturer shall use as demonstration test engines to provide test data.

(B) The manufacturer shall test and submit emissions and diagnostic test data from the following number of test engines:

1. If the manufacturer certifies for sale in California one to five engine families in the model year, one test engine.

2. If the manufacturer certifies for sale in California six to ten engine families in the model year, test engines from two different engine ratings for a total of two test engines.

3. If the manufacturer certifies for sale in California eleven or more engine families in the model year, test engines from three different engine ratings for a total of three test engines.

(3) Required Diagnostic Demonstration Testing. For engines required to meet the Stage 2 requirements in accordance with section (d)(2), the manufacturer shall test the following applicable diagnostics:

(A) For OBMD engines (i.e., engines required to meet section (d)(2)(A)):

1. OBM NO<sub>x</sub> emission threshold monitor (section (f)(1)(A)2.). For engines in power categories greater than or equal to 56 kW and less than or equal to 560 kW, the manufacturer shall test both the Bin B OBM NO<sub>x</sub> monitor and Bin C OBM NO<sub>x</sub> monitor independently.

2. PM filter filtering performance diagnostic (section (f)(1)(B)2.a.i.)

3. Tailpipe NO<sub>x</sub> sensor performance diagnostic (section (f)(1)(D)2.b.).

(B) For OBD engines (i.e., engines required to meet section (d)(2)(B)):

1. PM filter filtering performance diagnostic (section (f)(2)(A)2.a.i.).

2. EGR system low flow diagnostic (section (f)(2)(C)2.a.i.).

3. Fuel System Diagnostics.

a. Pressure control diagnostic (section (f)(2)(E)2.a.i.).

b. Injection quality diagnostic (section (f)(2)(E)2.b.i.).

c. Injection timing diagnostic (section (f)(2)(E)2.c.i.).

(C) For testing of the fuel system pressure control diagnostics on OBD engines under section (g)(3)(B)3.a., the manufacturer shall perform a test for each of the following that is applicable: (1) with a high side malfunction (i.e., malfunction that causes too much pressure, too much fuel quantity, too advanced timing) that affects all injectors equally; (2) with a low side malfunction (i.e., malfunction that causes too little pressure, too little fuel quantity, too retarded

timing) that affects all injectors equally; and (3) with a malfunction that affects the worst case injector (i.e., a malfunction on the injector that will result in the worst case emissions).

(4) *Testing Requirements.*

(A) Test Engine System Aging Requirements. Prior to conducting testing under sections (g)(4)(B) through (D), the manufacturer shall age the test engine system (engine, engine emission controls, and aftertreatment) using the following aging requirements:

1. Except as provided for in section (g)(4)(A)2. below, the manufacturer shall use a certification emission durability test engine system aged in accordance with Part IV: 40 CFR Part 1065, Subpart L, sections 1065.1131 through 1065.1145, as set forth in and modified by the "California 2029 and Later Model Year Test Procedures for Tier 5 Off-Road Compression-Ignition Engines," incorporated by reference in title 13, CCR, section 2423.1.

2. For testing of OBMD engines, in lieu of the engine system described in section (g)(4)(A)1. above, the manufacturer may use a low-hour engine with emissions stabilized using the same procedures the manufacturer uses for its low-hour emission-data certification engine. If the manufacturer selects this option, the manufacturer shall use the low-hour engine in combination with a tailpipe NO<sub>x</sub> sensor that is aged to full useful life. For the purposes of this section, a full useful life aged NO<sub>x</sub> sensor means a NO<sub>x</sub> sensor that has been aged as follows: **\*\*\*TBD\*\*\***

(B) Baseline Emission Test. The manufacturer shall perform a baseline emission test with no malfunctions implanted on the engine system (engine, engine emission controls, and aftertreatment) before performing the required testing in sections (g)(4)(C) and (g)(4)(D). The manufacturer shall collect NMHC, CO, NO<sub>x</sub>, and PM emissions data during this test.

(C) Tailpipe NO<sub>x</sub> Mass Accuracy Test. For engines required to meet the Stage 1 requirements in accordance with section (d)(2) and engines required to meet the Stage 2 requirements in accordance with section (d)(2) and the OBMD requirements in accordance with section (d)(2)(A), the manufacturer shall perform the following test to determine compliance with the NO<sub>x</sub> mass accuracy requirements in section (e)(2)(D)1.h.

1. Test Engine. The manufacturer shall use an engine in the baseline configuration (i.e., with no malfunctions on the engine, engine emission controls, and aftertreatment system).

## 2. Test Procedure.

a. For engines that certify to the transient test standard, the manufacturer shall conduct a transient test using the NRTC. The transient test shall be immediately preceded by a hot or cold-start preconditioning NRTC without cycling the ignition in between the two NRTCs to ensure that all NO<sub>x</sub> sensors are reporting NO<sub>x</sub> data throughout the entire transient test (i.e., the second NRTC).

b. For engines that do not certify to the transient test standard, the manufacturer shall conduct a steady-state test using either the discrete-mode cycle or RMC. The steady-state test shall be immediately preceded by a preconditioning cycle without cycling the ignition in between the preconditioning cycle and the steady-state test to ensure that all NO<sub>x</sub> sensors are reporting NO<sub>x</sub> data throughout the entire steady-state test. The preconditioning cycle shall be the same cycle used in the steady-state test.

3. Data Collection. The manufacturer shall collect the following data during the testing described above:

a. Data from the OR OBD System. The manufacturer shall collect the following data at a frequency of at least 1 Hertz from the OR OBD system throughout both the preconditioning cycle and the transient or steady-state test:

- i. Engine-out NO<sub>x</sub> mass emission rate, if equipped;
- ii. System-out (i.e., tailpipe) NO<sub>x</sub> mass emission rate;
- iii. Engine output energy;
- iv. Engine speed; and
- v. Actual indicated engine torque.

b. Data from the Test Facility for NRTC or RMC-based Testing. The manufacturer shall collect the following data at a frequency of at least 1 Hertz from the test facility system throughout the transient or steady-state test (not the preconditioning cycle).

- vi. System-out NO<sub>x</sub> Mass Emission Rate. To allow for a direct comparison with NO<sub>x</sub> data from the OR OBD system, the manufacturer shall not correct the test facility NO<sub>x</sub> mass data for humidity.
- vii. Engine speed.
- viii. Torque.

ix. Net brake work.

c. Data from the test facility for discrete-mode cycle based testing. The manufacturer shall collect the following data from the test facility system during the sampling period of each mode during the steady-state test (not the preconditioning cycle).

x. Sampling time.

xi. System-out NO<sub>x</sub> mass. To allow for a direct comparison with NO<sub>x</sub> data from the OR OBD system, the manufacturer shall not correct the test facility NO<sub>x</sub> mass data for humidity.

xii. Engine speed.

xiii. Torque.

xiv. Net brake work.

(D) Diagnostic Testing Protocol and Test Data Collection. For engines required to meet the Stage 2 requirements in accordance with section (d)(2), the manufacturer shall use the following testing protocol for each applicable diagnostic under section (g)(3).

1. Implanting of Malfunction and Malfunction Preconditioning Cycles.

a. Implanting of Malfunction.

i. The manufacturer shall implant a single malfunction with the component/system set at its malfunction criteria limit as determined by the manufacturer for meeting the requirements of section (f). Except as specified below, the component/system being evaluated shall be deteriorated to the applicable malfunction limit(s) established by the manufacturer and calibrated to the emission threshold malfunction criteria using methods established by the manufacturer in accordance with section (f)(5)(A)1.

I. For the OBM NO<sub>x</sub> emission threshold monitor test on OBMD engines (section (g)(3)(A)1.), the manufacturer shall implant the malfunction on one component/system of the manufacturer's choosing. The malfunction is not required to be representative of real-world aging and deterioration (e.g., a partially coated SCR catalyst is acceptable), but must result in an actual increase in NO<sub>x</sub> emissions (e.g., tailpipe NO<sub>x</sub> sensor signal manipulation is not acceptable).



II. For the fuel system diagnostic tests (section (g)(3)(B)3.) on OBD engines, the manufacturer may use computer modifications to cause the fuel system to operate at the malfunction limit if the manufacturer can demonstrate to the Executive Officer that the computer modifications produce test results equivalent to an induced hardware malfunction or that there is no reasonably feasible method to induce a hardware malfunction.

III. For the tailpipe NOx sensor diagnostic test (section (g)(3)(A)3.), the manufacturer may electronically simulate a malfunctioning sensor in lieu of using an induced hardware malfunction.

ii. The manufacturer shall implant the malfunction as follows:

I. If the Executive Officer approves the use of a malfunction preconditioning cycle under section (g)(4)(D)1.b. below, the manufacturer shall implant the malfunction on the test engine immediately prior to conducting the malfunction preconditioning cycle in section (g)(4)(D)1.b.

II. The manufacturer shall not replace, modify, or adjust the system or component after the last malfunction preconditioning cycle has taken place.

III. If the Executive Officer does not approve the use of any malfunction preconditioning cycle under sections (g)(4)(D)1.b. and c., the manufacturer shall implant the malfunction immediately prior to conducting the applicable malfunction detection cycle(s) and exhaust emission tests under section (g)(4)(D)2.

b. Optional Malfunction Preconditioning Cycle. The manufacturer may request Executive Officer approval to operate the test engine over a test cycle (i.e., a malfunction preconditioning cycle) prior to conducting the tests under section (g)(4)(D)2. below. The Executive Officer shall approve the request upon determining that a manufacturer has provided data or engineering evaluation that are complete and accurate and demonstrate that the malfunction preconditioning cycle is necessary for the emission control system to stabilize emissions (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 shall 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.

c. Optional Second Malfunction Preconditioning Cycle. The manufacturer may request Executive Officer approval to use an additional identical malfunction preconditioning cycle following a 20-minute hot soak after the first malfunction preconditioning cycle. The Executive Officer shall approve the request upon determining that a manufacturer has provided data or engineering evaluation that are complete and accurate and demonstrate that the additional malfunction preconditioning cycle:

i. Is necessary for the emission control system to stabilize emissions (e.g., through control system adaptation or learning) due to the introduction of the malfunction, and

ii. Is not solely intended for the purpose of adding monitoring time to detect a malfunction.

d. For test engines equipped with PM filters that experience infrequent regeneration events, the manufacturer shall not run a manual PM filter regeneration event immediately before or any time after the malfunction is implanted, except for the following:

i. When conducting the regeneration emission test under section (g)(4)(D)2.c.;

ii. If the diagnostic requires a regeneration event to enable monitoring; or

iii. With Executive Officer approval, if a regeneration event is expected to occur during demonstration testing of a specific diagnostic during the malfunction preconditioning cycles (section (g)(4)(D)1.b. or c.), the malfunction detection cycles (section (g)(4)(D)2.a.), or the exhaust emission test (section (g)(4)(D)2.b.). The Executive Officer shall approve the manual PM filter regeneration event if the manufacturer submitted data or engineering evaluation (soot model information) that are complete and accurate and that show that a regeneration event will most likely occur during demonstration testing of the diagnostic. If approved, the manufacturer shall run a manual PM filter regeneration event while operating the engine on an NRTC or the applicable steady-state cycle and before the malfunction is implanted for that specific diagnostic.

## 2. Demonstration Test Sequence.

a. Malfunction Detection Cycle. After the manufacturer has met the malfunction implanting and malfunction preconditioning cycle requirements under section (g)(4)(D)1., the manufacturer shall operate the

test engine over test cycles (i.e., malfunction detection cycles) to run the diagnostic as follows:

i. For the OBM NO<sub>x</sub> emission threshold monitor, the manufacturer shall operate the test engine over the applicable test cycle (i.e., NRTC, LLC, or applicable steady-state cycle) until the OR OBD system stores the MIL-on fault code and illuminates the MIL.

I. The manufacturer shall demonstrate the OBM NO<sub>x</sub> monitor's ability to make a diagnostic decision from a 2,400-window block of data comprised of windows from different operating cycles. To do so, the manufacturer shall separate test cycles by a soak period of at least five minutes such that setting the pending code requires at least two ignition cycles and setting the MIL-on fault code requires at least two ignition cycles.

II. To expedite malfunction detection, the manufacturer may run two repetitions of the appropriate test cycle within one ignition cycle. For example, a test sequence may consist of two NRTCs, a five-minute engine soak, two NRTCs to set the pending code, a five-minute engine soak, two NRTCs, a five-minute engine soak, and finally two more NRTCs to set the MIL-on fault code.

III. For engines certified to transient test standards, the malfunction detection cycle shall be the NRTC for the Bin C OBM NO<sub>x</sub> emission threshold monitor and the LLC for the Bin B OBM NO<sub>x</sub> emission threshold monitor.

ii. For all diagnostics except the OBM NO<sub>x</sub> emission threshold monitor that are designed to run on the NRTC in accordance with section (f)(3)(A)3.:

I. If the emission threshold malfunction criteria are based on the NRTC/transient test standard as determined in section (f)(5)(A)3., except as provided in section (g)(4)(D)2.a.v. below, the manufacturer shall operate the test engine over the NRTC to allow for initial detection of the malfunction (i.e., storage of a pending fault code). If a cold soak is required to run the diagnostic, the manufacturer may perform a cold soak prior to conducting this cycle.

II. If the emission threshold malfunction criteria are based on the applicable steady-state cycle/steady-state test standard as determined in section (f)(5)(A)3., except as provided in section (g)(4)(D)2.a.v. below, the manufacturer shall operate the test engine

over the NRTC to allow for initial detection of the malfunction (i.e., storage of a pending fault code), then over a second NRTC to allow the OR OBD system to store a MIL-on fault code and illuminate the MIL. If a cold soak is required to run the diagnostic, the manufacturer may perform a cold soak prior to conducting these cycles.

iii. For all diagnostics except the OBM NO<sub>x</sub> emission threshold monitor that are designed to run on the applicable steady-state cycle in accordance with section (f)(3)(A)3., except as provided in section (g)(4)(D)2.a.v. below, the manufacturer shall operate the test engine over the applicable steady-state cycle to allow for initial detection of the malfunction (i.e., storage of a pending fault code). If a cold soak is required to run the diagnostic, the manufacturer may perform a cold soak prior to conducting this cycle.

iv. For diagnostics designed to run over alternate monitoring conditions other than the NRTC and the applicable steady-state cycle that were approved under section (f)(3)(D), the manufacturer shall operate the test engine over the alternate conditions to allow for initial detection of the tested system or component malfunction (i.e., storage of a pending fault code), then over the alternate conditions again to allow for the OR OBD system to store the MIL-on fault code and illuminate the MIL.

v. The manufacturer shall omit the malfunction detection cycle(s) under sections (g)(4)(D)2.a. above if:

I. Initial detection of the tested system or component malfunction (i.e., storage of the pending fault code) was achieved during the malfunction preconditioning cycle under section (g)(4)(D)1.b or c. above, or

II. The diagnostic stores a MIL-on fault code and illuminates the MIL after the first detection of the malfunction.

b. Exhaust Emission Test. After the manufacturer has met the malfunction detection cycle requirements under section (g)(4)(D)2.a. above, the manufacturer shall operate the test engine over the exhaust emission test (transient test or steady-state test) determined by section (f)(5)(A)3. or (f)(5)(A)4.

i. For the Bin B OBM NO<sub>x</sub> emission threshold monitor, the manufacturer shall operate the test engine over the LLC exhaust emission test.

ii. Except as provided below, the “exhaust emission test” shall not include any other test cycle (e.g., any test cycle used to precondition the engine specifically for demonstrating compliance with the tailpipe emission standards) prior to running the exhaust emission test cycle. The manufacturer may request Executive Officer approval to operate the engine on an additional test cycle or other operating conditions prior to running the exhaust emission test. Executive Officer approval shall be granted upon determining that a manufacturer has provided data and/or an engineering evaluation that demonstrate that the additional test cycle/conditions is necessary to stabilize the emission control system.

c. Regeneration Emission Test. On engines equipped with PM filters that experience infrequent regeneration events, the manufacturer shall operate the test engine over the applicable exhaust emission test and trigger a PM filter regeneration event during this test (i.e., the regeneration emission test). The manufacturer shall run the regeneration emission test:

i. Immediately following the exhaust emission test under section (g)(4)(D)2.b. for each diagnostic, or

ii. After all exhaust emission tests under section (g)(4)(D)2.b. for all diagnostics have been completed.

### 3. Test Data Collection.

a. The manufacturer shall collect the following data during the test cycle in which the MIL is illuminated: Approximate time on the test cycle (in seconds after engine start) when the MIL illuminates (e.g., MIL illuminated at 200 seconds into the NRTC).

b. The manufacturer shall collect the following emission test data during the exhaust emission test and regeneration emission test under sections (g)(4)(D)2.b. and c.: NMHC, CO, NO<sub>x</sub>, and PM emission data as applicable (based on the applicable emission threshold malfunction criteria).

c. The manufacturer shall collect an OR OBD data snapshot immediately prior to engine shut-down at the end of each test cycle under section (g)(4)(D) (e.g., at the end of each malfunction preconditioning cycle, at the end of the exhaust emission test). If the manufacturer cannot collect the OR OBD data snapshot immediately prior to engine shut-down, the manufacturer shall collect the data immediately after engine shut-down.

4. Exceptions to Testing Protocol. For a manufacturer required to test more than one test engine under section (g)(2)(B), the manufacturer may utilize internal calibration sign-off test procedures (e.g., forced cool downs, less frequently calibrated emission analyzers) instead of official test procedures to obtain the emission test data required in section (g)(4)(D)3.b. for all but one of the required test engines. The manufacturer may use this option if the data from the alternative test procedure are representative of official emission test results. Manufacturers using this option are still responsible for meeting the emission threshold malfunction criteria specified in section (f) when emission tests are performed in accordance with official test procedures.

(5) *Evaluation Criteria.*

(A) For the tailpipe NO<sub>x</sub> mass accuracy test conducted in accordance with section (g)(4)(C), the test shall be considered a pass if the absolute error of the OR OBD tailpipe NO<sub>x</sub> mass emission rate relative to the test facility (determined according to section (h)(2)(C)4.e.) is less than or equal to **+/- TBD g/kW-h.**

(B) For each diagnostic test conducted in accordance with section (g)(4)(D):

1. The test shall be considered a pass if all the following occurs:

a. The tested diagnostic detects the malfunction, stores a MIL-on fault code, and illuminates the MIL before the end of the exhaust emission test specified in section (g)(4)(D)2.b.,

b. The emissions data collected during the exhaust emission test in accordance with section (g)(4)(D)3. are below the applicable emission threshold malfunction criteria specified in section (f), and

c. No default or emission control strategy is activated when the tested diagnostic detects the malfunction.

2. The test shall be considered a fail if any of the following occurs:

a. The tested diagnostic does not store a MIL-on fault code before the end of the exhaust emission test specified in section (g)(4)(D)2.b.,

b. The tested diagnostic does not illuminate the MIL before the end of the exhaust emission test specified in section (g)(4)(D)2.b., or

c. The tested diagnostic detects the malfunction, no default or emission control strategy is activated when the malfunction is detected, and the emissions data collected during the exhaust emission test in

accordance with section (g)(4)(D)3. exceed the applicable emission threshold malfunction criteria specified in section (f) for any emission constituent.

3. If the tested diagnostic illuminates the MIL with emissions below the applicable emission threshold malfunction criteria specified in section (f) and a default fuel or emission control strategy is activated when the malfunction is detected, the manufacturer shall retest the test engine with the tested system or component adjusted to the worst acceptable limit (i.e., the tested diagnostic indicates the system or component's performance is passing but at the closest possible value relative to the monitor/diagnostic threshold value at which a malfunction would be detected that would invoke the default strategy and illuminate the MIL).

a. The retest shall be considered a pass if emissions are below the applicable emission threshold malfunction criteria specified in section (f) for the tested diagnostic. 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/diagnostic threshold for malfunction detection.

b. The retest shall be considered a fail if emissions are above the applicable emission threshold malfunction criteria specified in section (f) for the tested diagnostic.

c. In lieu of retesting using a system/component adjusted to the worst acceptable limit as described above, the manufacturer may request Executive Officer approval to use computer modifications to disable the default fuel or emission control strategy when retesting the engine. Prior to retesting the engine, the manufacturer shall submit a proposed test plan for Executive Officer approval that identifies the computer modifications used to disable the default fuel or emission control strategy. The Executive Officer shall approve the plan upon determining that the test data and/or engineering evaluation submitted by the manufacturer are complete and accurate and demonstrate that testing the engine with the computer modifications used to disable the default fuel or emission control strategy

produce emissions results equivalent to testing the engine with the production-level calibration (i.e., emissions data from back-to-back tests of an engine with no malfunctions installed are equivalent, with one test not using the computer modifications and the other test(s) using the computer modifications).

i. The retest shall be considered a pass if the criteria under section (g)(5)(A) are met.

ii. The retest shall be considered a fail if the criteria under section (g)(5)(B) are met.

4. If the tested diagnostic illuminates the MIL with emissions above the applicable emission threshold malfunction criteria specified in section (f) and a default fuel or emission control strategy is activated when the malfunction is detected, the manufacturer shall retest the test engine with the tested system or component adjusted to the worst acceptable limit (i.e., the tested diagnostic indicates the system or component's performance is passing but at the closest possible value relative to the monitor/diagnostic threshold value at which a malfunction would be detected that would invoke the default strategy and illuminate the MIL).

a. The retest shall be considered a pass if emissions are below the applicable emission threshold malfunction criteria specified in section (f) for the tested diagnostic. 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/diagnostic threshold for malfunction detection.

b. The retest shall be considered a fail if emissions are above the applicable emission threshold malfunction criteria specified in section (f) for the tested diagnostic.

c. In lieu of retesting using a system/component adjusted to the worst acceptable limit as described above, the manufacturer may request Executive Officer approval to use computer modifications to disable the default fuel or emission control strategy when retesting the engine. Prior to



retesting the engine, the manufacturer shall submit a proposed test plan for Executive Officer approval that identifies the computer modifications used to disable the default fuel or emission control strategy. The Executive Officer shall approve the plan upon determining that the test data and/or engineering evaluation submitted by the manufacturer demonstrate that testing the engine with the computer modifications used to disable the default fuel or emission control strategy produce emissions results equivalent to testing the engine with the production-level calibration (i.e., emissions data from back-to-back tests of an engine with no malfunctions installed are equivalent, with one test not using the computer modifications and the other test(s) using the computer modifications).

i. The retest shall be considered a pass if the criteria under section (g)(5)(B)i. are met.

ii. The retest shall be considered a fail if the criteria under section (g)(5)(B)ii. are met.

5. If a test for a diagnostic is considered a fail, the manufacturer may recalibrate the diagnostic (e.g., change the malfunction criteria limit, change the monitoring conditions) and retest the system on the same test engine.

a. The manufacturer shall retest all diagnostics that were tested prior to the recalibration and are affected by the recalibration.

b. All diagnostics that are retested shall considered pass or fail based on the conditions in section (g)(5)(B)i. through iv. above.

(h) *Certification Documentation Requirements.*

(1) *Requirement.* The manufacturer is required to submit an application to the Executive Officer for certification of the OR OBD system on an engine each model year. The application shall include all the information required under section (h)(2).

(A) If any of the items listed in section (h)(2) below are standardized for all of a manufacturer's engines, the manufacturer may, for each model year, submit one set of documents covering the standardized items for all of its engines.

(B) In lieu of submitting an application for the OR OBD system on each engine, the manufacturer may submit an application for certification from one engine that is also representative of other engines (e.g., one engine that is representative of multiple engine ratings within an engine family, one engine representing more than one engine family) if the criteria below are met. The grouping of engines shall be referred to as an "OR OBD certification documentation group."

1. The representative engine shall be certified to the most stringent emission standards among the engines covered by the submitted documentation.

2. The representative engine shall cover all of the emission control devices for the engines covered by the submitted documentation.

3. The monitors/diagnostics on the representative engine shall cover all of the monitors/diagnostics on the other engines in the grouping.

4. The grouping shall not consist of a subset of engines required to meet the Stage 1 requirements under section (d)(1) and another subset of engines required to meet the Stage 2 requirements under section (d)(2).

5. For groupings of engines required to meet the Stage 2 requirements, the grouping shall not consist of a subset of engines required to meet the OBMD diagnostic requirements in section (f)(1) (i.e., equipped with an SCR system or tailpipe NO<sub>x</sub> sensor) and another subset of engines required to meet the OBD diagnostic requirements in section (f)(2) (i.e., not equipped with an SCR system and tailpipe NO<sub>x</sub> sensor).

(C) To the extent possible, the certification documentation shall use SAE J1930 or SAE J2403 terms, abbreviations, and acronyms.

(2) *Required Certification Documentation.* For each application, the manufacturer shall submit the applicable documentation specified below.

(A) For engines required to meet the Stage 1 requirements of section (d)(1):

1. A cover letter including the following information:
  - a. The manufacturer name;
  - b. The model year of the engine;
  - c. The engine family, engine rating, and power category of the engine;
  - d. For an OR OBD certification documentation group, the engine families, engine ratings, and power categories of all the engines in the group;
  - e. The types of equipment(s) the engines will be used in;
  - f. A statement that the engines comply with the Stage 1 requirements;

- g. The emission standards the engines are being certified to;
- h. All deficiencies applicable to the equivalent previous model year engines, the changes and/or resolution of each deficiency for the current model year engines, and all other known issues that apply to the current model year engines (e.g., issues found on another engine that also apply to these engines, unresolved issues identified during post-certification verification under section (i) from a previous model year); and
  - i. A statement of compliance indicating that the engines in the application comply with the requirements of section 2422, with the exception of issues indicated under section (h)(2)(A)1.h. above (if applicable), and indicating that the manufacturer will comply with the required deadlines for submission of results/data for post-certification verification according to section (i).
- 2. A written identification of the communication protocol utilized by each engine for communication with a scan tool.
- 3. A pictorial representation or written description (including any covers or labels) of the diagnostic link connector and its location representative of every equipment covered by the application. The manufacturer may submit one set of information for a group of equipment if the diagnostic connectors have the same design, orientation, and location on the equipment.
- 4. A diagram of the emission control system on the engine.
- 5. Information about the CVN algorithm used.
- 6. The following data to support compliance with the Phase 1 standardization requirements under section (e)(2):
  - a. OR OBD data snapshot. The manufacturer shall obtain snapshots of these data from an engine both before and after operating the engine over certification test cycles repeated as necessary to achieve at least one hour of operation.
  - b. A log of data stream parameters recorded over the period of engine operation indicated in section (h)(2)(A)6.a. above. The data shall be time aligned at a frequency of 1 Hertz and submitted in a CSV file format. The log shall include the following parameters if the engine is so equipped: engine speed, actual indicated engine torque, nominal engine friction torque, reference engine maximum torque, engine coolant temperature, engine oil temperature, engine fuel rate, modeled exhaust flow rate, engine intake 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 turbocharger position, corrected NOx sensor output, DEF dosing mode, stability of NOx sensor reading, commanded DEF dosing, 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.

(B) For engines required to meet the Stage 2 requirements of section (d)(2):

1. A cover letter including the following information:
  - a. The manufacturer name;
  - b. The model year of the engine;
  - c. The engine family, engine rating, and power category of the engine;
  - d. For an OR OBD certification documentation group, the engine families, engine ratings, and power categories of all the engines in the group;
  - e. The types of equipment(s) the engines will be used in;
  - f. A statement that the engines are meeting the Stage 2 requirements;
  - g. The emission standards the engines are being certified to;
  - h. A statement indicating the diagnostic requirements the engines are required to meet (i.e., the OBMD diagnostic requirements under section (f)(1) or the OBD diagnostic requirements under section (f)(2));
  - i. All deficiencies applicable to the equivalent previous model year engines, the changes and/or resolution of each deficiency for the current model year engines, and all other known issues that apply to the current model year engines (e.g., issues found on another engines that also apply to these engines, unresolved issues identified during post-certification verification under section (i) from a previous model year); and
  - j. A statement of compliance indicating that the engines in the application comply with the requirements of section 2422, with the

exception of issues indicated under section (h)(2)(B)1.i. above (if applicable), and indicating that the manufacturer will comply with the required deadlines for submission of results/data for post-certification verification according to section (i).

2. A written identification of the communication protocol utilized by each engine for communication with a scan tool.

3. A pictorial representation or written description (including any covers or labels) of the diagnostic link connector and its location representative of every equipment covered by the application. The manufacturer may submit one set of information for a group of equipment if the diagnostic connectors have the same design, orientation, and location on the equipment.

4. A timeline showing the start of engine production and the start of equipment production for the engine family, and the required deadlines for post-certification verification of standardization requirements and performance monitoring (according to section (i)).

5. A diagram of the emission control system on the engine.

6. A description of the functional operation of the OR OBD system including a complete written description for each diagnostic strategy required under section (f) that outlines every step in the decision-making process of the diagnostic. The manufacturer shall include algorithms, diagrams, or samples of data where necessary to adequately describe the information.

7. A table that meets the following requirements:

a. For each monitor/diagnostic required under section (f), the table shall include the following information:

- i. The name of the monitored component or system;
- ii. The corresponding fault code for the monitor/diagnostic;
- iii. The monitor/diagnostic strategy description (e.g., "filtering performance emission threshold" for the PM filter);
- iv. The malfunction criteria parameter used to detect a malfunction (e.g., pressure sensor reading);
- v. The malfunction criteria threshold for the malfunction parameter used to determine if there is a malfunction (e.g., pressure below a specific level);

- vi. The secondary parameters and their corresponding enable conditions necessary to run the monitor/diagnostic (e.g., engine speed < 1000 revolutions-per-minute), and the fault code(s) that disable the diagnostic;
  - vii. The time required for the monitor/diagnostic to run and complete;
  - viii. Whether the diagnostic runs on the NRTC, the applicable steady-state cycle, or neither the NRTC nor the applicable steady-state cycle;
  - ix. The number of times the diagnostic can run in an operating cycle (e.g., continuously, once per operating cycle, anytime the monitoring conditions are met in an operating cycle);
  - x. The criteria for storing each fault code (e.g., malfunction detected two times in an operating cycle before a pending fault code is stored); and
  - xi. The number of operating cycles required to illuminate the MIL.
- b. The table shall use the following engineering units:
- i. Degrees Celsius (°C) for temperature criteria;
  - ii. KiloPascals (kPa) for pressure criteria;
  - iii. Grams (g) for intake air mass criteria;
  - iv. Miles-per-hour (mph) for vehicle speed criteria;
  - v. Relative percent (%) for relative throttle position criteria (as defined in SAE J1939);
  - vi. Voltage (V) for absolute throttle position criteria (as defined in SAE J1939);
  - vii. Milligrams-per-stroke (mg/stroke) for fuel quantity-based per ignition event criteria and per stroke (/stroke) for other changes per ignition event based criteria (e.g., airflow in g/stroke instead of g/rev or g/firing);
  - viii. Per second for changes per time based criteria (e.g., g/sec); and
  - ix. Percent of nominal tank volume (%) for fuel tank level criteria.

8. A scale drawing of the MIL which specifies location (in the instrument panel or elsewhere on the equipment), wording, color, and intensity.
9. A listing of all electronic powertrain input and output signals (including those not monitored by the OBD system) that identifies which signals are monitored by the OBD system.
10. For each diagnostic required to detect a malfunction when a specific emission threshold is exceeded in sections (f)(1) and (f)(2):
  - a. Data supporting the criteria used to detect a malfunction,
  - b. The test cycle and standard determined by the manufacturer to be the most stringent in accordance with section (f)(5)(A)3.,
  - c. The malfunction criteria emission threshold level (e.g., 0.060 g/kW-hr), and
  - d. For engines with emission controls that experience infrequent regeneration events, the adjustment factors determined by the manufacturer and all details of how each adjustment factor was calculated for each applicable diagnostic in accordance with section (f)(5)(B).
11. A list of all the malfunction criteria required to be detected in section (f) and the corresponding diagnostic noted by fault code for each malfunction criterion.
12. A list of the test results required to be made available under section (e)(3)(E).
  - a. For engines using SAE J1939, the information shall include all of the following for each test result:
    - i. Suspect Parameter Number (SPN) Description;
    - ii. SPN;
    - iii. Failure Mode Identifier (FMI) Description;
    - iv. FMI;
    - v. Minimum test value;
    - vi. Maximum test value; and
    - vii. Unit for the minimum and maximum test values.

13. A written description of all parameters and conditions necessary to begin closed-loop/feedback control of emission control systems (e.g., fuel system, EGR flow, PM filter regeneration).

14. Data demonstrating the net brake torque reported by the engine dynamometer and the "calculated net brake torque" during the NRTC and the steady-state cycle used for certification (only the steady-state cycle for engines that do not certify to the transient test standard). 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 "reference engine maximum torque," "actual indicated engine torque," and "nominal engine friction torque," and the following equation:

$$\text{"Calculated net brake torque"} = (\text{reference engine maximum torque}) \times \frac{[(\text{actual indicated engine torque}) - (\text{nominal engine friction torque})]}{100}$$

15. A written description of each AECD utilized by the manufacturer including the sensor signals and calculated values used to invoke each AECD, the engineering data and analysis demonstrating the need for such an AECD, the actions taken when each AECD is activated, the expected in-use frequency of operation of each AECD, and the expected emission impact from each AECD activation.

16. Information about the CVN algorithm used.

17. For the demonstration testing required under section (g):

a. The manufacturer shall provide the following information:

i. A description of the testing sequence (e.g., the number and types of malfunction preconditioning cycles) for each tested monitor/diagnostic;

ii. A description of the method used for malfunction simulation for each test (e.g., description of the modified or deteriorated component/system, computer modifications);

iii. The data required to be collected in section (g)(4)(D)3.; and

iv. A summary of any issues that were found during testing under section (g), including issues where the engine does not meet one or more of the requirements in section 2422 (e.g., a diagnostic does not detect a malfunction when emissions exceed the emission threshold malfunction criteria in section (f)).



b. If the manufacturer does not have all the information in section (h)(2)(B)17.a. above at the time of the OR OBD certification application submission, the manufacturer may request Executive Officer approval for conditional certification of the OR OBD system prior to the submittal of the information. The manufacturer shall include with the request the reason for the delay in the information submission and the length of time until the information will be available. The Executive Officer will approve the request if the delay is due to unforeseen circumstances outside of the manufacturer's control, the information will be available and submitted to the Executive Officer within 3 months from the date of the OR OBD system conditional certification, and, if applicable, the manufacturer has shown previous success in submitting the information prior to certification for previous OR OBD systems.

(C) For all engines equipped with an SCR system or a tailpipe NOx sensor:

1. Information on Pausing of OR-REAL Tracking.

a. For Stage 1 engines, a list of manufacturer diagnostics and respective fault codes for malfunctions that pause tracking of OR-REAL data under sections (e)(2)(D)1.f.ii. and iii.

b. For Stage 2 engines, a list of diagnostics and respective fault codes for malfunctions that pause tracking of OR-REAL data under sections (e)(2)(D)1.g.ii. and iii.

2. A written description of all parameters and conditions that are technically necessary for each NOx sensor to begin reporting NOx concentration data after engine start and all parameters and conditions that are technically necessary to cause each NOx sensor to subsequently cease or pause reporting NOx concentration data.

3. 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) for each NOx sensor during the test cycle the engine uses for emissions certification.

a. For engines that certify to the transient test standard, the manufacturer shall provide these data over the cold-start NRTC and hot-start NRTC.

b. For engines that do not certify to the transient test standard, the manufacturer shall use a steady-state test cycle (either the discrete-mode or RMC variant).

c. The data shall also identify specifically which parameters and conditions documented in the certification application caused the NO<sub>x</sub> sensor to transition from one status to another (e.g., from not reporting NO<sub>x</sub> concentration data to actively reporting and from actively reporting to not reporting).

d. The manufacturer shall use an engine with no malfunctions on the system (engine, engine emission controls, and aftertreatment).

4. Data collected during NO<sub>x</sub> mass accuracy testing as described in section (g)(4)(C).

a. Data from the OR OBD System.

v. A file in CSV format with all the data that was continuously logged over both the preconditioning cycle and the test cycle.

vi. For NRTC or RMC-based testing, the summed values over the test cycle (not the preconditioning cycle) for engine-out NO<sub>x</sub> mass (if equipped), system-out NO<sub>x</sub> mass, and engine output energy.

vii. For discrete-mode cycle based testing, a table which contains (1) for each mode, the summed values for engine-out NO<sub>x</sub> mass (if equipped), system-out NO<sub>x</sub> mass, and engine output energy for the portion of each mode over which the test facility conducted emissions sampling; and (2) the weighted sum of all these values using the standard weighting factors defined in Appendix II to 40 CFR Part 1039.

b. *Data from the test facility for NRTC or RMC-based testing.*

viii. A file in CSV format with all the data that was continuously logged over the test cycle.

ix. The summed values over the test cycle for system-out NO<sub>x</sub> mass and net brake work.

c. Data from the Test Facility for Discrete-mode Cycle Based Testing.

x. A table with all the data that were collected for each mode of the test cycle with one row of data per mode.

xi. The weighted sum of system-out NO<sub>x</sub> mass and net brake work over all modes using the standard weighting factors defined in Appendix II to 40 CFR Part 1039.

d. *NO<sub>x</sub> Data Plot.* A plot of the system-out NO<sub>x</sub> mass emission rate from the OR OBD system and the system-out NO<sub>x</sub> mass emission rate from the test facility versus time over the test cycle (not the preconditioning cycle). For discrete-mode cycle-based testing, the test facility data shall be rendered as a dot for each mode.

e. *Error Calculation.* The test facility system-out NO<sub>x</sub> mass value shall be subtracted from the OR OBD system-out NO<sub>x</sub> mass value. The resulting value shall be divided by the test facility's net brake work. The resulting value shall be the absolute error (in units of g/kWh) of the OR OBD system relative to the test facility.

(3) *Certification Documentation Submission Website.* The manufacturer shall submit the certification documentation described in sections (h)(1) and (h)(2) above to CARB through [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov).

(i) *Post-Certification Verification Requirements.*

(1) *Verification of Standardized Requirements.*

(A) *Requirement.* For engines required to meet the Stage 2 requirements in accordance with section (d)(2), the manufacturer shall perform testing to verify that engines installed in equipment meet the standardization requirements of section (e) relevant to proper communication of required OR OBD-related messages between DEC ECUs and to an SAE J1939 scan tool.

1. The manufacturer shall perform the testing each model year on engines installed in the applicable equipment (i.e., production equipment).

2. The manufacturer shall perform the testing in section (i)(1)(D) no later than 3 months after the start of engine production or 1 month after the start of equipment production, whichever is later. The manufacturer shall submit the test log file and test report to the Executive Officer in accordance with the deadlines specified in section (i)(1)(E) below.

3. The manufacturer is not required to test and submit the test log file and test report for a production equipment in accordance with section (i)(1) if:

a. The manufacturer has previously submitted the data for production equipment from all engine ratings and power categories in all engine families, and

b. The engine, emission control system, and calibrations of the OR OBD system in all the previously tested engines have not changed to the extent that the standardized functions are affected since the engine was tested.

4. The manufacturer may request Executive Officer approval to carry over data from testing of previous model year engines. The Executive Officer shall approve the request upon finding that the software and hardware designed to comply with the standardization requirements of section (e) are identical to those of the previous model year and no other hardware or software changes that affect compliance with the standardization requirements have been made.

(B) *Test Engine and Equipment.* The manufacturer shall perform this testing every model year on 1 production engine (i.e., engine rating) per engine family with the engine installed in the applicable equipment.

1. For an engine family with more than one engine with a unique calibration, the manufacturer shall test the engine with the highest projected California sales number in the engine family. For an engine that is intended to be installed in more than one type of equipment, the manufacturer shall perform the testing with the engine installed in the applicable equipment with the highest projected California sales number.

2. When determining the engine with the highest projected California sales number in section (i)(1)(B)1., the manufacturer shall exclude engines that are not required to meet the Stage 2 requirements under section (d)(2).

3. For the engine with the highest projected California sales number in a given model year, if the manufacturer had already tested this engine but had not tested all the engine/equipment combinations for that engine in the previous model years, the manufacturer shall exclude the equipment used in the engine/equipment combinations already tested when determining the equipment with the highest projected California sales number.

4. For a given engine model year, if the manufacturer had tested the engine with the highest projected California sales number and with all engine/equipment combinations for that engine in the previous model years, the manufacturers shall exclude this engine when determining the engine with the highest projected California sales number.

(C) *Off-Board Device for Testing.*

1. For the testing required in section (i)(1)(D), the manufacturer shall utilize an Executive Officer-approved off-board device to conduct the testing.

2. Prior to conducting testing, the manufacturer shall request Executive Officer approval of the off-board device that the manufacturer will use to perform the testing. The Executive Officer shall approve the off-board device if the manufacturer submitted data, specifications, or engineering analysis demonstrating that the device will verify that the production equipment will be able to perform all of the required functions in section (i)(1)(D) for the specific engine. The manufacturer shall not perform the testing with an off-board device that has not been approved by the Executive Officer.

(D) *Required Testing.*

1. The testing shall verify that communication can be properly established between all DEC ECUs and between any DEC ECU and a SAE J1939 scan tool.

2. The testing shall verify that all applicable information required in sections (e)(2) and (e)(3) is properly communicated between all DEC ECUs and between any DEC ECU and a SAE J1939 scan tool in accordance with the requirements in section (e) and the applicable ISO and SAE specifications (e.g., specifications for physical layer, network layer, message structure, and message content).

3. The testing shall verify that the following information can be properly communicated to any SAE J1939 scan tool:

a. The MIL status while the MIL is commanded off and while the MIL is commanded on in accordance with SAE J1939 under the following conditions:

i. In the key on, engine off position, in accordance with section (e)(3)(E);

ii. While the engine is running, in accordance with section (e)(3)(E); and

iii. During the MIL functional check while the engine is off, in accordance with section (e)(3)(A)4.;

b. All data stream parameters required in sections (e)(2)(C) and, if applicable, (e)(3)(E) in accordance with SAE J1939 including the proper identification of each data stream parameter as supported in SAE J1939;

c. The CAL ID and CVN in accordance with SAE J1939 and sections (e)(2)(E), and (e)(2)(F); and

d. Except as provided for in section (i)(1)(D)5. below, a pending fault code and MIL-on fault code and the correct number of stored fault codes and MIL status for each DEC ECU in accordance with SAE J1939.

4. The testing shall verify that all DEC ECUs can properly respond to any SAE J1939 scan tool request to erase emission-related diagnostic information in accordance with section (e)(3)(G).

5. The manufacturer may be exempt from verifying a fault code from a specific DEC ECU can be properly communicated to any SAE J1939 scan tool under section (i)(1)(D)3.d. above if the malfunction cannot be implanted without damaging the engine or its components.

(E) *Reporting of Results.*

1. For each test, the manufacturer shall submit to the Executive Officer the test log file and a report containing all information described in sections (i)(1)(E)2. within the deadlines described in section (i)(1)(E)3. and 4. below for each test.

2. The manufacturer shall include the following information in the report for each test:

- a. Test log filename,
- b. Date the test log file was submitted to CARB,
- c. Date the test was conducted,
- d. Engine manufacturer,
- e. Engine model year,
- f. OR OBD certification documentation group (if applicable),
- g. Engine Family,
- h. Engine Rating,
- i. Power category,
- j. Powertrain type (i.e., conventional, hybrid electric),
- k. Start of engine production date,
- l. Start of equipment production date,
- m. Testing tool name and release number,
- n. Number of warnings,

- o. Number of failures,
- p. For each warning:
  - i. Warning message,
  - ii. Description/explanation of warning,
  - iii. Test number,
- q. For each failure:
  - i. Failure message,
  - ii. One of the following failure classifications:
    - I. Non-compliance failure (i.e., failure that is a non-compliance described under section (k)(8)),
    - II. Section 2422 standardization failure (i.e., failure due to the OR OBD system not complying with the standardization requirements of section 2422),
    - III. Testing tool specification failure (i.e., failure incorrectly identified by the tool's software),
    - IV. Operator/user error failure, or
    - V. Other failure (e.g., incorrect failure due to the equipment not meeting the requirement based on the implementation schedule),
  - iii. Description/explanation of failure,
  - iv. Test number,
- r. For each warning and failure identified, any additional notes, including corrective actions taken (e.g., running changes, field fixes, future model year updates) and titles and dates of presentations describing the issues/failures for a test.

3. If the production equipment meets all the required testing in section (i)(1)(D), the manufacturer shall submit to the Executive Officer the following information within three months of testing: the test log file, the report containing all information described in section (i)(1)(E)2., and a statement specifying that the production equipment passed all the tests.

4. If the production equipment fails any of the required testing in section (i)(1)(D), the manufacturer shall submit to the Executive Officer the

following information within one month of identifying the issue: the test log file, the report containing all information described in section (i)(1)(E)2., information about the problem(s) identified, and a corrective action plan to remedy the problem(s).

(F) *Test Report Submission Website.* The manufacturer shall submit the test log file, test report, and proposed corrective action described in section (i)(1)(E) above to CARB through [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov).

(2) *Verification of Diagnostic Requirements.*

(A) *Requirement.* For engines required to meet the Stage 2 requirements in accordance with section (d)(2), the manufacturer shall perform testing to verify that engines installed in equipment meet the diagnostic requirements of section (f) relevant to the ability of the OR OBD system to detect a malfunction, illuminate the MIL, and store MIL-on fault codes readable by a scan tool conforming to SAE J1939 when a malfunction is present for each individual diagnostic required by section (i)(2)(C)2. below.

1. The manufacturer shall perform the testing each model year on engines installed in the applicable equipment (i.e., production equipment).

2. The manufacturer shall perform the testing in section (i)(2)(C) and submit the test report (described in section (i)(2)(D)) no later than 6 months after the start of engine production or equipment production, whichever is later.

3. The manufacturer is not required to test and submit the test log file and test report for a production equipment in accordance with section (i)(2) if:

a. The manufacturer has previously submitted the data for all engine/equipment combinations for all engine ratings and power categories in all engine families, and

b. The engine, emission control system, and calibrations of all the diagnostics required to be tested (in accordance with section (i)(2)(C)2.) in all the previously tested engines have not changed to the extent that the diagnostics are affected since the engine was tested.

(B) *Test Engine and Equipment.*

1. For each engine selected for demonstration testing in section (g), manufacturers shall perform this testing on an engine from the same engine family and rating as the demonstration test engine, with the engine installed in the applicable equipment. For an engine that is intended to be installed in more than one type of equipment, the manufacturer shall perform the testing



with the engine installed in the applicable equipment with the highest projected California sales number.

2. For a given test engine, if the manufacturer had already tested this engine but had not tested all the engine/equipment combinations for that engine in the previous model years, the manufacturer shall exclude the equipment used in the engine/equipment combination already tested when determining the equipment with the highest projected California sales number.

(C) *Required Testing.*

1. Test Plan. The manufacturer shall submit a proposed test plan to the Executive Officer for approval prior to performing the evaluation testing. The test plan shall identify the method used to induce a malfunction for each required diagnostic, and the conditions under which the production equipment will be operated to run each diagnostic. The Executive Officer shall approve the plan upon determining that the method to induce the malfunction and the operating conditions meet the requirements in section (f)(1)(C)3.a.

2. Test Diagnostics.

a. For engines required to meet the OBMD requirements in section (f)(1), the manufacturer shall test the following applicable diagnostics:

i. PM filter diagnostics:

I. Non-emission threshold filtering performance diagnostic (section (f)(1)(B)2.a.ii.),

II. Frequent regeneration diagnostic (section (f)(1)(B)2.b.),  
and

III. Active/intrusive injection diagnostic (section (f)(1)(B)2.c.);

ii. PM sensor and heater diagnostics (section (f)(1)(C)2.);

iii. Tailpipe NO<sub>x</sub> sensor diagnostics:

I. Circuit diagnostics (section (f)(1)(D)2.a.),

II. Activity diagnostic (section (f)(1)(D)2.c.), and

III. Sensor heater diagnostics (section (f)(1)(D)2.d.);

iv. DOC diagnostic (section (f)(1)(E)2.);

v. Closed CV system diagnostics (section (f)(1)(F)2.); and

- vi. Comprehensive component diagnostics (section (f)(1)(G)2.).
  - b. For engines required to meet the OBD requirements in section (f)(2), the manufacturer shall test the following diagnostics:
    - i. PM filter diagnostics:
      - I. Non-emission threshold filtering performance diagnostic (section (f)(2)(A)2.a.ii.),
      - II. Frequent regeneration diagnostic (section (f)(2)(A)2.b.), and
      - III. Active/intrusive injection diagnostic (section (f)(2)(A)2.c.);
    - ii. PM sensor and heater diagnostics (section (f)(2)(B)2.);
    - iii. EGR system diagnostics:
      - I. Non-emission threshold low flow diagnostic (section (f)(2)(C)2.a.ii.),
      - II. High flow diagnostic (section (f)(2)(C)2.b.),
      - III. Slow response diagnostic (section (f)(2)(C)2.c.), and
      - IV. EGR cooler performance diagnostic (section (f)(2)(C)2.d.);
    - iv. DOC diagnostic (section (f)(2)(D)2.);
    - v. Fuel system diagnostics:
      - I. Non-emission threshold fuel system pressure control diagnostic (section (f)(2)(E)2.a.ii.),
      - II. Non-emission threshold fuel system injection quantity diagnostic (section (f)(2)(E)2.b.ii.),
      - III. Non-emission threshold fuel system injection timing diagnostic (section (f)(2)(E)2.c.ii.), and
      - IV. Feedback control diagnostics (section (f)(2)(E)2.d.);
    - vi. Closed CV system diagnostics (section (f)(2)(F)2.); and
    - vii. Comprehensive component diagnostics (section (f)(2)(G)2.).
3. Test Protocol.
- a. Verification of malfunction detection, fault code storage, and MIL illumination. For each diagnostic in section (i)(2)(C)2. above:

i. The manufacturer shall mechanically implant or electronically simulate the malfunction. The manufacturer shall not use internal on-board computer hardware or software changes to simulate malfunctions.

ii. The manufacturer shall operate the production equipment so that all the required monitoring conditions for the diagnostic are satisfied to execute the diagnostic and detect the malfunction. The manufacturer shall operate the engine over the number of operating cycles necessary to store the appropriate MIL-on fault code and illuminate the MIL.

b. The manufacturer may omit testing of a specific diagnostic if the testing cannot be reasonably performed without causing physical damage to the engine or equipment (e.g., on-board computer internal circuit faults) or jeopardizing the safety of personnel performing the testing.

(D) *Test Report.* For each test production equipment, the test report shall include the following information:

1. Report of the results filename;
2. Engine manufacturer;
3. Engine model year;
4. OBD certification documentation group (if applicable);
5. Engine family;
6. Engine rating;
7. Power category;
8. Equipment type;
9. Powertrain type (i.e., conventional, hybrid electric);
10. Start of engine production date;
11. Start of equipment production date;
12. Number of diagnostics tested;
13. Number of problems identified during testing; and
14. For each problem identified:
  - a. Fault code (SAE J1939 or manufacturer-defined),

- b. Fault code description,
- c. Method used to induce malfunction,
- d. Fail reason (e.g., monitor/diagnostic is unable to detect a malfunction, monitor/diagnostic is unable to store a fault code or illuminate the MIL when a malfunction is detected),
- e. Description/explanation of problem, and
- f. For each problem identified, any additional notes, including but not limited to corrective actions taken (e.g., running changes, field fixes, future model year updates) and titles and dates of presentations describing the issues/failures for a test.

(E) *Test Report Submission Website.* The manufacturer shall submit the test report described in section (i)(2)(D) above to CARB through [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov).

(3) *Verification of Monitor Activity Data Requirements.*

(A) *Requirement.* For engines required to meet the Stage 2 requirements in accordance with section (d)(2), the manufacturer shall collect and report monitor activity data (described in section (e)(3)(1)2.) and other standardized data to verify that engines installed in equipment meet the monitor activity data requirements of sections (e)(3)(F)2. and (f).

1. The manufacturer shall collect the data each model year from engines installed in equipment (i.e., production equipment) that have been operated in the field for at least 9 months.

2. The manufacturer shall collect and submit the data described in section (i)(3)(B) no later than 12 months after the production equipment was first introduced into commerce.

3. The manufacturer is not required to collect and submit data for an engine in accordance with section (i)(3) if the data specified in section (i)(3)(C)12. and 13. (i.e., the monitor activity data and OR OBD data snapshot) are required to be submitted for the same engine elsewhere in title 13, CCR (e.g., the off-road in-use compliance testing requirements in title 13, CCR section 2423.1(d)(6)).

(B) *Engine and Equipment Requirement.*

1. The manufacturer shall collect data from five production equipment in each of the following applicable power categories or from one production equipment per engine family in each applicable power category, whichever is less:

- a. Engines less than 19 kW,
- b. Engines greater than or equal to 19 kW and less than 56 kW,
- c. Engines greater than or equal to 56 kW and less than 130 kW,
- d. Engines greater than or equal to 130 kW and less than or equal to 560 kW, and
- e. Engines greater than 560 kW.

2. For the production equipment from which the manufacturer collects the required data, at least one of the production equipment shall be with an engine from the engine rating with the highest projected California sales number for the engine family.

(C) *Data Collection Requirements.* The manufacturer shall collect the following data from each production equipment:

1. Engine manufacturer;
2. Engine model year;
3. Engine power category;
4. Engine family;
5. Engine rating;
6. Engine serial number;
7. Equipment type;
8. Date the data were collected;
9. Equipment odometer reading (if equipped);
10. Total engine run time (section (e)(2)(D)2.);
11. Engine control module software calibration identification number;
12. Monitor activity data specified in section (e)(3)(F)2. (i.e., monitor activity data mini-numerator, mini-denominator, and monitor activity ratio); and
13. OR OBD data snapshot.

(D) *Test Data Submission Website.* The manufacturer shall submit the data described in section (i)(3)(C) above to CARB through [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov).

(j) *Deficiencies.*

(1) *General Requirements.*

(A) If the OR OBD system of an engine does not comply with one or more of the requirements of title 13, CCR section 2422, the Executive Officer may certify the OR OBD system with a deficiency for each issue. The Executive Officer shall grant the certification with the deficiency if the following factors are met:

1. The OR OBD system satisfies the majority of the requirements of title 13, CCR section 2422;
2. The manufacturer has demonstrated a good-faith effort to: (1) meet the requirements in full by evaluating and considering the best available monitoring technology (for issues relate to monitors/diagnostics) and software capacity, and (2) come into compliance as expeditiously as possible with regards to the issue; and
3. The issue is not described under section (k)(8).

(B) *Carry Over of Deficiency.*

1. If a deficiency from a previous model year is still applicable to the current model year, the manufacturer shall re-apply for Executive Officer approval of the deficiency for the current model year. The Executive Officer shall approve the carry-over of the deficiency if the factors identified in section (j)(1)(A) are met and the manufacturer's plan for addressing the deficiency ensures the deficiency is corrected before the deadlines specified in section (j)(1)(B)2. below.

2. For all deficiencies, the Executive Officer shall not allow manufacturers to carry over deficiencies for more than two model years unless the manufacturer can demonstrate that substantial equipment hardware modifications and additional lead time beyond two years would be necessary to correct the deficiency, in which case the Executive Officer shall allow the deficiency to be carried over for three model years (e.g., if the deficiency was first granted in the 2030 model year, the deficiency may be carried over up to and including the 2033 model year but shall not be carried over to the 2034 and later model years).

3. When determining the model years a deficiency can be carried over in section (j)(1)(B)2. above, the initial model year the deficiency was granted to an engine rating shall be considered the first model year the deficiency is granted for the engine rating and any other engine rating in future model years with the same deficiency (e.g., if the deficiency was first granted to an engine

rating in the 2030 model year and a new 2031 model year engine rating has the same deficiency, the new 2031 model year engine may carry over the deficiency up to and including the 2033 model year but not for 2034 and later model years).

(C) Except as allowed in section (j)(3), deficiencies shall not be retroactively granted after certification.

(2) *Deficiency Fines.* Manufacturers of OR OBD systems with deficiencies are subject to fines pursuant to section 43016 of the California Health and Safety Code. The fines apply to engines specified in section (j)(2)(A) below that are produced and delivered for sale in California.

(A) *Applicability.* The deficiency fines specified in section (j)(2) apply to the following engines that are required to meet the Stage 2 requirements:

1. For OR OBD parent rating engines, the following model years:
  - a. For power category  $130 \leq kW \leq 560$ : 2036 and subsequent model years, and
  - b. For all other power categories: 2037 and subsequent model years;
2. For OR OBD child rating engines, the following model years:
  - a. For power category  $130 \leq kW \leq 560$ : 2037 and subsequent model years, and
  - b. For all other power categories: 2038 and subsequent model years.

(B) *Deficiency Fine Determination and Amounts.*

1. The specified fines apply to the third and subsequently identified deficiencies, with the exception that fines shall apply to a deficiency where a required monitor/diagnostic is completely absent from the OR OBD system (i.e., there are no diagnostics for the component or system or no OBM NO<sub>x</sub> emission threshold monitor).

2. The following fine amounts apply for each deficiency per engine:

**Table 4. Deficiency Fine Amounts for OR OBD Engines**

<i>Power Category</i>	<i>Fine Amount Per Deficiency Per Engine</i>
< 19 kW	\$5
$19 \leq \text{kW} < 56$	\$20
$56 \leq \text{kW} < 130$	\$50
$130 \leq \text{kW} \leq 560$	\$150
> 560 kW	\$550

3. The total fines per engine shall not exceed the following amounts:

**Table 5. Maximum Total Deficiency Fine Amounts for OR OBD Engines**

<i>Power Category</i>	<i>Maximum Total Fine Amount Per Engine</i>
< 19 kW	\$50
$19 \leq \text{kW} < 56$	\$200
$56 \leq \text{kW} < 130$	\$500
$130 \leq \text{kW} \leq 560$	\$1,500
> 560 kW	\$5,500

(C) *Deficiency Fine Payment.*

1. Fines are payable to California Air Resources Board for deposit in the Air Pollution Control Fund.

2. The manufacturer shall submit the fines payment using one of the following schedules:

- a. The 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 and delivered for sale in California during the quarter and submit the total payment for the engines produced and delivered for sale during that quarter.



b. The manufacturer shall submit the fines payment within 30 calendar days after the end of production for the engine.

(3) *Retroactive Deficiencies.*

(A) The Executive Officer may grant a deficiency after certification of the OR OBD system for the engine and amend an engine's certification to conform to the granting of the deficiency for each aspect of the OR OBD system that is functioning different than the certified system or otherwise not meeting any requirement of section 2422. The Executive Officer may grant the retroactive deficiency if:

1. The conditions in section (j)(1)(A) are satisfied;
2. The manufacturer could not have reasonably anticipated the identified issue before commencement of production; and
3. Within the timeframe specified in section (j)(3)(B) below, the manufacturer found the issue (e.g., during testing required by section (i)), notified the Executive Officer of the issue, and requested a retroactive deficiency, or another party (e.g., the Executive Officer) found the issue.

(B) The Executive Officer shall not grant a retroactive deficiency if the manufacturer's request for the deficiency or the identification of the issue by other parties occurred after the later of the following dates:

1. When the last affected engine is produced (no later than December 31 of the calendar year for which the model year of the engine is named); or
2. Six months after commencement of equipment production for the affected engine and equipment combination.

(C) If the Executive Officer grants the deficiency and amends the certification, the approval would be retroactive to include all affected engines within the model year.

(D) In granting the amended certification for engines subject to deficiency fines under section (j)(2), the Executive Officer shall include all approved retroactive deficiencies with all previously approved deficiencies when computing fines in accordance with section (j)(2).

(4) *Non-Compliance Determination.*

(A) An OR OBD system installed on production engines that fails to conform with the certified OR OBD system for that engine or otherwise fails to meet the requirements of section 2422 and has not been granted a deficiency

pursuant to the provisions of section (j)(1) through (j)(3) is considered non-compliant and subject to the enforcement provisions of section (k).

(B) For OR OBD systems certified with a deficiency, if during any testing it is confirmed that the details of the issue for which the deficiency was granted are not the same as those disclosed by the manufacturer at the time the deficiency was granted, the OR OBD system shall be considered non-compliant and subject to enforcement in accordance with section (k).

(k) *Enforcement.*

(1) Failure to comply with any requirement of this subarticle constitutes a separate violation of this subarticle, including, but not limited to, failure to retain or produce any records or submit required reports.

(2) Submitting or producing inaccurate information or record(s) that are required to be submitted or retained by this subarticle constitutes a separate violation of this subarticle.

(3) Falsifying any information or record required to be submitted or retained by this subarticle constitutes a separate violation of this subarticle.

(4) Violations of this subarticle are subject to penalties under the Health and Safety Code, Division 26, Part 5 (commencing with section 43000).

(5) Any violation of this subarticle may be enjoined pursuant to Health and Safety Code section 41513.

(6) Each day or portion thereof that any requirement is not met, or each day or portion thereof that any registration, report, or plan required by this subarticle remains unsubmitted, is submitted late, or contains incomplete or inaccurate information, shall constitute a single, separate violation of this subarticle.

(7) Failure to pay the full amount of any fee required by this subarticle shall constitute a single, separate violation of this subarticle for each day or portion thereof that the fee has not been paid after the date the fee is due.

(8) *Non-Compliance Criteria.*

(A) The Executive Officer shall consider an OR OBD system non-compliant (i.e., the Executive Officer shall not certify the OR OBD system or the OR OBD system is subject to the enforcement if the OR OBD system is already certified) if the system has an issue that meets any of the following conditions:

1. For monitors/diagnostics that are required to detect a malfunction when emissions exceed a certain emission threshold (e.g., 2.0 g/kW-hr, 1.5

times the applicable standards) on engines required to meet the Stage 2 requirements (in accordance with section (d)(2)):

- a. The monitor/diagnostic is absent or deactivated on the engine;
  - b. The monitor/diagnostic is not able to detect a malfunction (e.g., the monitor/diagnostic cannot run, the malfunction threshold is calibrated such that a malfunction can never fail the threshold);
  - c. The monitor/diagnostic is able to run and detect a malfunction but is unable to store a fault code or illuminate the MIL in accordance with section (f);
  - d. For the first 3 model years the engine is required to meet the Stage 2 requirements but no later than the 2040 model year, a representative sample of engines indicates that the monitor/diagnostic does not detect a malfunction or illuminate the MIL when emissions exceed 3 times the malfunction criteria (e.g., 6.0 times the standard if the malfunction criterion is 2.0 times the standard); or
  - e. For all other model years not described in section (k)(8)(A)1.d. above, a representative sample of engines indicates that the monitor/diagnostic does not detect a malfunction or illuminate the MIL when emissions exceed 2 times the malfunction criteria (e.g., 4.0 times the standard if the malfunction criterion is 2.0 times the standard).
2. A generic scan tool or a tool designed to access the standardized parameters under section (e) cannot obtain valid and correct data for any of the following:
    - a. One or more parameters that are described under section (e)(2)(C)1.a. or (e)(2)(D)1., or
    - b. Stored fault codes for any monitor/diagnostic.
  3. For diagnostics required to meet the minimum MAR specified in section (f)(3)(C), **<TBD>**

(l) *Severability.*

If any subsection, paragraph, subparagraph, sentence, clause, phrase, or portion of this regulation is, for any reason, held invalid, unconstitutional, or unenforceable by any court of competent jurisdiction, such portion shall be deemed as a separate, distinct, and independent provision, and such holding shall not affect the validity of the remaining portions of the regulation.

Note: Authority cited: Health and Safety Code (HSC) sections 38501, 38505, 38510, 38560, 39600, 39601, 43013, 43016, 43018, 43101, 43102, 43104, and 43105; CCR, title 13, sections 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2139, 2139.5, 2420, and 2423.

Reference: HSC sections 38501, 38505, 38510, 38560, 39002, 39003, 43000, 43009.5, 43013, 43016, 43017, 43018, 43100, 43101, 43101.5, 43102, 43103, 43104, 43105, 43106, 43107, 43150, 43151, 43152, 43153, 43154, 43204, 43205, 43205.5, 43210, 43210.5, 43211, 43212, and 43213.

9. Amend Title 13, CCR, Chapter 9, Article 4, Section 2423 to read as follows:

**§ 2423. Tiers 1, 2, 3, and 4 Exhaust Emission Standards and Test Procedures - Off-Road Compression-Ignition Engines.**

(a) This section shall be applicable to new heavy-duty off-road compression-ignition engines, produced on or after January 1, 1996, and all other new 2000 and later model year Tiers 1, 2, 3, and 4 off-road compression-ignition engines. For the purposes of this section, these engines shall be called “compression-ignition engines.”

(b) *Exhaust Emission Standards.*

(1) Tiers 1, 2, 3, and 4 Exhaust Emission Standards.

(A) Exhaust emissions from new off-road compression-ignition engines, as sold in this state and as appropriate based on model year and maximum rated power, shall not exceed the levels contained in Table 1a with respect to steady-state testing. Table 1a follows:

**Table 1a. -- Tier 1, Tier 2, and Tier 3 Exhaust Emission Standards**

\* \* \* \* \*

<sup>7</sup> Tier 2 standards for propulsion marine compression-ignition engines below 37 kW remain in effect ~~beyond the 2007 end date~~ through the 2028 model year.

\* \* \* \* \*

(B) Exhaust emissions from new off-road compression-ignition engines, as sold in this state and as appropriate based on model year and maximum engine power, shall not exceed the levels contained in Table 1b, with respect to steady-state testing, transient testing, and, after application of the criteria in Table 1c, not-to-exceed testing, as applicable. Other compliance options are provided in the 2008-2010 or 2011-~~2028 and Later~~ Test Procedures as applicable. Compression-ignition engines used exclusively in transport refrigeration units may continue to certify to applicable Tier 4 standards in Table 1b in model years subsequent to those shown in this table. Compression-ignition engines used in both transport refrigeration units and other equipment applications shall comply with the model year applicability in Table 1b.

**Table 1b. - Tier 4 Exhaust Emission Standards**

Maximum Engine Power	Model Year <sup>9</sup>	Type	PM	NMHC+ NOx	NMHC	NOx	CO
			grams per kilowatt-hour				
kW<8 <sup>1</sup>	2008 and later through 2030	Final	0.40 <sup>2</sup>	7.5	-	-	8.0
8≤kW<19 <sup>1</sup>							6.6
19≤kW<37 <sup>1</sup>	2008-2012	Interim	0.30	7.5	-	-	5.5
	2013 and later through 2030	Final	0.03	4.7			
37≤kW<56 <sup>3</sup>	2008-2012	Interim	0.30	4.7	-	-	5.0
	2013 and later through 2030	Final	0.03				
56≤kW<75	2012-2014 <sup>4</sup>	Phase-In	0.02	-	0.19	0.40	5.0
		Phase-Out		4.7	-	-	
		or/ Alt NOx		-	0.19	3.4 <sup>5</sup>	
		or/ Alt NOx+NMHC <sup>8</sup>		3.5 <sup>5</sup>	-	-	
	2015 and later through 2030	Final	-	0.19	0.40		
75≤kW<130	2012-2014 <sup>4</sup>	Phase-In	0.02	-	0.19	0.40	5.0
		Phase-Out		4.0	-	-	
		or/ Alt NOx		-	0.19	3.4 <sup>5</sup>	
		or/ Alt NOx+NMHC <sup>8</sup>		3.5 <sup>5</sup>	-	-	
	2015 and later through 2030	Final	-	0.19	0.40		
130≤kW≤560	2011-2013	Phase-In	0.02	-	0.19	0.40	3.5
		Phase-Out		4.0	-	-	
		or/ Alt NOx		-	0.19	2.0	
		or/ Alt NOx+NMHC <sup>8</sup>		2.1	-	-	
	2014 and later through 2028	Final	-	0.19	0.40		
560 kW<GEN <sup>6</sup> ≤900 kW	2011-2014	Interim	0.10	-	0.40	3.5	3.5
	2015 and later through 2029	Final	0.03		0.19	0.67	
GEN>900 kW	2011-2014	Interim	0.10	-	0.40	0.67	3.5
	2015 and later through 2029	Final	0.03		0.19		
ELSE <sup>7</sup> >560 kW	2011-2014	Interim	0.10	-	0.40	3.5	3.5
	2015 and later through 2029	Final	0.04		0.19		

Notes:

- 1 Propulsion marine compression-ignition engines below 37 kW are not subject to Tier 4 standards or requirements. All previously adopted requirements remain applicable for these engines.
- 2 The Tier 4 PM standard for hand-start, air cooled, direct injection engines below 8 kW is 0.60 g/kW-hr, but is not required until 2010.
- 3 Engine families in this power category may alternately meet Tier 3 PM standards from 2008-2011 in exchange for introducing final PM standards in 2012.
- 4 Manufacturers have the option of complying with the Tier 4 standards over a two-year period at 50% per year using banked Tier 2 credits or over a three-year period at 25% per year without the use of Tier 2 credits. The three-year phase-in period is shown. The 2014 model year cannot extend beyond December 30, 2014, when the 3-year phase-in option is used.

- 5 Manufacturers may comply with the standards during the transitional implementation years using either a phase-in / phase-out approach or by using the Alternate NOx approach. The three-year 25% alternate NOx and alternate NOx + NMHC standards are shown in the table. The two-year 50% alternate NOx standard would be 2.3 g/kW-hr. The two-year 50% alternate NOx + NMHC standard would be 2.4 g/kW-hr.
- 6 "GEN" refers to generator engines only.
- 7 "ELSE" refers to all mobile machinery excluding generator engines.
- 8 An ALT NOx+NMHC standard equal to 0.5 g/kW-hr is available for one additional model year following the last model year of the ALT NOx+NMHC phase-in shown in the table.
- 9 A manufacturer may continue to certify its engines to Tier 4 final standards throughout the applicable phase-in period for the Tier 5 standards in title 13, CCR, section 2423.1 in accordance with subsection 2423.1(f).

**Table 1c. - Criteria for Determining NTE Limits<sup>1</sup>**

<i>Pollutant</i>	<i>Apply NTE Multiplier of 1.25 when ...</i>	<i>Apply NTE Multiplier of 1.50 when ...</i>
NOx	NOx Standard or FEL ≥ 2.5 g/kW-hr	NOx Standard <sup>2</sup> or FEL < 2.5 g/kW-hr
NMHC	NOx Standard or FEL ≥ 2.5 g/kW-hr	NOx Standard <sup>2</sup> or FEL < 2.5 g/kW-hr
NMHC+NOx	NMHC+NOx Standard or FEL ≥ 2.7 g/kW-hr	NMHC+NOx Standard <sup>2</sup> or FEL < 2.7 g/kW-hr
PM	PM Standard or FEL ≥ 0.07 g/kW-hr	PM <sup>2</sup> Standard or FEL <sup>3</sup> < 0.07 g/kW-hr
CO	Always	Never

Notes:

- 1 Other provisions described in the 2008-2010 or 2011-~~2028~~ and Later Test Procedures may affect the calculation of NTE limits.
- 2 Engines must be certified to these standards without the use of ABT credits.
- 3 For engines certified to a PM FEL less than or equal to 0.01 g/kW-hr, the PM NTE limit shall be 0.02 g/kW-hr.

(C) Additional Provisions for Propulsion Marine Compression-Ignition Engines Below 37 kW.

1. For the 2029 and subsequent model years, propulsion marine compression-ignition engines below 37 kW shall be certified to the federal emission standards in Part 1042, Title 40, Code of Federal Regulations, section 1042.101 (June 29, 2021), incorporated by reference herein.

2. Prior to the 2029 model year, propulsion marine compression-ignition engines below 37 kW may optionally be certified to the federal emission standards in Part 1042, Title 40, Code of Federal Regulations, section 1042.101 in lieu of the Tier 2 standards in subsection (b)(1)(A), Table 1a.

(2) Manufacturers may elect to include engine families in one of two averaging, banking, and trading (ABT) programs, corresponding to the engine family's model year and emissions categorization. The provisions of these separate ABT programs are specified in Part 89, Subpart C of the 2000 Plus Limited Test Procedures and Part 1039, Subpart H of the 2008-2010 or Part I-D of the 2011-~~2028~~ and Later Test Procedures as applicable.

\* \* \* \* \*

(B) For engine families subject to the 2008-2010 or 2011-~~2028~~ and Later Test Procedures, the manufacturer must set a family emission limit (FEL) not to

exceed, as applicable, the levels contained in Table 2b. Three distinct FEL types (primary, interim, and alternate) are available conditionally. Primary FEL types are applicable to all power categories indefinitely, whereas interim and alternate FEL types are of variable duration and may be selectively applied as applicable to total or partial engine family production volumes as described in the 2008-2010 or 2011-2028 and Later Test Procedures. The FEL established by the manufacturer serves as the emission standard for that engine family, and is used for determining NTE limits in conjunction with the criteria in Table 1c. Temporary compliance adjustment factors, as explained in the 2008-2010 or 2011-2028 and Later Test Procedures as applicable, shall be applied by the manufacturer to compensate for the use of transitional alternate FELs (Type ALT 20% in Table 2b) when calculating emission credits. Table 2b follows:

**Table 2b - Upper Limit for Tier 4 Family Emission Limits (FELs) and Alternate Allowances Part 1**

Maximum Engine Power	FEL Type	Model Year	PM	NOx	NMHC+NOx
			grams per kilowatt-hour		
kW<8	Primary	2008 and later through 2030	0.80	–	10.5
8≤kW<19	Primary	2008 and later through 2030	0.80	–	9.5
19≤kW<37	Interim	2008-2012	0.60	–	9.5
	Primary	2013 and later through 2030	0.05	–	7.5
	ALT 20% <sup>1</sup>	2013-2016 <sup>3</sup>	0.30	–	7.5
	ALT 5% <sup>2</sup>	2017 and later through 2030 <sup>3</sup>			
37≤kW<56	Interim	2008-2012 <sup>3</sup>	0.40	–	7.5
	Primary	2013 and later through 2030 <sup>3</sup>	0.05	–	7.5
	ALT 20%	2013-2016 <sup>3</sup>	0.30	–	7.5
	ALT 5%	2017 and later through 2030 <sup>3</sup>			
56≤kW<75	Phase-in	2012-2013/2014 <sup>5</sup>	0.04	0.80	–
	Phase-out			–	7.5
	ALT NOx Std <sup>4</sup>	2012-2013	0.04	3.0 <sup>7</sup>	–
		2012-2014		4.4	
	ALT NOx+NMHC Std <sup>4</sup>	2012-2013/2014 <sup>5</sup>	0.04	–	4.7 <sup>7</sup>
	Primary	2014/2015 <sup>5</sup> and later through 2030	0.04	0.80	–
	ALT 20% PM	2012-2015	0.40		–
	ALT 20% NOx	2012-2015 <sup>6</sup>		4.4	–
	ALT 20% NOx+NMHC Std	2012-2015 <sup>6</sup>	–	–	4.7
ALT 5%	2016 and later through 2030	0.40	4.4	–	

Notes:

1 This alternate FEL option is transitional for the four years specified and applies to at most 20% of a manufacturer's U.S. directed population of engine families per year.



- 2 This alternate FEL option is available indefinitely, but only applies to 5% of a manufacturer's U.S. directed population of engine families per year.
- 3 These dates correspond to the compliance option of meeting interim standards in 2008; else the primary and alternate FEL caps would begin and/or end one year earlier, and 2008-2011 engines would not be eligible for participation in the Tier 4 ABT program.
- 4 Two alternate NO<sub>x</sub> standards and corresponding FEL caps are available for this category with corresponding alternate phase-in options. Two alternate NO<sub>x</sub>+NMHC standards are also available; the FEL caps are the previously applicable NO<sub>x</sub>+NMHC standards from Table 1a of this section.
- 5 The effective date of the primary FEL cap follows the phase-in period and use of banked Tier 2 NO<sub>x</sub> credits of the selected NO<sub>x</sub> FEL cap.
- 6 For manufacturers certifying engines in this power category using a percentage phase-in/phase-out approach instead of the ALT NO<sub>x</sub> or ALT NO<sub>x</sub>+NMHC standards in Table 1b of §2423(b)(1)(B), the alternate NO<sub>x</sub> and NO<sub>x</sub>+NMHC FEL caps in the table apply only in the 2014-2015 model years if certifying in accordance with the provisions in §1039.102(d)(1) of the 2011-2028 and Later Test Procedures, and only in the 2015 model year if certifying under §1039.102(d)(2) of the 2011-2028 and Later Test Procedures.
- 7 If neither the alternate phase-in option nor banked Tier 2 credits are used, either NO<sub>x</sub> standard, or the NO<sub>x</sub>+NMHC standard, and corresponding FEL may be applied for this category.

**Table 2b - Upper Limit for Tier 4 Family Emission Limits (FELs) and Alternate Allowances  
Part 2**

Maximum Engine Power	FEL Type	Model Year	PM	NO <sub>x</sub>	NMHC+NO <sub>x</sub>	
			grams per kilowatt-hour			
75≤kW<130	Phase-in	2012-2013/2014 <sup>52</sup>	0.04	0.80	–	
	Phase-out			–	6.6	
	ALT NO <sub>x</sub> Std <sup>41</sup>	2012-2013		3.0 <sup>74</sup>	–	
		2012-2014		3.8	–	
	ALT NO <sub>x</sub> +NMHC Std <sup>41</sup>	2012-2013/2014 <sup>52</sup>		–	4.0 <sup>74</sup>	
	Primary	2014/2015 <sup>52</sup> and later through 2030		0.80	–	
	ALT 20% PM	2012-2015		0.30	–	
	ALT 20% NO <sub>x</sub>	2012-2015 <sup>63</sup>		–	3.8	
	ALT 20% NO <sub>x</sub> +NMHC Std <sup>41</sup>	2012-2015 <sup>63</sup>		–	–	4.0
ALT 5%	2016 and later through 2030	0.30	3.8	–		
130≤kW≤560	Phase-in	2011-2013	0.04	0.80	–	
	Phase-out			–	6.6/6.4 <sup>65</sup>	
	ALT NO <sub>x</sub> Std	2011-2013		2.7	–	
	ALT NO <sub>x</sub> +NMHC Std	2011-2013		–	4.0	
	Primary	2014 and later through 2028		0.80	–	
	ALT 20% PM	2011-2014		0.20	–	
	ALT 20% NO <sub>x</sub>	2011-2014 <sup>96</sup>		–	3.8	
	ALT 20% NO <sub>x</sub> +NMHC Std	2011-2014 <sup>96</sup>		–	–	4.0
	ALT 5%	2015 and later through 2028		0.20	3.8	–
GEN>560kW	Interim	2011-2014	0.20	6.2	–	
	Primary	2015 and later through 2029	0.05	1.07	–	
	ALT 20%	2015-2018	0.10	3.5	–	
	ALT 5%	2019 and later through 2029			–	
ELSE>560kW	Interim	2011-2014	0.20	6.2	–	
	Primary	2015 and later through 2029	0.07		–	
	ALT 20%	2015-2018	0.10		–	
	ALT 5%	2019 and later through 2029			–	

Notes:

- <sup>41</sup> Two alternate NO<sub>x</sub> standards and corresponding FEL caps are available for this category with corresponding alternate phase-in options. Two alternate NO<sub>x</sub>+NMHC standards are also available; the FEL caps are the previously applicable NO<sub>x</sub>+NMHC standards from Table 1a of this section.
- <sup>52</sup> The effective date of the primary FEL cap follows the phase-in period and use of banked Tier 2 NO<sub>x</sub> credits of the selected NO<sub>x</sub> FEL cap.
- <sup>63</sup> If interim Tier 4 standards are not met in 2008, the alternate NO<sub>x</sub> FEL would only be available for 2015. For manufacturers certifying engines in this power category using a percentage phase-in/phase-out approach instead of the ALT NO<sub>x</sub> or ALT NO<sub>x</sub>+NMHC standards in Table 1b of §2423(b)(1)(B), the ALT NO<sub>x</sub> and ALT NO<sub>x</sub>+NMHC FEL caps in the table apply only in the 2014-2015 model years if certifying in accordance with the provisions in §1039.102(d)(1) of the 2011-2028 and Later Test Procedures, and only in the 2015 model year if certifying under §1039.102(d)(2) of the 2011-2028 and Later Test Procedures.

- 74 If neither the alternate phase-in option nor banked Tier 2 credits are used, either NOx standard, or the NOx+NMHC standard, and corresponding FEL may be applied for this category.
- 85 The phase-out NMHC+NOx FEL cap is 6.6 g/kW-hr for engines < 225 kW, and 6.4 g/kW-hr for engines ≥ 225 kW in this category.
- 96 For manufacturers certifying engines in this power category using the percentage phase-in/phase-out approach instead of the ALT NOx standard or the ALT NOx+NMHC standard in Table 1b of §2423(b)(1)(B), the ALT NOx and ALT NOx+NMHC FEL caps in the table apply only for the 2014 model year.

(C) *Split family provision.* For generating or using credits in the  $56 \leq \text{kW} \leq 560$  power categories during the phase-in of Tier 4 standards, engine manufacturers may elect to split an engine family into two subfamilies (e.g., one which uses credits and one which generates credits for the same pollutant). The engine manufacturer must indicate in the application for certification that the engine family is to be split, and may calculate emission credits relative to different emissions standards (i.e., phase-in and phase-out standards) for different sets of engines within the engine family, but must certify the engine family to a single set of standards and FELs. The engine manufacturer shall calculate NMHC+NOx emission credits by adding the NOx FEL to the NMHC phase-in standard for comparison with the applicable NMHC+NOx phase-out standard. Any engine family certified under the provisions of this paragraph (C) must meet the applicable phase-in standard for NMHC. The engine manufacturer shall be responsible for assigning the number and configurations of engines within the respective subfamilies before the due date of the final report required in Part 1039, Subpart H of the 2008-2010 Test Procedures or Part I-D of the 2011-2028 and ~~Later~~ Test Procedures, as applicable. The same label must be applied to each engine in the family, and must include the NOx FEL to which the engine is certified.

(3) *Opacity.*

(A) The opacity of smoke emissions from new 1996 through 1999 model year heavy-duty off-road compression-ignition engines 175 to 750 horsepower, inclusive, or from all new 2000 and later model year compression-ignition engines sold in this State that certify to the standards in subsection (b)(1), shall not exceed, based on the applicable measurement techniques specified in Part 89, Subpart B of the 2000 Plus Limited Test Procedures and Part 1039, Subpart B of the 2008-2010 Test Procedures or Part I-D of the 2011-2028 and ~~Later~~ Test Procedures as applicable, the following:

\* \* \* \* \*

(5) Crankcase Emissions.

\* \* \* \* \*

(B) For off-road compression-ignition engines subject to the 2008-2010 or 2011-~~2028 and Later~~ Test Procedures, no crankcase emissions shall be discharged directly into the ambient atmosphere from any engine, unless the sum of those discharged emissions are added to the exhaust emissions (either physically or mathematically) during all emission testing. To be eligible for this option, a manufacturer must design its engines so that all crankcase emissions can be routed into the applicable sampling systems specified in the 2008-2010 or 2011-~~2028 and Later~~ Test Procedures as applicable, and must account for deterioration in crankcase emissions when determining exhaust deterioration factors. Crankcase emissions that are routed to the exhaust upstream of exhaust aftertreatment during all operation are not considered to be discharged directly into the ambient atmosphere. Furthermore, engines using charge-air compression that are certified to a transitional alternate FEL (Type ALT 20% in Table 2b) during the first four years of the Tier 4 standards for the applicable power category are exempt from this subsection, but must instead comply with the requirements in Section 2423(b)(5)(A).

(6) Engine manufacturers that voluntarily certify engines to the Tier 4 standards in Table 1b earlier than required under this article may, according to the provisions in the 2008-2010 or 2011-~~2028 and Later~~ Test Procedures as applicable, generate additional ABT credits, or as an alternative, offset future Tier 4 compliance requirements should the equipment manufacturer that was provided the engine decline to use its early introduction incentives according to the provisions in Section 2423(d)(9). Table 4, as follows, summarizes the incentives for the early introduction of Tier 4 engines and some of the conditions that determine eligibility.

\* \* \* \* \*

(9) *NTE deficiencies.* A manufacturer may petition the Executive Officer to accept an off-road compression-ignition engine as compliant with the NTE requirements specified in the 2008-2010 or 2011-~~2028 and Later~~ Test Procedures as applicable even though specific elements of those requirements may not be fully met. Such grants of compliance, otherwise known as deficiencies, shall be limited to engines that have functioning emission-control hardware capable of allowing the engine to comply with the NTE limits. Deficiencies shall be granted by the Executive Officer according to the following stipulations:

\* \* \* \* \*

(12) *Defeat devices.* Engines equipped with a defeat device shall not be certified for sale in California. A defeat device is a component or system that reduces the effectiveness of emission controls under conditions that the engine may reasonably be expected to encounter during normal operation and use. This prohibition does not apply to auxiliary-emission control devices identified in the certification application if one of more of the following is true:

(A) The operating conditions where the auxiliary-emission control device is active were substantially encountered during all testing requirements as described in Part 1039, Subpart F of the 2008-2010 Test Procedures or Part I-D of the 2011-~~2028~~ and Later Test Procedures as applicable.

\* \* \* \* \*

(c) *Test Procedures.*

(1) The test procedures for determining certification and compliance with the standards for gaseous exhaust emissions from new 1996-1999 heavy-duty off-road compression-ignition engines sold in the state are set forth in the 1996-1999 Heavy-Duty Test Procedures.

(2) Gaseous Emissions Test Procedures for 2000 and Later Model Years for Engines that Certify to the Standards in Subsection (b)(1).

(A) The test procedures for determining certification and compliance with the standards for gaseous exhaust emissions and the standards for opacity of smoke emissions from new 2000 model year and later off-road compression-ignition engines for which the standards in paragraph (b)(1)(A) are applicable, and sold in the state, are set forth in the 2000 Plus Limited Test Procedures.

(B) The test procedures for determining certification and compliance with the standards for gaseous exhaust emissions, particulate exhaust emissions, opacity of smoke emissions, and not-to-exceed emissions from new 2008 model year and later off-road compression-ignition engines for which the limits in paragraph (b)(1)(B) are applicable, and sold in the State, are set forth in the 2008-2010 or 2011-~~2028~~ and Later Test Procedures as applicable.

(3) The test procedures for determining certification and compliance with the standards for particulate exhaust emissions from new 1996 and later off-road compression-ignition engines for which the standards in paragraph (b)(1)(A) are applicable, and sold in the state, are set forth in the PM and Test Cycle Limited Test Procedures.

(4) The test procedures for determining certification and compliance with the standards for the opacity of smoke emissions from new 1996-1999 off-road

compression-ignition engines sold in the state are set forth in the 1996-1999 Smoke Test Procedures.

(d) *Implementation flexibility for equipment and vehicle manufacturers and post-manufacture marinizers.* For a limited time, off-road equipment and vehicle manufacturers and post-manufacture marinizers may produce equipment with engines that are subject to less stringent emission standards than required by Tables 1a and 1b for new 2000 model year and later off-road equipment and vehicles and marine compression-ignition engines, subject to the requirements of paragraph (e) of this section. Separate provisions are provided for equipment with engines subject to the 2000 Plus Limited Test Procedures versus equipment with engines subject to the 2008-2010 or 2011-~~2028~~ and Later Test Procedures as applicable, and are identified accordingly in the following subsections. Only manufacturers that have primary responsibility for designing and manufacturing equipment, and have manufacturing procedures for installing engines in equipment, are eligible to participate in the equipment manufacturer flexibility program provided by the 2008-2010 or 2011-~~2028~~ and Later Test Procedures as applicable. Equipment manufacturers participating in this flexibility program must comply with the notification and reporting requirements specified in Section 2423(d)(7). Engines produced for this flexibility program using FELs greater than the applicable standards must be offset with sufficient ABT credits. The following allowances apply separately to each engine power category subject to standards under Section 2423(b)(1):

(1) *Percent-of-production allowances.*

\* \* \* \* \*

(C) *Equipment subject to the 2008-2010 or 2011-~~2028~~ and Later Test procedures.* A manufacturer may produce equipment and vehicles with engines that are exempt from meeting current model year emission standards for a portion of its California-directed production volume. These percent-of-production flexibility allowances must be used within one of the seven-year flexibility usage periods specified in Table 6 for each applicable power category, provided that the seven-year sum of the U.S.-directed portion of the manufacturer's percent-of-production flexibility allowances does not exceed 80 percent, expressed in cumulative yearly percentage increments, except as provided for in paragraph (d)(6) or (f). Equipment used as percent-of-production flexibility allowances must contain only engines that have been certified to, at least, the standards listed in Table 6, corresponding to the flexibility usage period selected by the manufacturer. All flexibility allowances for a power category must be used within the same flexibility usage period.

\* \* \* \* \*

(2) Small volume allowances.

\* \* \* \* \*

(B) *Small volume allowances subject to the 2008-2010 or 2011-~~2028~~ and ~~Later~~ Test Procedures as applicable.* As an alternative to the percent-of-production allowance in Section 2423(d)(1)(C), an off-road equipment or vehicle manufacturer may produce equipment with engines that are exempt from meeting current model year emission standards for a portion of its California-directed production volume, provided that the exempt equipment is a subset of the manufacturer's U.S.-directed volume of exempt equipment and the manufacturer is in compliance with the following provisions:

\* \* \* \* \*

(3)

\* \* \* \* \*

(B) *Inclusion of engines not subject to Tier 4 requirements.* Off-road equipment and vehicles built with engines otherwise exempt from the requirements of the 2008-2010 or 2011-~~2028~~ and ~~Later~~ Test Procedures as applicable are not required to be counted toward the percentage, or number, of claimed flexibility allowances under the provisions in Subsections (d)(1)(C) and (d)(2)(B). Such exempted engines include unused inventories produced prior to the effective date of the Tier 4 standards, excluding stockpiled engines, and hand-startable, air cooled, direct-injection engines below 8 kW in 2008 and 2009 that do not meet the Tier 4 PM standard. Nonetheless, manufacturers may choose to include these engines in the count of total equipment produced from which the percentage of flexibility allowances in Subsection (d)(1)(C) is derived.

\* \* \* \* \*

(6) *Technical hardship allowances.* Equipment manufacturers may apply for additional flexibility allowances should extreme and unusual circumstances occur leading to technical obstacles in complying with the Tier 4 requirements. A manufacturer may request additional allowances for power categories  $19 \leq \text{kW} \leq 560$  if it claims allowances under the provisions of Section 2423(d)(1)(C), but may only request additional allowances for power categories  $19 \leq \text{kW} < 56$  if it claims allowances under the provisions of Section 2423(d)(2)(B). Additional flexibility allowances shall not be provided when the engine and equipment are produced by the same manufacturer, or affiliate. The Executive Officer shall review requests for additional flexibility allowances according to the following stipulations:

(A) The manufacturer requesting additional allowances must demonstrate that the circumstances necessitating them were outside the control of the manufacturer and could not have been avoided with reasonable discretion. The manufacturer must also demonstrate that it has exercised prudent planning and has taken reasonable steps to minimize the scope of the request.

(B) ~~A m~~Manufacturers applying for additional flexibility allowances ~~must shall do so through eFILE@arb.ca.gov~~ in writing to the Chief of the ~~Mobile Source Operations Division, or designee,~~ prior to the earliest date in which the applying manufacturer would be in violation of Section 2423(b)(1). All applications shall provide, at a minimum, the following information:

\* \* \* \* \*

(7) *Notification and reporting requirements for using Tier 4 flexibility allowances.* As a prerequisite to using any Tier 4 flexibility allowances, the equipment manufacturer shall notify the ARB of its intent to use such allowances. The manufacturer shall also send an annual report after each year that flexibility allowances have been used to verify that the allowances claimed do not exceed the number of allowances permitted.

(A) Before flexibility provisions will be used, a written notice informing CARB of the manufacturer's intent to use flexibility allowances must be sent to the ~~Mobile Source Operations~~ Emissions Certification and Compliance Division, or designee, at 4001 Iowa Avenue, Riverside, California, 92507, containing the following information:

\* \* \* \* \*

(8) *Import restrictions on the use of Tier 4 flexibility allowances.* Foreign equipment manufacturers may only import equipment with exempted flexibility engines into California according to the stipulations in Section 1039.626 of the 2008-2010 Test Procedures or Part I-D of the 2011-2028 ~~and Later~~ Test Procedures as applicable. These stipulations address the potential for abuse whereby individual importers could collectively import more flexibility allowances than permitted based on the foreign equipment manufacturer's total production for the United States market. The stipulations include acceptance by the foreign equipment manufacturer of random audits by CARB or its representatives, and the posting of a monetary bond for each imported engine to cover the cost of any potential enforcement actions. Foreign equipment manufacturers who comply with the stipulations will be eligible to receive the same flexibility allowances as domestic manufacturers.

(9) *Early introduction incentives for equipment manufacturers.* In addition to the equipment flexibility allowances provided in Subsections (d)(1)(C) and (d)(2)(B),



equipment manufacturers, as provided in the 2008-2010 or 2011-~~2028~~ ~~and Later~~ Test Procedures, as applicable, may earn additional allowances for the early introduction of equipment with engines meeting the Tier 4 standards in Table 1b. Equipment manufacturers installing engines at or above 19 kW that comply with the final Tier 4 PM and NOx standards could earn one flexibility allowance for each early Tier 4 compliant engine used in its equipment. Equipment manufacturers installing engines  $56 \leq \text{kW} \leq 560$  that comply with the final Tier 4 PM standard and the alternative NOx standard could earn one-half of a flexibility allowance for each early Tier 4 engine used in its equipment. Table 8, below, summarizes the incentives for the early introduction of Tier 4 compliant equipment and some of the conditions that determine eligibility. Should an equipment manufacturer decline flexibility allowances earned with this provision, the allowances would then be available to the engine manufacturer that had supplied the early introduction engine, subject to the provisions in Section 2423(b)(6).

\* \* \* \* \*

(f) *Economic hardship relief.* Off-road equipment and vehicle manufacturers and post-manufacture marinizers may request relief from the Executive Officer, or designee, subject to the following requirements:

(1) The application for relief ~~must~~ shall be submitted for approval to CARB through [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov) ~~the Chief of the Mobile Source Operations Division, or designee, in writing,~~ prior to the earliest date in which the applying manufacturer would be in violation of section 2423(b)(1). The off-road equipment or vehicle manufacturer applying for hardship relief ~~shall~~ must submit evidence for approval, showing that the following requirements have been met:

\* \* \* \* \*

(3) The Executive Officer may impose other conditions on the granting of relief, including provisions to recover the lost environmental benefit. The labeling requirements in the 2008-2010 and 2011-~~2028~~ ~~and Later~~ Test Procedures apply as applicable.

\* \* \* \* \*

(h) *Allowance for the production of engines.* To meet the demand for engines created under paragraph (d), (f), or (g) of this section, engine manufacturers may produce engines that do not meet current year emission requirements. However, engine manufacturers must receive written assurance from each equipment manufacturer, prior to production, that a certain number of these engines are needed for the equipment manufacturer's Tier 4 equipment flexibility allowances. Engine manufacturers shall provide to the Executive Officer annually, as part of the

certification application, a list of the equipment manufacturers requesting such engines for their Tier 2/3 and Tier 4 equipment flexibility allowances. The list shall include the equipment manufacturers' names, engine models, and estimated national production volumes. A copy of the original correspondence from the equipment manufacturer requesting the production of flexibility engines shall be kept on file by the engine manufacturer in addition to, and in accordance with, the provisions of § 1039.250 of the 2008-2010 Test Procedures or Part I-D of the 2011-~~2028~~ and Later Test Procedures, as applicable, and shall be made available without delay to the Executive Officer upon request. Furthermore, all engines produced for sale in California under either of the transitional flexibility provisions for equipment manufacturers, must be covered by an Executive Order starting January 1, 2007. To obtain an Executive Order for these engines, the engine manufacturer shall comply with the following:

(1) Prior to the start of production, a manufacturer shall submit a letter to the Chief of the Mobile Source Operations Division, or designee, requesting to CARB for certification for of flexibility engines intended for sale in California through [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov), and

\* \* \* \* \*

(j) *Replacement Engines.*

For purposes of this subsection (j), a replacement engine is a new compression-ignition off-road engine that is used to replace an engine that has already been placed into service (whether the previous engine is replaced in whole or in part with a new engine).

(1) A new compression-ignition off-road replacement engine intended solely to replace an engine in a piece of off-road equipment that was originally produced with an engine manufactured prior to the applicable implementation date as specified in section 2423, shall not be subject to the emission requirements that are applicable to the model year in which the engine is replaced of section 2423 provided that: if the following conditions are met:. In addition, engines that were originally certified in a previous model year to the same standards that apply for the current model year shall not be subject to the emission requirements of title 13, CCR, section 2423 if the following conditions are met.

(A) the engine manufacturer has ascertained that no engine produced by itself or the manufacturer of the engine that is being replaced, if different, and certified to the requirements of this article, is available with the appropriate physical or performance characteristics to repower the equipment; and

(B) in making the determination in subsection (j)(1)(A), the engine manufacturer shall follow the requirements in Part V: 40 CFR PART 1068, Subpart C, section 1068.240, subparagraph (b)(2)(iii); and

(BC) unless an alternative control mechanism is approved in advanced by the Executive Officer, the engine manufacturer or its agent takes ownership and possession of the engine being replaced; and

(CD) the engine manufacturer does not use the replacement-engine exemption to circumvent the regulations; and

(DE) the replacement engine is clearly labeled with the language in either subsection (j)(1)(DE)1., or subsection (j)(1)(DE)2., below, or similar alternate language approved in advance by the Executive Officer:

\* \* \* \* \*

(2) At the conclusion of each of the 2000 ~~through 2028~~ and later model years, the manufacturer must provide, by engine model and engine family, the actual number of replacement engines produced for California during the model year, and a description of the physical or performance characteristics of those models that indicate certified replacement engine(s) were not available as per paragraph (1).

(k) Any new engine certified to comply with California emission standards and test procedures for on-road applications may, upon approval by the Executive Officer, be considered to be in compliance with these regulations.

(l) ~~Practices, and labeling, recordkeeping, and reporting requirements for rebuilt engines.~~ This subsection shall apply as provided in paragraph (1) below to all off-road compression-ignition engines subject to the requirements of Section 2423 that are rebuilt after December 31, 2006, including those engines that were originally manufactured on, or prior to, December 31, 2006.

\* \* \* \* \*

(1) *Practices.* The rebuilding practices described in Part 89.130 of the incorporated 2000 Plus Limited Test Procedures, including the exemption for engines equal to or greater than 37 kW that meet the Tier 1 standard, and Part 1068.120 of the 2008-2010 Test Procedures or Part I-F of the 2011-~~2028~~ and Later Test Procedures as applicable shall apply. These practices are summarized in paragraphs (1)(A) and (1)(B) below, which are provided as respective references for the labeling requirements in paragraphs (2)(A) and (2)(B) of this subsection.

\* \* \* \* \*

(3) Recordkeeping and Reporting.

(A) Recordkeeping requirements specified in section 1068.120, subsections (j) and (k) of the "2011-2028 Test Procedures, Part I-F" shall apply to rebuilt off-road compression-ignition engines subject to the requirements of section 2423 and shall be followed by businesses that provide engine rebuilding services for profit.

(B) On and after January 1, 2029, specific reporting requirements in title 13, CCR, section 2423.1, subsection (q)(3), shall be followed by anyone who manufactures or sells off-road compression-ignition engines or equipment and rebuilds off-road compression-ignition engines.

(m) *Stockpiling prohibition.* Manufacturers may not circumvent the provisions of this article by stockpiling engines with a date of manufacture preceding new or changed emission standards by deviating from normal production and inventory practices. For purposes of this paragraph (m), normal production and inventory practices means those practices typically employed for similar engine families in years in which emission standards do not change. The Executive Officer may request the submission of routine production and inventory records from manufacturers that document normal practices for up to eight years to aid in determining whether or not a violation of this section has occurred. Other stockpiling prohibitions in § 1068.103 and § 1068.105 of the 2011-~~2028~~ and ~~Later~~ Test Procedures, Part I-E, apply.

(n) Beginning with the 2024 model year, manufacturers of auxiliary power units installed on tractors subject to GHG emission standards specified in 17 CCR § 95663(a)(2)(B) must comply with the emission standards and certification requirements specified in § 1039.699 of the "California Exhaust Emission Standards and Test Procedures for New 2011-~~2028~~ and ~~Later~~ Tier 4 Off-Road Compression-Ignition Engines, Part I-D," adopted October 20, 2005, as last amended ~~September 9, 2021~~ [INSERT DATE OF AMENDMENT], incorporated by reference herein. An "auxiliary power unit" has the definition assigned in § 1039.801 of those test procedures.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, and 43104, Health and Safety Code. Reference: Sections 43013, ~~43016~~, 43017, 43018, 43101, 43104, ~~43154~~, and 43211, ~~and~~ 43212, Health and Safety Code.

10. Adopt new Title 13, CCR, Division 3, Chapter 9, Article 4, Section 2423.1 to read as follows:

Note: The entire text of section 2423.1 set forth below is new language and is shown in "normal type" proposed to be added to the California Code of Regulations.

**§ 2423.1. Tier 5 Exhaust Emission Standards and Test Procedures - Off-Road Compression-Ignition Engines.**

(a) *Purpose and Applicability.*

(1) This section 2423.1 contains the California "Tier 5" exhaust emission standards for new 2029 and subsequent model year off-road compression-ignition engines. A manufacturer shall certify all compression-ignition engines to the Tier 5 standards described below, except as indicated in subsections (a)(1)(A) and (a)(1)(B). For the purposes of this section 2423.1, the engines subject to this section shall be called "off-road compression-ignition engines."

(A) A manufacturer of propulsion marine compression-ignition engines with a power rating below 37 kW shall certify these engines to the applicable federal Tier 3 requirements for Category 1 engines in Title 40, CFR, Part 1042, section 1042.101 (June 29, 2021), incorporated by reference herein.

(B) A manufacturer of off-road compression-ignition engines used in transport refrigeration units shall certify these engines in accordance with the following requirements:

1. Compression-ignition engines used in both transport refrigeration units and other equipment applications shall comply with the requirements of this section 2423.1, except as required in subsection (a)(1)(B)3.

2. Compression-ignition engines used exclusively in transport refrigeration units may certify to applicable Tier 4 final standards in section 2423, subsection (b)(1)(B), Table 1b as an alternative to complying with the requirements in this section 2423.1, except as required in subsection (a)(1)(B)3.

3. All model year 2023 and later compression-ignition engines used in trailer transport refrigeration units, domestic shipping container transport refrigeration units, railcar transport refrigeration units, and transport refrigeration unit generator sets shall certify to the PM emission standard of 0.02 g/hp-hr or lower, as required by section 2477.5, subsection (d).

(2) Unless otherwise noted, terms in this section shall have the definitions provided in title 13, CCR, section 2421.1. Unless otherwise noted, any reference to a

“section” shall mean a section in title 13, CCR and any reference to a “subsection” shall mean a subsection in this section 2423.1.

(3) A manufacturer shall comply with the exhaust emission standards in subsections (d) and (e) that are applicable to specific engine families, and with the phase-in requirements in subsection (f) that are applicable to the manufacturer’s entire engine production line.

(4) The exhaust standards in subsections (d) and (e) do not apply to zero-emission equipment or zero-emission powertrains.

(b) *General Provisions.*

(1) *Certification Requirements and Test Procedures.*

(A) The certification requirements and test procedures for determining compliance with the emission standards in this section are set forth in the “California 2029 and Later Model Year Test Procedures for Tier 5 Off-Road Compression-Ignition Engines” (“2029 and Later Test Procedures”), as adopted [INSERT DATE OF ADOPTION], which is incorporated by reference herein.

(B) Wherever this section 2423.1 requires data to be “rounded,” the rounding conventions in Part IV: 40 CFR PART 1065, Subpart A, section 1065.20 of the “2029 and Later Test Procedures” shall apply.

(C) Wherever this section 2423.1 requires that “a manufacturer shall notify the Executive Officer in writing,” the specified information shall be sent to the Chief of the Emissions Certification and Compliance Division, or designee, at 4001 Iowa Avenue, Riverside, California, 92507.

(D) Wherever this section 2423.1 requires that a manufacturer shall submit information to the Executive Officer or the manufacturer shall apply to use a specific provision of this regulation, but does not specify that this information shall be submitted “in writing” or that the manufacturer shall apply “in writing,” the specified information shall be submitted to CARB through [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov).

(E) *Attestation.*

Unless otherwise specified, where this section allows for or requires a manufacturer to provide an attestation, attestation means a statement signed and dated by an individual, who is employed by a manufacturer and authorized to affirm the attested statement on behalf of the manufacturer, certifying under penalty of perjury under the laws of the State of California that the attested statement is true, accurate, and complete.

(2) *Useful Life.*

For purposes of certification, a manufacturer shall demonstrate compliance with the standards set forth in subsection (d) over the full useful life of the engine, as defined in section 2421.1, subsection (b)(2).

(3) *Adjustable Parameters.*

Manufacturers that design engines with adjustable parameters shall meet all the requirements of Part V: 40 CFR PART 1068, Subpart A, section 1068.50 of the "2029 and Later Test Procedures."

(4) *Prohibited Controls.*

A manufacturer shall not design engines with emission control devices, systems, or elements of design that adversely affect public health, welfare, or safety while operating. An example of such a design would be the use of copper zeolite catalysts to reduce NO<sub>x</sub> without properly engineering the aftertreatment system to account for a corresponding increase in N<sub>2</sub>O. Technologies that increase one regulated pollutant in exchange for decreasing another regulated pollutant are prohibited controls.

(5) *Defeat Devices.*

Engines equipped with a defeat device shall not be certified for sale in California. A defeat device is a component or system that reduces the effectiveness of emission controls under conditions that the engine may reasonably be expected to encounter during normal operation and use. This prohibition does not apply to auxiliary-emission control devices identified in the certification application if one or more of the following is true:

(A) The operating conditions where the auxiliary-emission control device is active were substantially encountered during all testing requirements as described in Part III: 40 CFR PART 1039 of the "2029 and Later Test Procedures."

(B) The design of the auxiliary-emission control device is shown to be necessary for preventing engine (or equipment) damage or accidents.

(C) The auxiliary-emission control device only reduces the effectiveness of emissions control during engine starting.

(6) *Hybrid Electric Equipment.*

For the 2029 and subsequent model years, an engine manufacturer shall include any engine used in hybrid electric equipment in the engine manufacturer's selected phase-in option in subsection (f) and the engine shall be certified to either the exhaust emission standards in this section 2423.1, or to the Tier 4 final exhaust emission standards in section 2423, subsection (b)(1)(B) Table 1b, in accordance with

the provisions in subsection (f) that establish the conditions under which Tier 4 final engines may be certified.

(c) *Abbreviations and Acronyms.* The following abbreviations and acronyms are used in this section 2423.1:

"40 CFR" means Title 40, Code of Federal Regulations.

"CA-ABT" means California averaging, banking, and trading program.

"CCR" means California Code of Regulations.

"CCV" means closed crankcase ventilation.

"CFR" means Code of Federal Regulations.

"CH<sub>4</sub>" means methane.

"CO" means carbon monoxide.

"CO<sub>2</sub>" means carbon dioxide.

"DARAP" means Diesel Aftertreatment Rapid Aging Protocol.

"DMC" means Discrete Mode Cycle.

"ELSE" refers to all mobile machinery excluding generator engines.

"Federal ABT program" means the Averaging, Banking, and Trading program in 40 CFR, Part 1039, subpart H, which includes § 1039.701 (October 25, 2016), § 1039.705 (October 25, 2016), § 1039.710 (October 25, 2016), § 1039.715 (April 30, 2010), § 1039.720 (April 30, 2010), § 1039.725 (October 25, 2016), § 1039.730 (October 25, 2016), § 1039.735 (October 25, 2016), § 1039.740 (June 29, 2021), and § 1039.745 (June 29, 2004).

"FCL" means family certification limit.

"FEL" means family emission limit.

"g/kW-hr" means grams per kilowatt-hour.

"GEN" means equipment in which generator-set engines are installed, where "generator-set engines" are defined in Part III: 40 CFR PART 1039, Subpart I, section 1039.801 of the "2029 and Later Test Procedures."

"GHG" means greenhouse gas.

"kW" means kilowatt.

"MY" means model year.



"NMHC" means non-methane hydrocarbons.

"n/a" means not applicable.

"NO<sub>x</sub>" means oxides of nitrogen.

"N<sub>2</sub>O" means nitrous oxide.

"NRTC" means the Nonroad Compression-Ignition Composite Transient Cycle.

"P" means the emission-data engine's maximum power for the engine family, in units of kW.

"PM" means particulate matter.

"RMC" means the Steady-State Ramped Modal Cycles.

"Tier 4" means the Tier 4 exhaust emission standards in section 2423.

"U.S. EPA" means the United States Environmental Protection Agency.

(d) *Tier 5 Criteria Pollutant Exhaust Emission Standards.*

(1) *Criteria Pollutant Exhaust Emission Standards Applicable to the NRTC and Steady-State Test Cycles.*

(A) The following standards are the maximum Tier 5 exhaust emissions permitted for the full useful life from new off-road compression-ignition engines as sold in the state of California and as appropriate based on model year and maximum engine power as indicated in the table. These standards are applicable to off-road compression-ignition engines that are less than or equal to 560 kW, except for constant-speed engines, and certification testing shall be conducted using both the NRTC and the applicable steady-state duty cycle. For off-road compression-ignition engines that are greater than 560 kW and all constant-speed engines, these standards only apply when an engine is tested using the manufacturer's choice of applicable steady-state duty cycle defined in section 2421.1, subsection (b). NOTE: The On-Board Diagnostics requirements in section 2422 may require malfunction detection demonstration over the ramped modal testing duty cycles.

### Tier 5 Exhaust Emission Standards (g/kW-hr)

Power Category	Model Year <sup>1</sup>	Type	NOx	PM	NMHC	CO
< 8 kW	2031-2033	Interim	6.0 <sup>2</sup>	0.3	n/a	8.0
	2034 +	Final	5.0 <sup>2</sup>	0.2	n/a	8.0
8 ≤ kW < 19	2031-2033	Interim	5.5 <sup>2</sup>	0.2	n/a	6.6
	2034 +	Final	4.0 <sup>2</sup>	0.1	n/a	6.6
19 ≤ kW < 56	2031-2033	Interim	3.7	0.015	0.19	5.0
	2034 +	Final	2.5	0.008	0.19	5.0
56 ≤ kW < 130	2031-2033	Interim	0.22	0.005	0.19	5.0
	2034 +	Final	0.040	0.005	0.080 <sup>3</sup>	5.0
130 ≤ kW ≤ 560	2029-2032	Interim	0.22	0.005	0.19	3.5
	2033 +	Final	0.040	0.005	0.080 <sup>3</sup>	3.5
> 560 kW (Gen Sets)	2030-2033	Interim	0.50	0.015	0.19	3.5
	2034 +	Final	0.35	0.008	0.080 <sup>3</sup>	3.5
> 560 kW (Mobile)	2030-2033	Interim	3.5	0.040	0.19	3.5
	2034 +	Final	3.0	0.040	0.19	3.5

<sup>1</sup> Phase-in options for Tier 5 exhaust emission standards are shown in subsection (f).

<sup>2</sup> Denotes NMHC+NOx.

<sup>3</sup> The NMHC standard for lean-burn natural gas engine families is 0.19 g/kW-hr.

#### (B) Family Emission Limits.

1. For Tier 5 engine families, a manufacturer may generate or use emission credits, as applicable, under the California Averaging, Banking, and Trading (CA-ABT) program described in subsection (h) for demonstrating compliance with NOx, NOx + NMHC, and PM emission standards in subsection (d) and greenhouse gas emission standards in subsection (e). Manufacturers shall meet the NMHC and CO emission standards in subsection (d) without generating or using emission credits.

2. To generate or use emission credits, a manufacturer shall specify a family emission limit for each engine family. A manufacturer shall declare the family emission limit corresponding to full useful life for engine operation over the NRTC duty cycle,  $FEL_{NRTC}$ , expressed to the same number of decimal places as the emission standard. If the NRTC is not applicable to the engine family, a manufacturer shall declare the FEL over a steady-state cycle, RMC or DMC,  $FEL_{RMC/DMC}$  to calculate emission credits in subsection (h).  $FEL_{NRTC}$  equals  $FEL_{RMC/DMC}$ .

3. The FEL over the NRTC, RMC, or DMC shall not be higher than the limits in the following table.

### Upper Limit for Tier 5 FELs

<i>Maximum Engine Power</i>	<i>PM</i>	<i>NMHC + NOx</i>	<i>NOx</i>
	<i>grams per kilowatt-hour</i>		
kW<8	0.40 <sup>1</sup>	7.5	n/a
8≤kW<19	0.40	7.5	n/a
19≤kW<37	0.03	n/a	3.8
37≤kW<56	0.03	n/a	3.8
56≤kW<75	0.02	n/a	0.40
75≤kW<130	0.02	n/a	0.40
130≤kW≤560	0.02	n/a	0.40
560 kW<GEN <sup>2</sup> ≤900 kW	0.03	n/a	0.67
GEN >900 kW	0.03	n/a	0.67
ELSE <sup>3</sup> >560 kW	0.04	n/a	3.5

<sup>1</sup> The Tier 5 upper limit FEL for hand-start, air cooled, direct injection engines below 8 kW is 0.60 g/kW-hr.

<sup>2</sup> "GEN" refers to generator engines only.

<sup>3</sup> "ELSE" refers to all mobile machinery excluding generator engines.

4. The NO<sub>x</sub>, NO<sub>x</sub> + NMHC, or PM FEL that applies for each cycle,  $FEL_{cycle}$ , is calculated using the following equation.

$$FEL_{cycle} = FEL_{Ref} \cdot \frac{Std_{cycle}}{Std_{Ref}}$$

Where:

$FEL_{Ref}$  is the NO<sub>x</sub>, NO<sub>x</sub> + NMHC, or PM reference FEL based on the NRTC, RMC, or Discrete-Mode Cycle, as applicable.

$Std_{cycle}$  is the NO<sub>x</sub>, NO<sub>x</sub> + NMHC, or PM emission standard for a test cycle. The LLC is currently the only off-road diesel test cycle for which standards differ from the reference standards. For all other cycles, the ratio of cycle standard to reference standard reduces to unity resulting in the FEL for both the reference cycle and the specific cycle being identical.

$Std_{Ref}$  is the NO<sub>x</sub>, NO<sub>x</sub> + NMHC, or PM reference emission standard value based on the NRTC, RMC, or Discrete-Mode Cycle, as applicable. The NRTC defines the reference standard whenever the NRTC is required for certification. For other applications that only require steady-state certification, such as constant speed engines and engines > 560 kW, the RMC or discrete mode cycle used for certification defines the reference standard.

(2) *Low-Load Cycle Emission Standards.*

(A) The following standards are the maximum Tier 5 Low-Load Cycle exhaust emissions for the full useful life from new 2029 and subsequent model year off-road compression-ignition engines greater than or equal to 56 kW and less than or equal to 560 kW that certify to the Tier 5 final standards in subsection (d)(1)(A), except for constant-speed engines. These standards are applicable to off-road compression-ignition engines that are tested using the Low-Load Test Cycle in Part VI, Subpart B of the "2029 and Later Test Procedures."

**Tier 5 Low-Load Cycle Exhaust Emission Standards<sup>1,2</sup>**

<b>Power Category</b>	<b>NO<sub>x</sub> Final Standard (g/kW-hr)</b>	<b>PM Final Standard (g/kW-hr)</b>	<b>NMHC Final Standard (g/kW-hr)</b>
< 19 kW	n/a	n/a	n/a
19 ≤ kW < 56	n/a	n/a	n/a
56 ≤ kW < 130	0.060	0.005	0.19
130 ≤ kW ≤ 560	0.060	0.005	0.19
> 560 kW (Gen Sets)	n/a	n/a	n/a
> 560 kW (Mobile Machines)	n/a	n/a	n/a

<sup>1</sup> The model year applicability for these standards is based on the phase-in option selected by the engine manufacturer in accordance with subsection (f).

<sup>2</sup> These standards do not apply to engines that are certified to Tier 5 Interim standards.

(B) The FEL for LLC is calculated using the equation described in subsection (d)(1)(B)4. Further details of the CA-ABT program are provided in subsection (h).

(3) *Idle NO<sub>x</sub> Emission Standards.*

(A) The following standards are the maximum Tier 5 Idle NO<sub>x</sub> emissions for the full useful life from new off-road compression-ignition engines that certify to the Tier 5 final standards in subsection (d)(1)(A). Idle NO<sub>x</sub> emission standards do not apply to engines exclusively designed for constant speed applications (including but not limited to generator sets, transport refrigeration units, pumps, and welders). These Idle NO<sub>x</sub> emission standards are applicable to off-road compression-ignition engines that are tested using the Idle Speed Cycle in Part VI, Subpart C of the "2029 and Later Test Procedures."

### Tier 5 Idle NOx Exhaust Emission Standards<sup>1,2</sup>

Power Category	Application	Idling NOx Standard (g/hr)
< 19 kW	All	n/a
19 ≤ kW < 56	All	0.536*P <sup>3</sup>
56 ≤ kW < 130	All	n/a <sup>4</sup>
130 ≤ kW ≤ 560	All	n/a <sup>4</sup>
> 560 kW	Gen Sets	n/a
> 560 kW	Mobile Machines	50

<sup>1</sup> The model year applicability for these standards is based on the phase-in option selected by the engine manufacturer in accordance with subsection (f).

<sup>2</sup> These standards do not apply to engines that are certified to Tier 5 Interim standards.

<sup>3</sup> "P" means the emission-data engine's maximum power for the engine family, in units of kW.

<sup>4</sup> Idle testing is not required for certification in these power categories. However, engines shall meet the "SOS Emissions In-Use Threshold" for PEMS Bin A in Part II, Subpart A, section 3.5.1.2 of the "2029 and Later Test Procedures."

#### (B) *Compliance Options.*

1. For each model year, engines within the power categories greater than or equal to 56 kW and less than or equal to 560 kW shall comply with the applicable low-load cycle NOx emission standards in subsection (d)(2)(A) for each engine family for each model year for the purpose of certification. Subsection (f) specifies the applicability and implementation timing of the low-load cycle NOx emission standards in subsection (d)(2)(A). The "SOS Emissions In-Use Thresholds" in Part II, Subpart A, section 3.5.1.2 of the "2029 and Later Test Procedures" apply for in-use testing [screening and portable emissions measurement system (PEMS) testing].

2. For each model year, engines within a power category less than 56 kW or greater than 560 kW shall comply with subsection (d)(3) in accordance with either subsection (d)(3)(B)2.a or subsection (d)(3)(B)2.b for the model year for the purpose of certification. Subsection (f) specifies the applicability of the idle NOx emission standards in subsection (d)(3) for implementation Options 1 through 4. The idle NOx emission standards in subsection (d)(3) apply for in-use testing [screening and PEMS testing].

a. A manufacturer shall certify each engine family to the applicable idle NO<sub>x</sub> standard in subsection (d)(3)(A) based on engine testing; or

b. As an alternative to engine testing, a manufacturer may demonstrate that an engine family complies with the applicable idle NO<sub>x</sub> standard in subsection (d)(3) by demonstrating that the engines within the engine family are equipped with a system that automatically shuts down the engine during idling in accordance with the Part VI, Subpart C, section 2 of the "2029 and Later Test Procedures."

(4) *Opacity.*

(A) The opacity of smoke emissions from new off-road compression-ignition engines sold in this State shall not exceed the following, based on the applicable measurement techniques specified in Part III: 40 CFR Part 1039 of the "2029 and Later Test Procedures":

1. 20 percent during the engine acceleration mode;
2. 15 percent during the engine lugging mode; or
3. 50 percent during the peaks in either mode.

(B) The following engines are exempt from the requirements of this subsection (d)(4):

1. Single-cylinder engines;
2. Propulsion marine compression-ignition engines;
3. Constant-speed engines; and
4. Engines certified to a PM emission standard or FEL of 0.07 grams per kilowatt-hour or lower.

(5) *In-Use Compliance.* All manufacturers of 2029 and subsequent model year Tier 5 off-road compression-ignition engines shall comply with the in-use compliance requirements in Part II of the "2029 and Later Test Procedures."

(A) Requirements for Engine Families within a Power Category < 56 kW or > 560 kW.

1. All engines within a power category < 56 kW or > 560 kW shall comply with the in-use "not-to-exceed" NMHC, NO<sub>x</sub>, CO, and PM emission limits and test procedures in Part II, Subpart C, section 1 of the "2029 and Later Test Procedures."

2. For each engine family, a manufacturer shall submit with its application for certification an attestation that the engine family is compliant with all “not-to-exceed” emission limits specified in Part II, Subpart C, section 1 of the “2029 and Later Test Procedures.”

(B) Requirements for Engine Families within a Power Category  $56 \leq \text{kW} \leq 560 \text{ kW}$ .

1. All engines within a power category  $56 \leq \text{kW} \leq 560 \text{ kW}$  shall comply with the SOS Emissions In-Use Thresholds for NMHC, NO<sub>x</sub>, CO, and PM in accordance with Part II, Subpart A, section 3.5.1.2 of the “2029 and Later Test Procedures” and the moving average window test procedures in Part II, Subpart D of the “2029 and Later Test Procedures.”

2. For each engine family, a manufacturer shall submit with its application for certification an attestation that the engine family is compliant with all SOS Emissions In-Use Thresholds specified in Part II, Subpart A, section 3.5.1.2 of the “2029 and Later Test Procedures.”

(6) *In-Use Testing.* All manufacturers of 2029 and subsequent model year Tier 5 off-road compression-ignition engines within a power category  $56 \leq \text{kW} \leq 560 \text{ kW}$  shall comply with the manufacturer-run in-use testing requirements in Part II, Subparts A, B, and D of the “2029 and Later Test Procedures.” Engines within a power category  $< 56 \text{ kW}$  or  $> 560 \text{ kW}$  are not subject to in-use testing requirements.

(7) *Voluntary Blue Sky Series Engines Requirements.*

(A) *Voluntary Standards.* Engines subject to the standards in subsection (d)(1)(A) shall be designated “Blue Sky Series” engines by meeting the voluntary standards contained in the following table, which apply to all certification and in-use testing.

**Voluntary Emission Standards**

<i>Maximum Rated Power (kW)</i>	<i>NMHC+NO<sub>x</sub> (g/kW-hr)</i>	<i>NMHC (g/kW-hr)</i>	<i>NO<sub>x</sub> (g/kW-hr)</i>	<i>PM (g/kW-hr)</i>
kW < 8	2.50	n/a	n/a	0.10
$8 \leq \text{kW} < 19$	2.00	n/a	n/a	0.05
$19 \leq \text{kW} < 56$	n/a	0.10	1.25	0.004
$56 \leq \text{kW} \leq 560$	n/a	0.04	0.02	0.003
kW > 560 (Gen Sets)	n/a	0.04	0.175	0.004
kW > 560 (Mobile)	n/a	0.10	1.5	0.020

(B) *Additional Standards.* Blue Sky Series engines are subject to all provisions that would otherwise apply under this part, including the greenhouse gas emission standards in subsection (e).

(C) *CA-ABT Credit Eligibility.* Blue Sky Series engines shall be eligible to earn emission credits under the CA-ABT program in subsection (h). However, credit multipliers for early introduction shall not apply.

(8) *Crankcase Emissions.*

No crankcase emissions shall be discharged directly into the ambient atmosphere from any engine, unless the sum of those discharged emissions is added to the exhaust emissions (either physically or mathematically) during all emissions testing. To be eligible for this option, a manufacturer shall design its engines so that all crankcase emissions can be routed into the applicable sampling systems specified in the "2029 and Later Test Procedures" and shall account for deterioration in crankcase emissions when determining exhaust deterioration factors. Crankcase emissions that are routed to the exhaust upstream of exhaust aftertreatment during all operations are not considered to be discharged directly into the ambient atmosphere.

(e) *Tier 5 Greenhouse Gas Emission Standards and Credits.*

(1) Tier 5 greenhouse gas emission standards do not apply to engines that are certified to the Tier 5 Interim Criteria Pollutant Exhaust Emission Standards in subsection (d)(1).

(2) The following standards are the maximum Tier 5 greenhouse gas emissions for the full useful life from new 2029 and subsequent model year off-road compression-ignition engines that are certified to the Tier 5 Final Criteria Pollutant Exhaust Emission Standards in subsection (d)(1). These standards are applicable to off-road compression-ignition engines that are tested using both the NRTC and the Steady-State Duty Cycle. For engines above 560 kW and constant speed engines, only Steady-State Duty Cycle testing is applicable.



### Tier 5 Greenhouse Gas Emission Standards<sup>1,2</sup>

<i>Power Category</i>	<i>CO<sub>2</sub> Reducing (g/kW-hr)</i>	<i>CO<sub>2</sub> Capping (g/kW-hr)</i>	<i>N<sub>2</sub>O (g/kW-hr)</i>	<i>CH<sub>4</sub> (g/kW-hr)</i>
kW < 19	n/a	n/a	n/a	n/a
19 ≤ kW < 56	n/a	962.5	0.150	0.130
56 ≤ kW < 130	773.4-724.2 <sup>3</sup>	n/a	0.150	0.130
130 ≤ kW ≤ 560	724.2-690.9 <sup>3</sup>	n/a	0.150	0.130
kW > 560	n/a	726.5	0.150	0.130

<sup>1</sup> The model year applicability for these standards is based on the phase-in option selected by the engine manufacturer in accordance with subsection (f).

<sup>2</sup> These standards do not apply to engines that are certified to Tier 5 Interim standards.

<sup>3</sup> Calculated using the reducing standard equation:  $CO_2 \text{ (g/kW-hr)} = 677.5 + 2977*(P[\text{kW}])^{-0.8535}$ , where "P" means the emission-data engine's maximum power for the engine family, in units of kW.

#### (3) *Greenhouse Gas Emission Testing.*

For each engine family, a manufacturer shall demonstrate compliance with the Tier 5 greenhouse gas emission standards in subsection (e)(2) by measuring emissions from the tested configuration in accordance with Part III: 40 CFR PART 1039, Subpart C, section 1039.235, subsection (a)(3) of the "2029 and Later Test Procedures." The emission-data engine shall meet the applicable greenhouse gas standards using both the NRTC and the applicable Steady-State Duty Cycle. The Steady-State Duty Cycle used for greenhouse gas emission testing shall be the same Steady-State Duty Cycle used by a manufacturer to demonstrate compliance with the applicable criteria pollutant exhaust emission standards in subsection (d)(1)(A). For engines above 560 kW and constant speed engines, only the applicable Steady-State Duty Cycle shall be used.

#### (4) *CO<sub>2</sub> Family Certification Levels.*

(A) For each engine family, a manufacturer shall declare a CO<sub>2</sub> Family Certification Level that is equal to or greater than the CO<sub>2</sub> emission test results for all certified emission-data engines. The CO<sub>2</sub> Family Certification Level serves as the emission standard for the engine family with respect to certification testing if it is different than the otherwise applicable standard.

(B) For each engine family, compliance with the CO<sub>2</sub> Family Certification Level is the basis for CO<sub>2</sub> credit generation and certification testing requirements.

(5) *Greenhouse Gas Family Emission Limits.*

(A) For each engine family, a manufacturer shall declare a CO<sub>2</sub> Family Emission Limit that is equal to the CO<sub>2</sub> Family Certification Limit multiplied by 1.03.

(B) The Greenhouse Gas Family Emission Limit serves as the standard that applies for testing individual certified engines with respect to all required testing instead of the standards specified in subsection (e)(2).

(6) For an engine family with a production volume greater than 50 units, at least 1 percent of the production volume of the engine family (rounded to the nearest integer) shall have CO<sub>2</sub> emission rates at or below the CO<sub>2</sub> Family Certification Level and CH<sub>4</sub> and N<sub>2</sub>O emission rates at or below the applicable Family Emission Limits.

(f) *Phase-In Options for Tier 5 Requirements.*

(1) *General.*

(A) A manufacturer other than a California small volume engine manufacturer shall comply with this section 2423.1 using one of the following implementation options. The implementation option selected by a manufacturer shall apply to all engines in all power categories produced and delivered for sale in California by that manufacturer. A manufacturer shall notify the Executive Officer in writing of the selected implementation option before January 1, 2028. California small volume engine manufacturers may comply with subsection (i) as an alternative to complying with this subsection (f).

(B) For all phase-in options 1 through 4, all engines in all power categories that certify to the Tier 5 interim exhaust emission standards or to the Tier 5 final exhaust emission standards in subsection (d)(1) shall comply with the applicable OR OBD requirements in section 2422.

(C) *Limited Production of Tier 4 Final or Tier 5 Interim Engines.*

1. For each of the implementation options in this subsection (f), a manufacturer may continue to produce a limited number of engine families that meet all of the requirements that apply to engines that meet the Tier 4 final emission standards under section 2423, subsection (b)(1) and engine families that meet all of the requirements that apply to engines that meet the Tier 5 interim emission standards under subsection (d)(1)(A) of this section. The combined number of engines produced and delivered for sale in California that certify to the Tier 4 final emission standards and engines that certify to the Tier 5 interim emission standards may not exceed 5 percent of a manufacturer's annual total California production volume across all or any power categories.

2. This allowance shall only apply for five model years starting with the first model year in which "100 percent Tier 5 Final Compliance" is required based on the applicable power category and phase-in option selected by the manufacturer. This allowance does not apply during the phase-in periods in subsection (f).

3. A manufacturer that elects to produce engines that meet the Tier 4 final emission standards or Tier 5 interim emission standards under this subsection (f)(1)(C) shall offset the emissions from these engines using CA-ABT credits, in accordance with subsection (h)(2)(B)2.

4. A manufacturer that elects to certify Tier 4 final engines or Tier 5 interim engines, as applicable, under this provision, subsection (f)(1)(C), shall notify the Executive Officer of that decision (before January 1, 2028 - same as selection of phase-in option notification).

5. A manufacturer that elects to comply with the Tier 5 Requirement using Phase-in option 1 specified in subsection (f)(2) shall produce only Tier 5 interim engines under this allowance.

(D) *Tier 5 Requirements Referenced in this Subsection (f).*

1. References to "Criteria Pollutant Standards" mean the exhaust emission standards in subsection (d)(1)(A).

2. References to "Enhanced Defects Reporting" mean the requirements in Part V: 40 CFR PART 1068, Subpart F, section 1068.501, subsection (f) of the "2029 and Later Test Procedures."

3. References to "Greenhouse Gas Standards," "Greenhouse Gas Capping Standards," and "Greenhouse Gas Reducing Standards," mean the standards in subsection (e)(2). The general term "Greenhouse Gas Standards" include both the "Greenhouse Gas Capping Standards" and the "Greenhouse Gas Reducing Standards."

4. References to "Idle Reduction Provisions" mean compliance with subsection (d)(3).

5. References to "In-Use Testing Program" mean the Manufacturer-Run Off-Road In-Use Testing (ORIUT) Program requirements in Part II, Subparts A, B, and applicable sections of Subpart D of the "2029 and Later Test Procedures." The general term "In-Use Testing Program" includes both the "In-Use Testing Pilot Program" and the "In-Use Testing Enforceable Program." All engines certified for all model years are subject to the CARB-Run Off-Road In-Use

Compliance (ORIUC) Program requirements in Part II, Subpart C of the “2029 and Later Test Procedures.”

6. References to “In-Use Testing Pilot Program (NO<sub>x</sub>)” and “In-Use Testing Pilot Program (PM)” mean the ORIUT Pilot Program requirements in Part II, Subpart A of the “2029 and Later Test Procedures” shall only apply to NO<sub>x</sub> screening or to PM screening, respectively.

7. References to “In-Use Testing Enforceable Program (NO<sub>x</sub>)” and “In-Use Testing Enforceable Program (PM)” mean the ORIUT Enforceable Program requirements in Part II, Subpart A of the “2029 and Later Test Procedures” shall only apply to NO<sub>x</sub> screening or to PM screening, respectively.

8. References to “Longer Useful Life and Warranty” mean the requirements section 2421.1, subsection (b)(2) and section 2425, subsections (b)(2)(B) and (c)(3)(B).

9. References to “Low-Load Cycle Certification” mean compliance with subsection (d)(2).

10. References to “Revised Durability Demonstration” mean the Diesel Aftertreatment Rapid Aging Protocol.

11. References to “SCR Inducements” mean the requirements in Part VI, Subpart A of the “2029 and Later Test Procedures.”

(2) *Option 1.*

A manufacturer that elects to comply with this section 2423.1 using Option 1 shall not use CA-ABT credits to comply.

(A) A manufacturer shall certify 100 percent of its off-road compression-ignition engines in the power category less than 19 kW to the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 1 Implementation Schedule for Power Category < 19 kW**

<i>Tier 5 Requirement</i>	<i>100% Tier 5 Interim Compliance</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	2031-2033 MY	2034+ MY
Revised Durability Demonstration	2031-2033 MY	2034+ MY
SCR Inducements <sup>1</sup>	2031-2033 MY	2034+ MY
Longer Useful Life and Warranty	2031-2033 MY	2034+ MY
Enhanced Defects Reporting	2031-2033 MY	2034+ MY
Greenhouse Gas Standards <sup>2</sup>	n/a	n/a
Low-Load Cycle Certification	n/a	n/a
Idle Reduction Provisions	n/a	n/a
In-Use Testing Program <sup>3</sup>	n/a	n/a

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Neither the "capping" standards nor the "reducing" standards apply.

<sup>3</sup> Neither the "Pilot" program requirements nor the "Enforceable" program requirements apply.

(B) A manufacturer shall certify 100 percent of its off-road compression-ignition engines in the power category greater than or equal to 19 kW and less than 56 kW to the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 1 Implementation Schedule for Power Category  
19 ≤ kW < 56**

<i>Tier 5 Requirement</i>	<i>100% Tier 5 Interim Compliance</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	2031-2033 MY	2034+ MY
Revised Durability Demonstration	2031-2033 MY	2034+ MY
SCR Inducements <sup>1</sup>	2031-2033 MY	2034+ MY
Longer Useful Life and Warranty	2031-2033 MY	2034+ MY
Enhanced Defects Reporting	2031-2033 MY	2034+ MY
Greenhouse Gas Capping Standards	n/a	2034+ MY
Greenhouse Gas Reducing Standards	n/a	n/a
Low-Load Cycle Certification	n/a	n/a
Idle Reduction Provisions <sup>2</sup>	n/a	2034+ MY
In-Use Testing Program <sup>3</sup>	n/a	n/a

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.

<sup>3</sup> Neither the "Pilot" program requirements nor the "Enforceable" program requirements apply.

(C) A manufacturer shall certify 100 percent of its off-road compression-ignition engines in the power category greater than or equal to 56 kW and less than 130 kW to the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 1 Implementation Schedule for Power Category  
56 ≤ kW < 130**

<i>Tier 5 Final Requirement</i>	<i>100% Tier 5 Interim Compliance</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	2031-2033 MY	2034+ MY
Revised Durability Demonstration	2031-2033 MY	2034+ MY
SCR Inducements <sup>1</sup>	2031-2033 MY	2034+ MY
Longer Useful Life and Warranty	2031-2033 MY	2034+ MY
Enhanced Defects Reporting	2031-2033 MY	2034+ MY
Greenhouse Gas Capping Standards	n/a	n/a
Greenhouse Gas Reducing Standards	n/a	2034+ MY
Low-Load Cycle Certification <sup>2</sup>	n/a	2034+ MY
Idle Reduction Provisions <sup>2</sup>	n/a	2034+ MY
In-Use Testing Pilot Program (NOx)	2031-2032 MY	n/a
In-Use Testing Enforceable Program (NOx)	n/a	2033+ MY
In-Use Testing Pilot Program (PM)	2034-2035 MY	n/a
In-Use Testing Enforceable Program (PM)	n/a	2036+ MY

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.

(D) A manufacturer shall certify 100 percent of its off-road compression-ignition engines in the power category greater than or equal to 130 kW and less than or equal to 560 kW to the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 1 Implementation Schedule for Power Category  
130 ≤ kW ≤ 560**

<i>Tier 5 Final Requirement</i>	<i>100% Tier 5 Interim Compliance</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	2029-2032 MY	2033+ MY
Revised Durability Demonstration	2029-2032 MY	2033+ MY
SCR Inducements <sup>1</sup>	2029-2032 MY	2033+ MY
Longer Useful Life and Warranty	2029-2032 MY	2033+ MY
Enhanced Defects Reporting	2029-2032 MY	2033+ MY
Greenhouse Gas Capping Standards	n/a	n/a
Greenhouse Gas Reducing Standards	n/a	2033+ MY
Low-Load Cycle Certification <sup>2</sup>	n/a	2033+ MY
Idle Reduction Provisions <sup>2</sup>	n/a	2033+ MY
In-Use Testing Pilot Program (NOx)	2029-2030 MY	n/a
In-Use Testing Enforceable Program (NOx)	n/a	2031+ MY
In-Use Testing Pilot Program (PM)	2032-2033 MY	n/a
In-Use Testing Enforceable Program (PM)	n/a	2034+ MY

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.



(E) A manufacturer shall certify 100 percent of its off-road compression-ignition engines in the power category greater than 560 kW to the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 1 Implementation Schedule for Power Category  
> 560 kW**

<i>Tier 5 Final Requirement</i>	<i>100% Tier 5 Interim Compliance</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	2030-2033 MY	2034+ MY
Revised Durability Demonstration	2030-2033 MY	2034+ MY
SCR Inducements <sup>1</sup>	2030-2033 MY	2034+ MY
Longer Useful Life and Warranty	2030-2033 MY	2034+ MY
Enhanced Defects Reporting	2030-2033 MY	2034+ MY
Greenhouse Gas Capping Standards	n/a	2034+ MY
Greenhouse Gas Reducing Standards	n/a	n/a
Low-Load Cycle Certification	n/a	n/a
Idle Reduction Provisions <sup>2</sup>	n/a	2034+ MY
In-Use Testing Program <sup>3</sup>	n/a	n/a

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.

<sup>3</sup> Neither the "Pilot" program requirements nor the "Enforceable" program requirements apply.

(3) *Option 2.*

A manufacturer that elects to comply with this section 2423.1 using Option 2 may certify a maximum of 50 percent of its off-road compression-ignition engines to the Tier 4 Final standards in section 2423, subsection (b)(1)(B), Table 1b and shall certify a minimum of 50 percent of its off-road compression-ignition engines to the Tier 5 Final standards in section 2423.1, subsection (d)(1)(A) during the applicable phase-in period. Engines that certify to the Tier 5 Final standards during the applicable phase-in period shall comply with all applicable Tier 5 requirements as shown in the table. Engines that certify to the Tier 4 Final standards during the applicable phase-in period are not required to comply with the Tier 5 requirements as shown in the table.

(A) A manufacturer that elects to certify its off-road compression-ignition engines in the power category less than 19 kW to this section 2423.1 using Option 2 shall comply with the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 2 Implementation Schedule for Power Category < 19 kW**

<i>Tier 5 Requirement</i>	<i>Phase-In</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	2031-2033 MY	2034+ MY
Revised Durability Demonstration	2031-2033 MY	2034+ MY
SCR Inducements <sup>1</sup>	2031-2033 MY	2034+ MY
Longer Useful Life and Warranty	2031-2033 MY	2034+ MY
Enhanced Defects Reporting	2031-2033 MY	2034+ MY
Greenhouse Gas Standards <sup>2</sup>	n/a	n/a
Low-Load Cycle Certification	n/a	n/a
Idle Reduction Provisions	n/a	n/a
In-Use Testing Program <sup>3</sup>	n/a	n/a

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Neither the “capping” standards nor the “reducing” standards apply.

<sup>3</sup> Neither the “Pilot” program requirements nor the “Enforceable” program requirements apply.

(B) A manufacturer that elects to certify its off-road compression-ignition engines in the power category greater than or equal to 19 kW and less than 56 kW to this section 2423.1 using Option 2 shall comply with the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 2 Implementation Schedule for Power Category  
19 ≤ kW < 56**

<i>Tier 5 Requirement</i>	<i>Phase-In</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	2031-2033 MY	2034+ MY
Revised Durability Demonstration	2031-2033 MY	2034+ MY
SCR Inducements <sup>1</sup>	2031-2033 MY	2034+ MY
Longer Useful Life and Warranty	2031-2033 MY	2034+ MY
Enhanced Defects Reporting	2031-2033 MY	2034+ MY
Greenhouse Gas Capping Standards	n/a	2034+ MY
Greenhouse Gas Reducing Standards	n/a	n/a
Low-Load Cycle Certification	n/a	n/a
Idle Reduction Provisions <sup>2</sup>	n/a	2034+ MY
In-Use Testing Program <sup>3</sup>	n/a	n/a

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.

<sup>3</sup> Neither the “Pilot” program requirements nor the “Enforceable” program requirements apply.

(C) A manufacturer that elects to certify its off-road compression-ignition engines in the power category greater than or equal to 56 kW and less than 130 kW to this section 2423.1 using Option 2 shall comply with the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 2 Implementation Schedule for Power Category  
56 ≤ kW < 130**

<i>Tier 5 Requirement</i>	<i>Phase-In</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	2031-2033 MY	2034+ MY
Revised Durability Demonstration	2031-2033 MY	2034+ MY
SCR Inducements <sup>1</sup>	2031-2033 MY	2034+ MY
Longer Useful Life and Warranty	2031-2033 MY	2034+ MY
Enhanced Defects Reporting	2031-2033 MY	2034+ MY
Greenhouse Gas Capping Standards	n/a	n/a
Greenhouse Gas Reducing Standards	n/a	2034+ MY
Low-Load Cycle Certification <sup>2</sup>	n/a	2034+ MY
Idle Reduction Provisions <sup>2</sup>	n/a	2034+ MY
In-Use Testing Pilot Program (NOx)	2031-2032 MY	n/a
In-Use Testing Enforceable Program (NOx)	n/a	2033+ MY
In-Use Testing Pilot Program (PM)	2034-2035 MY	n/a
In-Use Testing Enforceable Program (PM)	n/a	2036+ MY

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.

(D) A manufacturer that elects to certify its off-road compression-ignition engines in the power category greater than or equal to 130 kW and less than or equal to 560 kW to this section 2423.1 using Option 2 shall comply with the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 2 Implementation Schedule for Power Category  
130 ≤ kW ≤ 560**

<i>Tier 5 Requirement</i>	<i>Phase-In</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	2029-2032 MY	2033+ MY
Revised Durability Demonstration	2029-2032 MY	2033+ MY
SCR Inducements <sup>1</sup>	2029-2032 MY	2033+ MY
Longer Useful Life and Warranty	2029-2032 MY	2033+ MY
Enhanced Defects Reporting	2029-2032 MY	2033+ MY
Greenhouse Gas Capping Standards	n/a	n/a
Greenhouse Gas Reducing Standards	n/a	2033+ MY
Low-Load Cycle Certification <sup>2</sup>	n/a	2033+ MY
Idle Reduction Provisions <sup>2</sup>	n/a	2033+ MY
In-Use Testing Pilot Program (NOx)	2029-2030 MY	n/a
In-Use Testing Enforceable Program (NOx)	n/a	2031+ MY
In-Use Testing Pilot Program (PM)	2032-2033 MY	n/a
In-Use Testing Enforceable Program (PM)	n/a	2034+ MY

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.

(E) A manufacturer that elects to certify its off-road compression-ignition engines in the power category greater than 560 kW to this section 2423.1 using Option 2 shall comply with the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 2 Implementation Schedule for Power Category > 560 kW**

<i>Tier 5 Requirement</i>	<i>Phase-In</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	2030-2033 MY	2034+ MY
Revised Durability Demonstration	2030-2033 MY	2034+ MY
SCR Inducements <sup>1</sup>	2030-2033 MY	2034+ MY
Longer Useful Life and Warranty	2030-2033 MY	2034+ MY
Enhanced Defects Reporting	2030-2033 MY	2034+ MY
Greenhouse Gas Capping Standards	n/a	2034+ MY
Greenhouse Gas Reducing Standards	n/a	n/a
Low-Load Cycle Certification	n/a	n/a
Idle Reduction Provisions <sup>2</sup>	n/a	2034+ MY
In-Use Testing Program <sup>3</sup>	n/a	n/a

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.

<sup>3</sup> Neither the "Pilot" program requirements nor the "Enforceable" program requirements apply.

(4) *Option 3.*

A manufacturer that elects to comply with this section 2423.1 using Option 3 shall comply with the applicable Option 1 implementation schedules in subsection (f)(2), except that the manufacturer may use CA-ABT credits to comply.

(5) *Option 4.*

A manufacturer that elects to comply with this section 2423.1 using Option 4 may certify 100 percent of its off-road compression-ignition engines to the Tier 4 Final standards in section 2423, subsection (b)(1)(B), Table 1b during the applicable phase-in period. A manufacturer that elects to comply with this section 2423.1 using Option 4 shall not use CA-ABT credits to comply during the phase-in period.

(A) A manufacturer that elects to certify its off-road compression-ignition engines in the power category less than 19 kW to this section 2423.1 using Option 4 shall comply with the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 4 Implementation Schedule for Power Category < 19 kW**

<i>Tier 5 Requirement</i>	<i>Phase-In</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	n/a	2033+ MY
Revised Durability Demonstration	n/a	2033+ MY
SCR Inducements <sup>1</sup>	n/a	2033+ MY
Longer Useful Life and Warranty	n/a	2033+ MY
Enhanced Defects Reporting	n/a	2033+ MY
Greenhouse Gas Standards <sup>2</sup>	n/a	n/a
Low-Load Cycle Certification	n/a	n/a
Idle Reduction Provisions	n/a	n/a
In-Use Testing Program <sup>3</sup>	n/a	n/a

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Neither the "capping" standards nor the "reducing" standards apply.

<sup>3</sup> Neither the "Pilot" program requirements nor the "Enforceable" program requirements apply.

(B) A manufacturer that elects to certify its off-road compression-ignition engines in the power category greater than or equal to 19 kW and less than 56 kW to this section 2423.1 using Option 4 shall comply with the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 4 Implementation Schedule for Power Category  
19 ≤ kW < 56**

<i>Tier 5 Requirement</i>	<i>Phase-In</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	n/a	2033+ MY
Revised Durability Demonstration	n/a	2033+ MY
SCR Inducements <sup>1</sup>	n/a	2033+ MY
Longer Useful Life and Warranty	n/a	2033+ MY
Enhanced Defects Reporting	n/a	2033+ MY
Greenhouse Gas Capping Standards	n/a	2033+ MY
Greenhouse Gas Reducing Standards	n/a	n/a
Low-Load Cycle Certification	n/a	n/a
Idle Reduction Provisions <sup>2</sup>	n/a	2033+ MY
In-Use Testing Program <sup>3</sup>	n/a	n/a

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.

<sup>3</sup> Neither the "Pilot" program requirements nor the "Enforceable" program requirements apply.

(C) A manufacturer that elects to certify its off-road compression-ignition engines in the power category greater than or equal to 56 kW and less than 130 kW to this section 2423.1 using Option 4 shall comply with the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 4 Implementation Schedule for Power Category  
56 ≤ kW < 130**

<i>Tier 5 Requirement</i>	<i>Phase-In</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	n/a	2033+ MY
Revised Durability Demonstration	n/a	2033+ MY
SCR Inducements <sup>1</sup>	n/a	2033+ MY
Longer Useful Life and Warranty	n/a	2033+ MY
Enhanced Defects Reporting	n/a	2033+ MY
Greenhouse Gas Capping Standards	n/a	n/a
Greenhouse Gas Reducing Standards	n/a	2033+ MY
Low-Load Cycle Certification <sup>2</sup>	n/a	2033+ MY
Idle Reduction Provisions <sup>2</sup>	n/a	2033+ MY
In-Use Testing Pilot Program (NOx)	n/a	n/a
In-Use Testing Enforceable Program (NOx)	n/a	2033+ MY
In-Use Testing Pilot Program (PM)	n/a	2034-2035 MY
In-Use Testing Enforceable Program (PM)	n/a	2036+ MY

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.



(D) A manufacturer that elects to certify its off-road compression-ignition engines in the power category greater than or equal to 130 kW and less than or equal to 560 kW to this section 2423.1 using Option 4 shall comply with the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 4 Implementation Schedule for Power Category  
130 ≤ kW ≤ 560**

<i>Tier 5 Requirement</i>	<i>Phase-In</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	n/a	2031+ MY
Revised Durability Demonstration	n/a	2031+ MY
SCR Inducements <sup>1</sup>	n/a	2031+ MY
Longer Useful Life and Warranty	n/a	2031+ MY
Enhanced Defects Reporting	n/a	2031+ MY
Greenhouse Gas Capping Standards	n/a	n/a
Greenhouse Gas Reducing Standards	n/a	2031+ MY
Low-Load Cycle Certification <sup>2</sup>	n/a	2031+ MY
Idle Reduction Provisions <sup>2</sup>	n/a	2031+ MY
In-Use Testing Pilot Program (NOx)	n/a	n/a
In-Use Testing Enforceable Program (NOx)	n/a	2031+ MY
In-Use Testing Pilot Program (PM)	n/a	2033-2034 MY
In-Use Testing Enforceable Program (PM)	n/a	2035+ MY

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.

(E) A manufacturer that elects to certify its off-road compression-ignition engines in the power category greater than 560 kW to this section 2423.1 using Option 4 shall comply with the Tier 5 requirements in accordance with the implementation schedule shown in the following table.

**Tier 5 Option 4 Implementation Schedule for Power Category  
> 560 kW**

<i>Tier 5 Requirement</i>	<i>Phase-In</i>	<i>100% Tier 5 Final Compliance</i>
Criteria Pollutant Standards	n/a	2032+ MY
Revised Durability Demonstration	n/a	2032+ MY
SCR Inducements <sup>1</sup>	n/a	2032+ MY
Longer Useful Life and Warranty	n/a	2032+ MY
Enhanced Defects Reporting	n/a	2032+ MY
Greenhouse Gas Capping Standards	n/a	2032+ MY
Greenhouse Gas Reducing Standards	n/a	n/a
Low-Load Cycle Certification	n/a	n/a
Idle Reduction Provisions <sup>2</sup>	n/a	2032+ MY
In-Use Testing Program <sup>3</sup>	n/a	n/a

<sup>1</sup> Only applies to engines certified with selective catalytic reduction.

<sup>2</sup> Does not apply to steady-state engine families.

<sup>3</sup> Neither the "Pilot" program requirements nor the "Enforceable" program requirements apply.

(g) *Labeling Requirements.* Engines certified under the Tier 5 Options shall be labeled, as appropriate, per the following:

(1) For engines certified under subsection (f)(2), engine manufacturers shall meet the labeling requirements in section 2424 and Part III: 40 CFR PART 1039, Subpart B, section 1039.135 of the "2029 and Later Test Procedures," but shall use the following in place of the otherwise required statement of compliance in section 2424, subsection (c)(4): "THIS ENGINE COMPLIES WITH CALIFORNIA REGULATIONS FOR [CURRENT MODEL YEAR] OFF-ROAD COMPRESSION-IGNITION ENGINES UNDER 13 CCR § 2423.1(f)(2)." State the FELs to which the engines are certified if certification depends on the CA-ABT provisions under subsection (h) and Part III: 40 CFR PART 1039, subpart H of the "2029 and Later Test Procedures."

(2) For engines certified under subsection (f)(3), engine manufacturers shall meet the labeling requirements in section 2424 and Part III: 40 CFR PART 1039, Subpart B, section 1039.135 of the "2029 and Later Test Procedures," but shall use the following in place of the otherwise required statement of compliance in section 2424, subsection (c)(3) or (c)(4), as applicable: "THIS ENGINE COMPLIES

WITH CALIFORNIA REGULATIONS FOR [CURRENT MODEL YEAR] OFF-ROAD COMPRESSION-IGNITION ENGINES UNDER 13 CCR § 2423.1(f)(3).” State the FELs to which the engines are certified if certification depends on the CA-ABT provisions under subsection (h) and Part III: 40 CFR PART 1039, subpart H of the “2029 and Later Test Procedures.”

(3) For engines certified under subsection (f)(4), engine manufacturers shall meet the labeling requirements in section 2424 and Part III: 40 CFR PART 1039, Subpart B, section 1039.135 of the “2029 and Later Test Procedures,” but shall use the following in place of the otherwise required statement of compliance in section 2424, subsection (c)(4): “THIS ENGINE COMPLIES WITH CALIFORNIA REGULATIONS FOR [CURRENT MODEL YEAR] OFF-ROAD COMPRESSION-IGNITION ENGINES UNDER 13 CCR § 2423.1(f)(4).” State the FELs to which the engines are certified if certification depends on the CA-ABT provisions under subsection (h) and Part III: 40 CFR PART 1039, subpart H of the “2029 and Later Test Procedures.”

(4) For engines certified under subsection (f)(5), engine manufacturers shall meet the labeling requirements in section 2424 and Part III: 40 CFR PART 1039, Subpart B, section 1039.135 of the “2029 and Later Test Procedures,” but shall use the following in place of the otherwise required statement of compliance in section 2424, subsection (c)(3): “THIS ENGINE COMPLIES WITH CALIFORNIA REGULATIONS FOR [CURRENT MODEL YEAR] OFF-ROAD COMPRESSION-IGNITION ENGINES UNDER 13 CCR § 2423.1(f)(5).” State the FELs to which the engines are certified if certification depends on the CA-ABT provisions under subsection (h) and Part III: 40 CFR PART 1039, subpart H of the “2029 and Later Test Procedures.”

(5) For limited production Tier 4 final engines certified under subsection (f)(1)(C), engine manufacturers shall meet the labeling requirements in section 2424 and Part III: 40 CFR PART 1039, Subpart B, section 1039.135 of the “2029 and Later Test Procedures,” but shall use the following in place of the otherwise required statement of compliance in section 2424, subsection (c)(3): “THIS ENGINE COMPLIES WITH CALIFORNIA REGULATIONS FOR [CURRENT MODEL YEAR] OFF-ROAD COMPRESSION-IGNITION ENGINES UNDER 13 CCR § 2423.1(f)(1)(C).” State the FELs to which the engines are certified if certification depends on the CA-ABT provisions under subsection (h) and Part III: 40 CFR PART 1039, subpart H of the “2029 and Later Test Procedures.”

(h) *California Averaging, Banking, and Trading Program.*

Beginning in the 2026 model year, a manufacturer may generate or use CA-ABT emission credits according to the provisions in Part III: 40 CFR PART 1039, Subpart H of the "2029 and Later Test Procedures." Participation in this program is voluntary.

(i) *California Small-Volume Engine Manufacturers.*

(1) A California small-volume engine manufacturer may comply with this section 2423.1 using the provisions in this subsection (i) instead of complying with one of the phase-in options in subsection (f). A California small volume engine manufacturer that elects to comply with this section 2423.1 using the provisions in this subsection (i) shall notify the Executive Officer in writing of the intent to use these provisions before January 1, 2028. A California small-volume engine manufacturer that does not notify the Executive Officer in writing of the intent to use the provisions in this subsection (i) before January 1, 2028, may not use any of the provisions herein.

(2) *Tier 5 Phase-In Requirements.*

(A) The provisions in subsection (f)(1) shall apply to California small volume engine manufacturers.

(B) A California small-volume engine manufacturer may comply with the Tier 5 phase-in requirements as follows:

1. The manufacturer shall select one of the Tier 5 phase-in options from subsections (f)(2) through (f)(5).

2. The manufacturer may delay compliance with the "100 percent Tier 5 Final Compliance" requirements for the selected phase-in option for only the two model years after the requirement becomes applicable.

(3) California small-volume engine manufacturers shall meet the following conditions for the model years in which compliance with the otherwise applicable standards under this subsection (i) is delayed:

(A) Produce engines that meet all the emission standards and other requirements under the "2011-2028 Test Procedures" or "2029 and Later Test Procedures," as applicable, except as noted in this subsection (i).

(B) Meet the labeling requirements in section 2424 and Part III: 40 CFR PART 1039, Subpart B, section 1039.135 of the "2029 and Later Test Procedures," but shall use the following in place of the otherwise required statement of compliance in section 2424, subsection (c)(3) or (c)(4), as applicable: "THIS ENGINE COMPLIES WITH CALIFORNIA REGULATIONS FOR [CURRENT MODEL YEAR] OFF-ROAD COMPRESSION-IGNITION ENGINES UNDER 13 CCR §

2423.1(i).” The referencing of similar federal requirements under this provision is permitted.

(4) A manufacturer may not circumvent the provisions of this article by falsifying California sales volumes in order to qualify as a California small-volume engine manufacturer. A manufacturer that violates this provision shall be subject to civil penalties under Division 26 of the California Health and Safety Code.

(j) *Tier 5 Zero-Emission Credit Program.*

(1) An equipment manufacturer that produces and delivers for sale in California zero-emission off-road equipment between calendar years 2026 and 2028 may earn “zero-emission credits” that may be sold or otherwise transferred to engine manufacturers to comply with the emission standards in subsection (d). In order to qualify for zero-emission credits under this provision, the zero-emission equipment shall be certified for sale in California in accordance with Part III: 40 CFR PART 1039, Subpart C, section 1039.205 of the “2029 and Later Test Procedures.”

(2) In order to earn zero-emission credits, an equipment manufacturer shall replace its production of new equipment historically powered with an off-road compression-ignition engine with a power rating that is greater than or equal to 130 kW with equipment powered with a zero-emission powertrain. However, an engine manufacturer may use zero-emission credits to certify engine families with a power rating that is less than 130 kW.

(3) *Zero-Emission Equipment Family Group Certification.* Zero-emission equipment shall be certified according to family groups. Equipment manufacturers shall include in the same family group zero-emission equipment that has the same: available battery configuration(s) or fuel cell configuration(s), motor configuration, and expected degradation in usable battery energy or expected fuel cell degradation, as applicable. Equipment manufacturers shall use good engineering judgment to combine equipment into family groups for the purposes of certification.

(4) *Certification Application.* The equipment manufacturer shall submit a certification application for each zero-emission family group in accordance with Part III: 40 CFR PART 1039, Subpart C, section 1039.205 of the “2029 and Later Test Procedures.”

(5) *Warranty Requirements.*

(A) A manufacturer of zero-emission equipment shall warrant to the ultimate purchaser and each subsequent purchaser that the zero-emission powertrain is free from defects in material and workmanship that would cause the energy storage system, fuel cell stack (if applicable), power electronics, electric motors, or on-board battery charger to fail during the full warranted period.

(B) A manufacturer of zero-emission equipment shall warrant to the ultimate purchaser and each subsequent purchaser against corrosion of the energy storage system, fuel cell stack (if applicable), power electronics, electric motor(s), or on-board battery charger for the full warranted period.

(C) The duration of the warranty period for zero-emission powertrain components shall be identical to the defects warranty period for off-road compression-ignition engines in section 2425, subsection (b)(2)(B).

(6) Credits cannot be generated from the following types of zero-emission equipment:

(A) Transport Refrigeration Units;

(B) Cargo Handling Equipment;

(C) Other off-road equipment with zero-emission powertrains acquired by fleets subject to sections 2015, 2015.1, 2015.2, 2015.3, 2015.4, 2015.5, 2015.6, 2013, 2013.1, 2013.2, 2013.3, and 2013.4; or

(D) All engines and equipment that fall within the scope of the preemption of Section 209(e)(1) of the Federal Clean Air Act (42 U.S.C. § 7543(e)(1)), and as defined by regulation of the United States Environmental Protection Agency (U.S. EPA).

(7) Emission credits earned under the Tier 5 Zero-Emission Credit Program in accordance with subsection (j) are subject to the provisions in subsection (h).

(8) *Calculation of Zero-Emission Credits.*

Zero-emission credits shall be calculated in accordance with Part III: 40 CFR PART 1039, Subpart H, section 1039.705, subsection 5.3 of the "2029 and Later Test Procedures."

(9) *Zero-Emission Credit Reporting Requirements.*

The reporting requirements in Part III: 40 CFR PART 1039, Subpart H of the "2029 and Later Test Procedures" shall apply.

(10) *Zero-Emission Equipment Labeling Requirements.*

(A) Zero-emission equipment for which credits are claimed under the Tier 5 Zero-Emission Credit Program shall be labeled in accordance with this subsection (j)(10).

(B) Zero-emission equipment manufacturers shall affix a permanent label to the zero-emission powertrain or to another readily visible part of each piece of

equipment that cannot be easily removed. The label shall be in the English language, and shall include the following information:

1. The label heading "EMISSION CONTROL INFORMATION."
2. The equipment manufacturer's corporate name and trademark.
3. The calendar year in which the equipment is manufactured.
4. An e-mail address and phone number to contact for further information, or a website that includes this contact information.
5. The following statement:

"THIS EQUIPMENT [or identify the type of equipment] HAS A ZERO-EMISSION POWERTRAIN THAT MEETS CALIFORNIA REQUIREMENTS UNDER 13 CCR § 2423.1(j)."

(k) *California Transition Program for Equipment Manufacturers (CA-TPEM).*

The provisions of this subsection allow equipment manufacturers to produce equipment with engines that are subject to less stringent emission standards than the Tier 5 emission standards required in this section 2423.1 after the Tier 5 emission standards begin to apply.

(1) *General Requirements and Restrictions.*

(A) Only manufacturers that have primary responsibility for designing and manufacturing equipment, and have manufacturing procedures for installing engines in equipment, are eligible to participate in the CA-TPEM in accordance with the provisions in Part III: 40 CFR PART 1039, Subpart G, section 1039.625 of the "2029 and Later Test Procedures."

(B) Equipment manufacturers participating in the CA-TPEM shall comply with the notification and reporting requirements specified in subsection (k)(7).

(C) Engines produced and sold under this program shall not be included in the phase-in schedules under subsection (f).

(D) Engines produced under the CA-TPEM using FELs greater than the applicable standards shall be offset with CA-ABT credits.

(2) *Allowances Based on Percent of Historical California Equipment Sales.*

The following allowances apply separately to each engine power category subject to standards under subsection (d)(1):

(A) For the applicable portion of a manufacturer's California-directed sales volume, in accordance with subsection (k)(2)(D) and (k)(2)(E), excluding

engines or equipment that fall within the scope of the preemption of Section 209(e)(1) of the Federal Clean Air Act, and as defined by regulation of the U.S. EPA, an equipment manufacturer may produce equipment and vehicles with engines that are exempted from meeting Tier 5 emission standards for a portion of its California-directed sales volume. For the purposes of this subsection (k), the calculated total number of pieces of equipment that may be exempted from meeting Tier 5 emission standards is referred to as an "allowance." The applicable CA-TPEM engine standards and usage period for CA-TPEM allowances for each power category are shown in subsection (k)(3).

(B) An equipment manufacturer shall calculate its historical three-year average of California equipment sales, differentiated by engine power category, using actual 2026 through 2028 calendar year California sales volumes. (For the 2028 calendar year, a manufacturer may calculate this average using projected sales in lieu of actual sales, but actual sales are required for 2026 and 2027.) These sales volumes shall exclude engines or equipment that fall within the scope of the preemption of Section 209(e)(1) of the Federal Clean Air Act, and as defined by regulation of the U.S. EPA. The number of available allowances is a percentage of this calculated average as specified in subsections (D) and (E) below, as applicable. The engine power categories are defined in the tables in subsections (3)(A)1. and (3)(A)2. below:

(C) All CA-TPEM allowances for a power category shall be used within the same CA-TPEM usage period, as specified in subsections (k)(3)(A) or (k)(3)(B), as applicable. The number of CA-TPEM allowances that a manufacturer may earn in accordance with subparagraphs (k)(2)(D) and (k)(2)(E), as applicable, are the total number of allowances that may be used over the entire usage period, not the number of allowances that may be used each calendar year.

(D) *Equipment with Engines Rated at or Above 56 kW.* For equipment and vehicles that use engines rated at or above 56 kW, a manufacturer's CA-TPEM allowances may not exceed 50 percent of the California-directed historical three-year average equipment sales for each individual power category.

(E) *Equipment with Engines Rated Under 56 kW.* For equipment and vehicles that use engines rated under 56 kW, a manufacturer's CA-TPEM allowances may not exceed 80 percent of the California-directed historical three-year average equipment sales for each individual power category).



(3) *CA-TPEM Implementation.*

(A) *CA-TPEM Implementation for Phase-In Options 1, 2, and 3.*

1. *General Availability of Allowances (Tier 5 Interim CA-TPEM).*

The allowances in the following table are available to manufacturers that elect to comply with the requirements of this section 2423.1 using Phase-in Option 1, 2, or 3 and choose to use credits prior to 100 percent Tier 5 final compliance. These provisions are available for the years shown in the following table, except as provided in subsection (k)(3)(A)2.

<i>General Availability of Allowances (Tier 5 Interim CA-TPEM)</i>		
<i>Power Category</i>	<i>Usage Period: Calendar Years</i>	<i>CA-TPEM Engine Standard</i>
kW < 19	2031 - 2034	Tier 4 Final
19 ≤ kW < 56	2031 - 2034	Tier 4 Final
56 ≤ kW < 130	2031 - 2033	Tier 4 Final
130 ≤ kW ≤ 560	2029 - 2031	Tier 4 Final
kW > 560	2030 - 2032	Tier 4 Final

2. *Delayed Availability of Allowances (Tier 5 Final CA-TPEM).*

Only an equipment manufacturer that does not use any allowances in a power category before the earliest dates shown in the following table may delay the start of the applicable usage period for using allowances under this section, shown as follows:

<i>Delayed Availability of Allowances (Tier 5 Final CA-TPEM)</i>		
<i>Power Category</i>	<i>Usage Period: Calendar Years</i>	<i>CA-TPEM Engine Standard</i>
kW < 19	2034 - 2037	Tier 5 Interim
19 ≤ kW < 56	2034 - 2037	Tier 5 Interim
56 ≤ kW < 130	2034 - 2036	Tier 5 Interim
130 ≤ kW ≤ 560	2033 - 2035	Tier 5 Interim
kW > 560	2034 - 2036	Tier 5 Interim

(B) *CA-TPEM Implementation for Phase-In Option 4.*

1. *Availability of Allowances (Tier 5 Final CA-TPEM).*

<i>Availability of Allowances (Tier 5 Final CA-TPEM)</i>		
<i>Power Category</i>	<i>Usage Period: Calendar Years</i>	<i>CA-TPEM Engine Standard</i>
kW < 19	2033 - 2036	Tier 4 Final
19 ≤ kW < 56	2033 - 2036	Tier 4 Final
56 ≤ kW < 130	2033 - 2035	Tier 4 Final
130 ≤ kW ≤ 560	2031 - 2033	Tier 4 Final
kW > 560	2032 - 2034	Tier 4 Final

(4) *Inclusion of Engines Not Subject to Tier 5 Requirements.*

Off-road equipment and vehicles built with engines otherwise exempt from the requirements of this section 2423.1 are not required to be counted toward the percentage, or number, of claimed CA-TPEM allowances under the provisions in subsection (k)(2). Such exempted engines include unused inventories produced prior to the effective date of the Tier 5 standards, excluding stockpiled engines. Nonetheless, manufacturers may choose to include these engines in the count of total equipment produced from which the percentage of CA-TPEM allowances in subsection (k)(2) is derived.

(5) *Labeling Requirements.* Allowances claimed under the Tier 5 CA-TPEM shall be labeled, as appropriate, per the following:

(A) *Engine Labeling.* Engine manufacturers shall meet the labeling requirements provided in section 2424, with the following substitutions:

For CA-TPEM engines meeting previous year emission requirements, the engine manufacturer shall substitute the following for the statement of compliance required in section 2424, subsection (c)(1)(E)6 and section 2424, subsections (c)(3) or (c)(4), as applicable:

“THIS ENGINE COMPLIES WITH CALIFORNIA EMISSION REQUIREMENTS UNDER 13 CCR § 2423.1(k). SELLING OR INSTALLING THIS ENGINE FOR ANY PURPOSE OTHER THAN FOR THE CA-TPEM PROVISIONS CITED MAY BE A VIOLATION OF STATE LAW SUBJECT TO CIVIL PENALTY.” [Insert Engine Family Name, CA-TPEM Engine Standard, and state the FELs to which the engines are certified if certification depends on the CA-ABT provisions under

subsection (h) and Part III: 40 CFR PART 1039, subpart H of the "2029 and Later Test Procedures."]

(B) *Equipment Labeling.* For all allowances claimed under the Tier 5 CA-TPEM, equipment manufacturers shall affix a permanent label to the engine or to a readily visible section of the equipment that cannot be easily removed, according to the provisions in section 2424. The label shall be in the English language, shall supplement the manufacturer's emission control information label, and shall include the following information:

1. The label heading "EMISSION CONTROL INFORMATION."
2. The equipment manufacturer's corporate name and trademark.
3. The calendar year in which the equipment is manufactured.
4. An e-mail address and phone number to contact for further information, or a website that includes this contact information.
5. The following statement:

"THIS EQUIPMENT [or identify the type of equipment] HAS AN ENGINE THAT MEETS CALIFORNIA EMISSION STANDARDS UNDER 13 CCR § 2423.1(k)."

This label content does not preclude the referencing of similar federal requirements that would be satisfied simultaneously by meeting the provisions of subsection (k).

(6) *Technical Hardship Allowances.* Equipment manufacturers may apply for additional CA-TPEM allowances should extreme and unusual circumstances occur leading to technical obstacles in complying with the Tier 5 requirements. Additional CA-TPEM allowances shall not be provided when the engine and equipment are produced by the same manufacturer, or affiliate. The Executive Officer shall review requests for additional CA-TPEM allowances according to the following stipulations:

(A) The manufacturer requesting technical hardship allowances shall demonstrate that the circumstances necessitating them were outside the control of the manufacturer and not the result of negligent business practices or high-risk corporate decisions. An example of legitimate technical hardship may include material shortages caused by verifiable and unanticipated supply chain issues. An example of technical hardship that may not be approved would be a failure to hire skilled employees capable of developing the technical products required. The manufacturer shall also demonstrate that it has taken reasonable steps to minimize the scope of the request.

(B) A manufacturer shall apply for additional CA-TPEM allowances prior to the earliest date in which the applying manufacturer would be in violation of subsection (d)(1). All applications shall provide, at a minimum, the following information:

1. A description of the manufacturer's equipment design process.
2. A description of the relationship with the engine supplier regarding product design.
3. An explanation of the technical hardship leading to this request, why it cannot be addressed without additional CA-TPEM allowances, and an explanation of the circumstances behind the technical hardship and why it was unavoidable.
4. A description of the information and products provided by the engine supplier related to equipment design, including specifications, performance data, prototypes, and the dates of delivery.
5. A comparison of the design processes of the equipment model(s) for which additional allowances are needed versus those of other models that do not need additional allowances, and an explanation of how the technical differences between the models justify the request for additional allowances.
6. A description of all efforts to find and use other compliant engines, or otherwise an explanation why none are available.
7. A description of the steps taken to minimize the scope of the manufacturer's request, and any other relevant information.
8. An estimation of the number of additional allowances needed for each equipment model covered by the request, subject to subsection (k).

Notwithstanding, the Executive Officer may require additional information as deemed necessary before making a determination for relief.

(C) The following limits shall apply for technical hardship allowances granted under the CA-TPEM program in subsection (k)(2):

1. The maximum number of CA-TPEM allowances under these technical hardship provisions shall be limited to an additional 50 percent or 80 percent of a manufacturer's three-year average of Historical California Sales, as appropriate based on the power category of the engine families for which technical hardship is requested.
2. All primary CA-TPEM allowances shall be completely used up prior to the use of any additional CA-TPEM allowances.

3. All technical hardship allowances shall expire 24 months after the start of the applicable CA-TPEM usage period for each power category, as specified in subsection (k)(3). These allowances shall only be used for the specific equipment models covered in the manufacturer's application for relief.

(7) *Notification and Reporting Requirements for Using Tier 5 CA-TPEM Allowances.* As a prerequisite to using any Tier 5 CA-TPEM allowances, the equipment manufacturer shall notify CARB of its intent to use such allowances no less than six months prior to the first use of CA-TPEM allowances as provided in subsection (k)(3). The manufacturer shall provide its three-year historical average California sales in accordance with subsection (k)(2)(B) prior to using the allowances, including the total annual California sales for each calendar year that the historical average was calculated. These sales shall be used to verify that the CA-TPEM allowances have been calculated correctly. The manufacturer shall also submit, by March 31 of the following calendar year, an annual report that CA-TPEM allowances have been used to verify that the allowances claimed do not exceed the number of allowances permitted.

(A) A manufacturer shall inform CARB of its intent to use CA-TPEM allowances prior to using CA-TPEM provisions in accordance with subsection (b)(1)(D) and shall provide to CARB the following information:

1. The equipment manufacturer's name and address, and the name and address of the parent company, if applicable.
2. The name, telephone number, and e-mail address of a person to contact for more information.
3. The calendar years for which the Tier 5 CA-TPEM provisions shall apply.
4. Each engine manufacturer's name and address expected to produce the engines which will be used in the equipment claimed as CA-TPEM allowances.
5. An accurate estimate of the number of CA-TPEM allowances in each power category that will be produced under the provisions in subsection (k)(2).
6. A tabulation of California-directed CA-TPEM allowances in each power category that have been sold in previous calendar years under the provisions of subsection (k).

(B) For each calendar year that Tier 5 CA-TPEM allowances are used, the equipment manufacturer shall submit, by March 31 of the following calendar year, a report to CARB in accordance with subsection (b)(1)(D) that documents the

utilization of those allowances. In the report, the manufacturer shall identify the total count of equipment sold by the manufacturer during the preceding calendar year for each power category, based on actual California-directed sales information, and shall identify the CA-TPEM allowances in each power category by reporting the percentages of California-directed CA-TPEM sales. If the manufacturer(s) of the engine installed in the equipment has not already been identified as required in subsection (k)(7)(A)4., the equipment manufacturer shall identify the name and address of this engine manufacturer(s) in the report. The report shall also identify the cumulative yearly totals and percentages for all CA-TPEM allowances sold for each power category. Alternatively, the percentage figures may be omitted from the report if the report states that CA-TPEM allowances were not used.

(l) *Recordkeeping and Calculation to Verify Compliance.*

The following shall apply to off-road equipment manufacturers that produce CA-TPEM equipment or vehicles under the Tier 5 CA-TPEM provisions of subsection (k), except as otherwise noted:

(1) For each power category in which exempted off-road equipment are produced, a calculation to verify compliance with the requirements of subsection (k) shall be made by the off-road equipment manufacturer. This calculation shall be made for CA-TPEM allowances under the Tier 5 program as indicated in subsection (k)(7)(B). The calculation shall be based on actual California sales information from the subject years. If the CA-TPEM allowances have been exceeded, then the manufacturer is in violation of section 2420, subsection (a)(3), except as provided under subsection (k)(7) and subsection (m) of this section and is subject to civil penalties under California Health and Safety Code, Division 26.

(2) An off-road equipment manufacturer shall keep records of all off-road equipment and vehicles sold in California under the provisions of subsection (k), for each power category in which CA-TPEM allowances are claimed. These records shall include equipment and engine model numbers, serial numbers, engine family name, dates of manufacture, and maximum engine power for Tier 5 CA-TPEM engines. In addition, the manufacturer shall keep records sufficient to demonstrate the verifications of compliance required in subsection (l)(1) and the notifications and reports specified in subsection (k)(7), as applicable. All records shall be kept for five full calendar years for CA-TPEM allowances under the Tier 5 program after the final year in which allowances are available for each power category and shall be submitted to the Executive Officer within one year after the conclusion of the applicable CA-TPEM usage period.

(m) *Economic Hardship Relief.*

Off-road equipment and vehicle manufacturers may request additional CA-TPEM allowances from the Executive Officer, based on economic hardship if the following requirements are met:

(1) A manufacturer shall submit the application for relief to CARB for approval prior to the earliest date in which the applying manufacturer would be in violation of subsection (d)(1). The off-road equipment manufacturer applying for hardship relief shall submit evidence for approval, showing that the following requirements have been met:

(A) The off-road equipment manufacturer applying for hardship relief shall not be the manufacturer of the engines used in the equipment for which relief is sought.

(B) The conditions causing the impending violation shall not be the fault of the applying manufacturer.

(C) The conditions causing the impending violation shall be such that the off-road equipment manufacturer applying for hardship relief will experience serious economic hardship, as determined by the Executive Officer according to the considerations in Part V: 40 CFR PART 1068, Subpart C, section 1068.255, if relief is not granted.

(D) The off-road equipment manufacturer applying for hardship relief shall demonstrate that no allowances under subsection (k) will be available to avoid the impending violation.

(2) Any relief granted shall begin within one year after the implementation date of the standard applying to the engines being used in the equipment for which relief is requested and may not exceed 12 months in duration.

(3) As a condition for economic hardship relief, a manufacturer shall submit a plan for recovering the lost environmental benefits from that relief. The labeling requirements in Part V: 40 CFR PART 1068, Subpart C, section 1068.255 of the "2029 and Later Test Procedures" apply.

(n) *Allowance for the Production of Previous Model Year Engines.*

To meet the demand for engines created under subsections (k) or (m), engine manufacturers may produce engines that do not meet current model year emission requirements. However, engine manufacturers shall receive written assurance from each equipment manufacturer, prior to production, that a certain number of these engines are needed for the equipment manufacturer's Tier 5 equipment CA-TPEM allowances. Engine manufacturers shall provide to the Executive Officer annually, as

part of the certification application, a list of the equipment manufacturers requesting such engines for their Tier 5 equipment CA-TPEM allowances. The list shall include the equipment manufacturers' names, engine models, the individual serial number of each engine, and estimated California production volumes. A copy of the original correspondence from the equipment manufacturer requesting the production of CA-TPEM engines shall be kept on file by the engine manufacturer in addition to, and in accordance with, the provisions of Part III: 40 CFR PART 1039, Subpart C, section 1039.250 of the "2029 and Later Test Procedures" and shall be provided to the Executive Officer as part of the engine manufacturer's application for certification. Furthermore, all engines produced for sale in California under the CA-TPEM provisions for equipment manufacturers, shall be covered by an Executive Order. To obtain an Executive Order for these engines, the engine manufacturer shall comply with the following:

(1) The manufacturer shall submit a request to CARB at: [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov) of CA-TPEM engines intended for sale in California prior to the start of production and

(2) The manufacturer shall provide an attestation to CARB at: [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov) that the CA-TPEM engines to be produced will be identical in all material respects to those for which a valid Executive Order has been issued in a previous model year. The engine family name of the previously certified engine family shall be included in the manufacturer's request for certification.

Upon determination that the conditions in subsections (n)(1) and (n)(2) have been satisfied, the Executive Officer shall provide the engine manufacturer with an Executive Order covering the requested CA-TPEM engine families for the current model year. The engine family names included in the Executive Order shall either be the same as, or a subset of the previously certified engine family names and shall remain the same for as long as the engines continue to qualify as CA-TPEM allowances regardless of model year. These engine family names shall be used by the engine manufacturer to comply with the labeling requirements of subsection (k)(5).

(o) *Replacement Engines.*

For purposes of this subsection (o), a replacement engine is a new compression-ignition off-road engine that is used to replace an engine that has already been placed into service (whether the previous engine is replaced in whole or in part with a new engine).

(1) A replacement engine shall not be subject to the emission requirements that are applicable to the model year in which the engine is replaced if the following conditions are met. In addition, engines that were originally certified in a previous model year to the same standards that apply for the current model year shall not be



subject to the emission requirements of section 2423.1 if the following conditions are met:

(A) The engine manufacturer has ascertained that no engine produced by itself or the manufacturer of the engine that is being replaced, if different, and certified to the requirements of this article, is available with the appropriate physical or performance characteristics to repower the equipment;

(B) In making the determination in subsection (o)(1)(A), the engine manufacturer shall also consider whether any cleaner tier engines are being produced with the appropriate physical or performance characteristics for replacing the original engine so that the cleanest available engine is used as the replacement;

(C) Unless an alternative control mechanism is approved in advance by the Executive Officer, the engine manufacturer or its agent takes ownership and possession of the engine being replaced or confirms that the engine has been destroyed;

(D) The engine manufacturer does not use the replacement-engine exemption to circumvent the regulations;

(E) The replacement engine is clearly labeled with the language in either subsection (o)(1)(E)1 or subsection (o)(1)(E)2, or similar alternate language approved in advance by the Executive Officer:

1. If the replacement engine is built to a configuration that was not subject to any emission standards under this Article 4, add a permanent label with your corporate name and trademark and the following language:

“THIS ENGINE DOES NOT COMPLY WITH CALIFORNIA OFF-ROAD EMISSION REQUIREMENTS. SALE OR INSTALLATION OF THIS ENGINE FOR ANY PURPOSE OTHER THAN AS A REPLACEMENT ENGINE FOR AN ENGINE MANUFACTURED PRIOR TO JANUARY 1 [Insert appropriate year reflecting when the earliest tier of emission standards began to apply to engines of that size and type] MAY BE A VIOLATION OF CALIFORNIA LAW SUBJECT TO CIVIL PENALTY.”

The following additional information shall also be included on the emission control label:

ENGINE POWER:	{insert the advertised power of the specific engine configuration or the applicable power category for the engine family in kilowatts}
DATE OF MANUFACTURE:	{insert the engine build date}

In lieu of including “Engine Power” or “Date of Manufacture” on the emissions control label, manufacturers may provide this information on a supplemental label attached to the engine in accordance with the provisions of section 2424.

2. If the replacement engine is built to a configuration that was subject to emission standards under this Article 4, add a permanent label with your corporate name and trademark and the following language:

“THIS ENGINE COMPLIES WITH CALIFORNIA OFF-ROAD EMISSION REQUIREMENTS FOR [Identify the appropriate emission standards (by model year, tier, or emission levels) for the replaced engine] ENGINES UNDER 13 CCR § 2423.1(o). SELLING OR INSTALLING THIS ENGINE FOR ANY PURPOSE OTHER THAN TO REPLACE AN [Identify the appropriate emission standards (by model year, tier, or emission levels) for the replaced engine] OFF-ROAD ENGINE MAY BE A VIOLATION OF CALIFORNIA LAW SUBJECT TO CIVIL PENALTY.

The following additional information shall also be included on the emission control label:

ENGINE POWER:	{insert the certified power in kilowatts of the specific engine configuration, if applicable, otherwise insert advertised power in kilowatts}
REFERENCE FAMILY NAME:	{insert the engine family name of the replacement engine as recorded in the Executive Order for the engine family to which the replacement engine was originally certified}
DATE OF MANUFACTURE:	{insert the engine build date}

3. In lieu of including “Engine Power,” “Reference Family Name,” or “Date of Manufacture” on the emissions control label, manufacturers may provide this information on a supplemental label attached to the engine in accordance with the provisions of section 2424. Manufacturers may state the applicable power category in kilowatts for the certified engine family on the emission control or supplemental label when indicating “Engine Power.”

Additionally, manufacturers may indicate the "Emissions Tier" of the replacement engine on the emissions control or supplemental label instead of the "Reference Family Name." For the purpose of this section, "Emissions Tier" is the emissions standard designation (e.g., Tier 1, Tier 2, Tier 3, Tier 4i, Tier 4f, Tier 5i, Tier 5f) of the engine recorded in the Executive Order for the engine family to which the replacement engine was originally certified. Certified power means the configuration-specific power of the replacement engine as originally identified in the application for certification of the reference engine family (see Part III: 40 CFR Part 1039, Subpart C, section 1039.205(a)). Advertised power means engine power as stated by the manufacturer in sales literature;

(F) The engine manufacturer makes the replacement engine in a configuration identical in all material respects to the engine being replaced (or that of another certified engine of the same or later model year as long as the engine is not certified with a family emission limit higher than that of the old engine). This requirement applies only if the old engine was certified to emission standards less stringent than those in effect when you produce the replacement engine; and

(G) The engine manufacturer has completed and submitted a checklist to the CARB Executive Officer as a condition to sell new replacement engines in California, unless the engine(s) will be built to current model year emission requirements. This checklist shall contain the following information and be submitted, beginning with model year 2029, for each of the estimated numbers of replacement engines by engine family and engine model to be produced for California and identified in subsection (o)(2).

1. Identify the equipment, including serial number, for which the engine(s) is to be replaced;
2. Identify all the engines, by family, model number, power category, and emissions tier, that you investigated in determining that a cleaner engine was not available with the physical or performance characteristics necessary to repower the equipment (replacement engine shall meet the cleanest feasible standards, or match the tier of the engine being replaced if no other cleaner engines are available);
3. Identify the specific characteristic(s) that you found incompatible with the cleaner engines including a comparison of part numbers, part dimensions, applicable chassis dimensions, and any other unsuitable parameters;
4. Provide specifications justifying the identified incompatibilities;

5. Identify the modifications needed to alter the equipment to be able to use the cleaner engines you rejected as incompatible. Software or EPROM modifications are not considered incompatible modifications;

6. Attest in a letter under the penalties of the California Health and Safety Code, Division 26, and corresponding regulations, that this information is true, accurate, and complete under penalty of perjury, and you have performed due diligence in selecting the cleanest emissions configuration that the engine can be replaced with according to this checklist.

(2) The Executive Officer shall use good engineering judgment to evaluate the information provided by the engine manufacturer pursuant to subsections (o)(1)(G)1 through (o)(1)(G)6. If the Executive Officer concludes that the information provided does not support the use of the replacement engine under the criteria set forth in subsections (o)(1)(A) through (o)(1)(G), the Executive Officer shall notify the engine manufacturer in writing. As of the date of the written notification, it shall be a violation of this section for the engine manufacturer to sell or use or cause to be used the replacement engines identified in the Executive Officer's written notice.

(3) By September 30 of the year following the end of each of the 2029 and later model years, the engine manufacturer shall send the following information to CARB:

(A) A list of the replacement engines, by engine family name, engine model, unique engine serial number, power category, and tier level, produced for California during the model year, paired with a list of the engines being replaced described by engine family name, engine model, unique engine serial number, power category, and tier level;

(B) A completed checklist for each replacement engine produced and sold during the model year;

(C) The total number of both new replacement engines and new certified engines produced and sold for California; and

(D) The attestation letter required in subsection (o)(1)(G).

(4) Replacement engines under subsection (o) may not generate or use emission credits nor be part of any associated credit calculations.

(p) *Allowances for the Use of Certified On-Road Engines in Off-Road Applications.*

(1) An engine manufacturer may introduce new on-road compression-ignition engines into commerce if the engine family meets all of the following requirements:

(A) The engine family has already been certified to the requirements that apply to compression-ignition engines under title 13, CCR, section 1956.8 for the appropriate model year in accordance with the requirements in Part III: 40 CFR PART 1039, Subpart G, section 1039.605 of the "2029 and Later Test Procedures."

(B) The on-road standards shall be at least as stringent as the off-road standards for the power category in question.

(C) The on-road diesel engine manufacturer shall attest that the on-road diesel engine will remain durable throughout the useful life applicable to an off-road engine of the same power category.

(D) The on-road compression-ignition engine manufacturer shall comply with all off-road compression-ignition engine warranty requirements in sections 2425 and 2425.1 and all on-road on-board diagnostics requirements in section 1968.2 or 1971.1, as applicable.

(E) All new on-road compression-ignition engines that are introduced into commerce under the provisions of this subsection (p) are subject to the CARB-run in-use compliance program in Part II, Subpart C of the "2029 and Later Test Procedures."

(q) *Practices, Labeling, Recordkeeping, and Reporting Requirements for Rebuilt Engines.*

This subsection shall apply as provided in subsection (1) below to all off-road compression-ignition engines subject to the requirements of this section 2423.1.

(1) *Practices.* The rebuilding practices described in Part V: 40 CFR PART 1068 of the "2029 and Later Test Procedures" shall apply. These practices are summarized in subsections (q)(1)(A) and (q)(1)(B), which are provided as respective references for the labeling requirements in subsections (q)(2)(A) and (q)(2)(B).

(A) Any person who rebuilds an engine that either remains installed in a piece of equipment during the rebuilding process or will be reinstalled after the rebuilding process has been completed shall rebuild the engine to the same certified configuration or the certified configuration of a later model year engine. For the purposes of this section, these engines shall be referred to as "rebuilt original engines."

(B) Any person who replaces the engine in a piece of equipment with a rebuilt engine (this includes engines that have been substantially assembled from parts originally belonging to one or more other engines) shall use a replacement engine with a certified configuration that is at least equivalent, from an emissions

standpoint, to that of the engine being replaced. For the purposes of this section, these engines shall be referred to as “rebuilt replacement engines.”

(2) *Labeling Requirements.*

(A) *Rebuilt Original Engines.* Any person who rebuilds engines for which the practices in subsection (q)(1)(A) apply shall ensure that the rebuilt engines are labeled as follows:

1. An original engine that is rebuilt to the same emissions configuration employed by the engine at the time it was issued an Executive Order shall retain the emissions control label described in section 2424. The rebuilder shall not remove or deface in any manner the original label and shall take care to protect it from the effects of sandblasting, acid dipping, or any other restorative processes. Notwithstanding the preceding requirements and prohibitions of this subsection (q)(2)(A)1, the rebuilder shall substitute a new permanent label containing the text in subsection (q)(2)(A)2 for the original emission control label if the rebuilder determines that the label has been irreparably corrupted due to extreme and unintentional circumstances (e.g., fire or collision). The rebuilder shall provide to the Executive Officer annually a list of all rebuilt engines for which original labels have been removed under this provision no later than March 1 after the end of each calendar year. The rebuilder shall retain all removed labels, or otherwise document the degree to which the labels were damaged or missing (e.g., photographic proof of the corruption), for a period of no less than eight years following the date of renovation and shall make these available to the Executive Officer upon request. The rebuilder shall be subject to civil penalty under State law should the Executive Officer determine that the original emission control label did not warrant replacement or that the rebuilder is not in compliance with the legal requirements of the provision;

2. An original engine that is rebuilt to a more stringent emissions configuration shall be permanently re-labeled using the following text:

“THIS ENGINE HAS BEEN REBUILT UNDER 13 CCR § 2423.1(q) USING MATCHED COMPONENTS OF THE SAME SPECIFICATIONS AND CALIBRATIONS AS THOSE OF A CERTIFIED TIER [*insert the numerical tier designation of the rebuilt engine*] OFF-ROAD COMPRESSION-IGNITION ENGINE. IF PLACED INTO SERVICE IN AN OFF-ROAD APPLICATION, THIS ENGINE MUST BE INSTALLED IN EQUIPMENT ORIGINALLY SOLD WITH A TIER [*insert the numerical tier designation of the rebuilt engine*] OR EARLIER ENGINE. [*insert the engine family name of the reference engine*].

For the purpose of this label, "MATCHED" means a complete set of components corresponding to the certified emissions configuration being referenced (see the definition of "certified emissions configuration" in title 13, CCR, section 2421.1, subsection (b)(2)). The reference engine is the engine family name corresponding to the certified emissions configuration to which the engine has been rebuilt. The label shall conform to the provisions of title 13, CCR, section 2424 regarding location and visibility.

(B) *Rebuilt Replacement Engines.* Any person who rebuilds engines for which the practices in subsection (q)(1)(B) apply shall ensure that the rebuilt engines are labeled as follows:

1. A replacement engine that is rebuilt to the same California emissions configuration employed by the engine at the time it was issued an Executive Order shall retain the emission control label described in title 13, CCR, section 2424 and include a supplemental label using the text in subsection (q)(2)(A)2. A replacement engine that is rebuilt to the same emissions configuration employed by the engine at the time it was issued a federal Certificate of Conformity, and for which no Executive Order exists, shall be permanently re-labeled using the text in subsection (q)(2)(A)2 prior to being installed in equipment that was originally sold with a California certified engine;

2. A replacement engine that is rebuilt to a more stringent emissions configuration shall be permanently re-labeled using the text in subsection (q)(2)(A)2;

3. An incomplete rebuilt replacement engine shall be permanently relabeled using the text specified below.

"THIS ENGINE HAS BEEN REBUILT UNDER 13 CCR § 2423.1(q) AS AN INCOMPLETE ENGINE USING ONLY MATCHED COMPONENTS OF THE SAME SPECIFICATIONS AND CALIBRATIONS AS THOSE FOUND IN OFF-ROAD COMPRESSION-IGNITION ENGINES CERTIFIED TO THE [*insert the numerical tier or multiple tiers designation of the rebuilt engine*]."

Any person who completes an incomplete rebuilt replacement engine with components that are not matched components, and the resulting engine is sold, offered for sale, or entered into commerce in California, is in violation of the rebuilding practices referenced under subsection (1) of this subsection and subject to civil penalty under State law.

(C) *Supplemental Labeling Requirements.* Except as noted below, any person who sells or offers for sale any rebuilt engine subject to the provisions of subsection (q) shall affix a supplemental label to the rebuilt engine that:

1. states the name of the rebuilder, month and year of rebuild, and other information as determined by the rebuilder to be essential to the rebuilding process. An example of such essential information would be documentation that a part from an engine other than an off-road diesel engine, or a part that was modified to fit the off-road diesel engine being rebuilt, was used in the rebuild, but which has identical function to the part being replaced despite different part numbers. Such a part may trigger an enforcement investigation if not identified by the rebuilder as a nonstandard element of the rebuild. Another example would include documenting the installation of an identically performing turbocharger from a locomotive engine to replace the turbocharger on an off-road diesel engine, but with modifications to the mounting bracket being necessary for fitment;
2. is clearly visible without the need to remove any engine components;
3. does not obscure in any way the visibility of the original emission control label or the labels required under subsection (q)(2)(A)2 or subsection (q)(2)(B)3;
4. does not state or imply that the rebuilt engine is “new” or that it belongs to an engine family other than the one to which it was originally certified; and
5. has sufficient durability to remain intact and legible throughout all mandatory recordkeeping periods for rebuilt engines.

The requirement for a supplemental label shall be waived in cases where the rebuilder alternately chooses to incorporate the information in (C)1. above into the new permanent label specified in subsection (q)(2)(A)2 or subsection (q)(2)(B)3.

(D) *Rebuilt New Engines.* Notwithstanding any other requirement of this subsection (q), any person who rebuilds an engine to comply with current-year emission requirements (including, but not limited to, durability and warranty), with the intent to sell or offer for sale the rebuilt engine as “new” under the coverage of a new and unique Executive Order, shall replace the original emission control label on that engine with one identifying the engine as belonging to a family meeting current-year emission requirements in accordance with the provisions of title 13, CCR, section 2424. If desired, the rebuilder of such an engine may optionally affix to it a supplemental label, but such a label would be required to comply with the same requirements specified in subsection (q)(2)(C) for any other rebuilt engine.



(3) *Recordkeeping and Reporting.* Recordkeeping requirements specified in Part V: 40 CFR PART 1068, Subpart B, section 1068.120, subsection 1 of the "2029 and Later Test Procedures" shall be followed by rebuilders of off-road compression-ignition engines, and specific reporting requirements in 1068.120, subsection 2 of the same test procedures shall be followed by anyone who manufactures or sells off-road engines or equipment and also rebuilds off-road compression-ignition engines.

(r) *Stockpiling Prohibition.*

Manufacturers may not circumvent the provisions of this article by stockpiling engines with a date of manufacture preceding new or changed emission standards by deviating from normal production and inventory practices. The Executive Officer may request that manufacturers submit routine production and inventory records that document normal business practices for up to eight years to aid in determining whether or not a violation of this section has occurred. Other stockpiling prohibitions in Part V: 40 CFR PART 1068, Subpart B, sections 1068.103 and 1068.105 of the "2029 and Later Test Procedures" shall apply.

(s) Manufacturers of auxiliary power units installed on tractors subject to greenhouse gas emission standards specified in title 17, CCR, section 95663, subsection (a)(2)(B) shall comply with the emission standards and certification requirements specified in Part III: 40 CFR PART 1039, Subpart G, section 1039.699 of the "2029 and Later Test Procedures." An "auxiliary power unit" is defined in Part III: 40 CFR PART 1039, Subpart I, section 1039.801 of those test procedures.

(t) *Disclosure of Records.*

(1) *Public Disclosure.*

Unless identified as a trade secret or otherwise confidential under title 17, CCR, section 91011, and supported as such under title 17, CCR, section 91022, records in the Board's possession for the vehicles subject to the requirements of this section 2423.1 are subject to disclosure as public records.

(2) *Disclosure to the U.S. Environmental Protection Agency.*

Records in the Board's possession for the vehicles subject to the requirements of this section 2423.1 shall be subject to disclosure to the federal Environmental Protection Agency, which protects trade secrets as provided in section 114(c) of the Clean Air Act and amendments thereto (42 U.S.C. § 7401 et seq.) and in federal regulations.

(u) *Severability.*

Each provision of this section is severable, and in the event that any provision of this section is held to be invalid, the remainder of this section and this article remains in full force and effect.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, and 43104, Health and Safety Code. Reference: Sections 43013, 43016, 43017, 43018, 43101, 43104, 43211, and 43212, Health and Safety Code.

11. Amend Title 13, CCR, Chapter 9, Article 4, Section 2424 to read as follows:

**§ 2424. Emission Control Labels - 1996 and Later Off-Road Compression-Ignition Engines.**

(a) *Purpose.* The California Air Resources Board recognizes that certain emissions-critical or emissions-related parts must be properly identified and maintained in order for engines to meet the applicable emission standards. The purpose of these specifications is to require engine manufacturers to affix a label (or labels) on each production engine (or equipment) to provide the engine or equipment owner and service mechanic with information necessary for the proper maintenance of these parts in customer use. For engines used in auxiliary power systems which, in turn, are used to comply with the diesel-fueled commercial vehicle idling requirements of title 13, CCR, section 2485(c)(3)(A), additional labeling requirements for the engine or equipment manufacturers apply, as set forth in section 35.B.4 of the "California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles," as incorporated by reference in title 13, CCR, section 1956.8(b).

\* \* \* \* \*

(c) *Label Content and Location.*

\* \* \* \* \*

(4) For 2029 and later model year Tier 5 off-road compression-ignition engines, the label content and location shall comply with the requirements in Part III: 40 CFR PART 1039, Subpart B, section 1039.135 of the "2029 and Later Test Procedures."

\* \* \* \* \*

(l) An emission control information label shall not be altered or removed from an engine, subject to civil penalty under State law, except that a dealer or distributor may remove an incorrect label, prior to the transfer of title of the engine to an ultimate purchaser, and replace the incorrect label with the correct label supplied by the certifying manufacturer or an authorized agent. For the purpose of this section, an incorrect label means an emission control information label that was affixed to an engine in good faith by the certifying manufacturer or authorized agent, but which fails to accurately describe the engine's emission performance as required under this Article due to unintentional or clerical error. In this context, good faith means an honest intent to act without seeking to gain an unfair advantage or to circumvent the regulations. Notwithstanding, an emission control label may be removed and replaced according to the labeling provisions for rebuilt engines in title 13, CCR, §

section 2423, subsection (l) or section 2423.1, subsection (q)(2), as applicable. For new replacement engines manufactured in accordance with the provisions of title 13, CCR, § section 2423, subsection (j) or section 2423.1, subsection (o), as applicable, a dealer or distributor may affix supplemental labels, prior to the transfer of title of the engine to an ultimate purchaser, as allowed in title 13, CCR, § section 2423, subsection (j)(1) or section 2423.1, subsection (o)(1), as applicable. Other provisions in § 1068.101(b)(7) of the "2011-2028 and Later Test Procedures," Part I-E, or in Part V: 40 CFR PART 1068, Subpart B, section 1068.101, subsection (b)(7) of the "2029 and Later Test Procedures," as applicable, may also apply.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102, and 43104, Health and Safety Code. Reference: Sections 43013, 43016, 43017, 43018, 43101, 43102, 43104, and 43105, 43154, Health and Safety Code.

12. Amend Title 13, CCR, Chapter 9, Article 4, Section 2425 to read as follows:

**§ 2425. Defects Warranty Requirements for 1996 and Later Off-Road Compression-Ignition Engines.**

(a) *Applicability.* This section shall apply to new 1996-1999 model year heavy-duty off-road compression-ignition engines and new 2000 and later model year compression-ignition engines. For 2011 and later model year compression-ignition engines that certify to title 13, CCR, section 2423, the requirements in § 1039.120 and § 1039.125 of the "2011-2028 and Later Test Procedures," Part I-D, shall also apply. For compression-ignition engines that certify to title 13, CCR, section 2423.1, the requirements in Part III: 40 CFR PART 1039, Subpart B, section 1039.120 and Part V: 40 CFR PART 1068, Subpart B, sections 1068.101, 1068.110, and 1068.115 of the "2029 and Later Test Procedures" shall apply. The warranty period shall begin on the date the engine or equipment is delivered to an ultimate purchaser. The use of alternate fuels shall not void the warranties on any engine certified to use such fuel.

(b) *General Emissions Warranty Coverage.* The manufacturer of each off-road compression-ignition engine shall warrant to the ultimate purchaser and each subsequent purchaser that the engine is:

(1) Designed, built, and equipped so as to conform with all applicable regulations adopted by the California Air Resources Board pursuant to its authority in Chapters 1 and 2, Part 5, Division 26 of the California Health and Safety Code; and

(2) Free from defects in materials and workmanship which cause the failure of a warranted part to be identical in all material respects to the part as described in the engine manufacturer's application for certification as follows:

(A) Engines Certified to title 13, CCR, section 2423.

1. The general emission warranty coverage shall apply for a period of five years or 3,000 hours of operation, whichever occurs first, for all engines rated at 19kW and greater, except as noted below. In the absence of a device to measure hours of use, the engine shall be warranted for a period of five years.

2. For all engines rated less than 19kW, and for constant-speed engines rated under 37kW with rated speeds higher than or equal to 3,000 rpm, the general emission warranty coverage shall apply for a period of two years or 1,500 hours of operation, whichever occurs first, ~~shall apply~~. In the absence of a device to measure hours of use, the engine shall be warranted for a period of two years.

(B) Engines Certified to title 13, CCR, section 2423.1.

1. For all engines rated at less than 19 kW, the general emission warranty coverage shall apply for a period of three years or 1,500 hours of operation, whichever occurs first. In the absence of a device to measure hours of use, the engine shall be warranted for a period of three years.

2. For constant-speed engines rated at greater than or equal to 19 kW and less than 37 kW that operate at a rotational speed greater than or equal to 3,000 revolutions per minute (RPM), the general emission warranty coverage shall apply for a period of three years or 1,500 hours of operation, whichever occurs first. In the absence of a device to measure hours of use, the engine shall be warranted for a period of three years.

3. For constant-speed engines rated at greater than or equal to 19 kW and less than 37 kW that operate at a rotational speed less than 3,000 RPM and for all variable speed engines rated at greater than or equal to 19 kW and less than 37 kW, the general emission warranty coverage shall apply for a period of eight years or 3,000 hours of operation, whichever occurs first. In the absence of a device to measure hours of use, the engine shall be warranted for a period of eight years.

4. For all engines rated at greater than or equal to 37 kW, the general emission warranty coverage shall apply for a period of eight years or 3,000 hours of operation, whichever occurs first. In the absence of a device to measure hours of use, the engine shall be warranted for a period of eight years.

(c) The warranty on emissions-related parts shall be interpreted as follows:

\* \* \* \* \*

(3) Warranty on Parts Replaced During Scheduled Maintenance.

(A) Prior to, and not including, the 2029 model year, Any warranted part which that is scheduled for replacement as required maintenance in the written instructions required in subsection (e) shall be warranted for the period of time prior to the first scheduled replacement point for that part. If the part fails prior to the first scheduled replacement, the part shall be repaired or replaced by the engine manufacturer according to subsection (4) below. Any such part repaired or replaced under warranty shall be warranted for the remainder of the period prior to the first scheduled replacement point for the part.

(B) In 2029 and subsequent model years, all emission-related components covered under this section 2425 shall be warranted throughout the full warranty period regardless of their minimum allowable maintenance interval.

\* \* \* \* \*

(10) Add-on or modified parts, as defined in Section 1900(b)(1) and (b)(10), Title 13, that are not exempted by the California Air Resources Board may not be used. The use of any non-exempted add-on or modified parts shall be grounds for disallowing a warranty claim made in accordance with this article. The engine manufacturer shall not be liable under this article to warrant failures of warranted parts caused by the use of a non-exempted add-on or modified part.

\* \* \* \* \*

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102, 43104 and 43105, Health and Safety Code. Reference: Sections 43013, 43016, 43017, 43018, 43101, 43102, 43154, and 43205.5, Health and Safety Code.

13. Amend Title 13, CCR, Chapter 9, Article 4, Section 2425.1 to read as follows:

**§ 2425.1. Defect Investigation and Reporting Requirements.**

(a) *Applicability.* This section shall apply to new off-road compression-ignition engines subject to the standards in title 13, CCR, Ssection 2423, subsection (b)(1)(B) and the incorporated "2008-2010 Test Procedures," or "2011-2028 and Later Test Procedures," as applicable, or to the standards in title 13, CCR, section 2423.1 and the incorporated "2029 and Later Test Procedures," and shall address defects for any of the emission-related components, or systems containing the components listed in title 13, CCR, Ssection 2425, subsection (d)(1).

(b) *General Requirements.* Engine manufacturers shall investigate their engines that have been introduced into commerce in California for incorrect, improperly installed, or otherwise defective emission-related components or systems, and shall submit a report to the CARB through [eFILE@arb.ca.gov](mailto:eFILE@arb.ca.gov) based on federal triggering thresholds documenting these activities, as required, and their findings. If available, California-specific incidence rates shall also be included in this report.

(c) *Investigation and Reporting Procedures.* Engine manufacturers shall perform the investigation and reporting procedures specified in Part 1068, Subpart F of the "2008-2010 Test Procedures," or Part I-EE of the "2011-2028 and Later Test Procedures," or Part V: 40 CFR PART 1068, Subpart B, sections 1068.101 and 1068.115 and Subpart F, section 1068.501 of the "2029 and Later Test Procedures," as applicable.

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102, 43104 and 43105, Health and Safety Code. Reference: Sections 43013, 43016, 43017, 43018, 43101, 43102, 43154, and 43205.5, Health and Safety Code.



14. Adopt new Title 13, CCR, Division 3, Chapter 9, Article 4, Section 2425.2 to read as follows:

Note: The entire text of section 2425.2 set forth below is new language and is shown in “normal type” proposed to be added to the California Code of Regulations.

**§ 2425.2. Required Off-Road Compression-Ignition Engine Recall and Corrective Action for Failures of Emission-Related Components.**

(a) A manufacturer of off-road compression-ignition engines shall recall an engine family, test group, or subgroup of pieces of equipment or engines and provide an extended warranty for the components that are replaced to correct the systemic failure, as defined in title 13, CCR, section 2166.1, of an exhaust aftertreatment device, on-board computer or system, urea doser, hydrocarbon injector, exhaust gas recirculation valve, exhaust gas recirculation cooler, turbocharger, fuel injector, or functional equivalent when the number of valid failures meets or exceeds the corrective action thresholds, as determined by the Executive Officer pursuant to title 13, CCR, section 2143, following the procedures specified in Part V: 40 CFR PART 1068, Subpart F, sections 1068.501 through 1068.535 of the “2029 and Later Test Procedures.” The manufacturer shall submit a corrective action plan to the Executive Officer no later than 90 calendar days after the corrective action threshold specified in title 13, CCR, section 2143 has been exceeded.

(b) A manufacturer of off-road compression-ignition engines shall perform corrective action when the number of valid failures meets or exceeds the corrective action thresholds, as determined by the Executive Officer pursuant to title 13, CCR, section 2143. The corrective action shall follow the procedures specified in Part V: 40 CFR PART 1068, Subpart F, sections 1068.501 through 1068.535 of the “2029 and Later Test Procedures.” An example of a corrective action is providing an extended warranty as defined in title 13, CCR, section 2421.1, to correct the systemic failure, as defined in title 13, CCR, section 2166.1, of an emission control component other than an exhaust aftertreatment device, on-board diagnostic computer and system, urea doser, hydrocarbon injector, exhaust gas recirculation cooler, turbocharger, fuel injector, or functional equivalent. The corrective action plan shall be submitted no later than 90 calendar days after the corrective action threshold specified in title 13, CCR, section 2143 has been exceeded.

(c) The Executive Officer may determine a recall is necessary pursuant to title 13, CCR, section 2148 for the circumstances specified in subsection (b).

NOTE: Authority cited: Sections, 39003, 39500, 39600, 39601, 43000.5, 43013, 43018, 43204, 43205.5, and 43214, Health and Safety Code; Engine Mfrs Assn v. California Air Resources Board, (2014) 231 Cal. App.4th 1022. Reference: Sections 43000, 43016, 43100, 43101, 43102, 43106, 43154, Health and Safety Code.

15. Amend Title 13, CCR, Chapter 9, Article 4, Section 2427 to read as follows:

**§ 2427. Production Engine Testing, Selection, Evaluation, and Enforcement Action.**

\* \* \* \* \*

(c) *Selective Enforcement Audit.*

(1) Applicable Test Procedures

\* \* \* \* \*

(B) The 2008 and later model year Tier 4 off-road compression-ignition engines certified for sale in California shall be subject to the Selective Enforcement Audit requirements specified in Subpart E of Part 1068 of the 2008-2010 Test Procedures or Part I-E of the 2011-2028 and Later Test Procedures as applicable.

(C) The 2029 and later model year Tier 5 off-road compression-ignition engines for sale in California shall be subject to the Selective Enforcement Audit requirements specified in Part IV, Subpart E of the "2029 and Later Test Procedures."

(2) These procedures specify the Selective Enforcement Audit test procedures in conjunction with the "2000 Plus Limited Test Procedures," and the "2000 and Later Test Procedures," and the "2029 and Later Test Procedures," as applicable. An engine is in compliance with these Selective Enforcement Audit standards and test procedures only when all portions of these Selective Enforcement Audit test procedures are fulfilled.

(3) California Air Resources Board (CARB) personnel and mobile laboratories shall have access to engine or equipment assembly plants, distribution facilities, and test facilities for the purpose of engine selection, testing, and observation. Scheduling of access shall be arranged with the designated manufacturer's representative and shall not unreasonably disturb normal operations.

\* \* \* \* \*

NOTE: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43102, 43104, and 43105, Health and Safety Code. Reference: Sections 43013, 43016, 43017, 43018, 43101, 43102, 43104, and 43154, 43210, 43210.5, 43211, and 43212, Health and Safety Code.

16. Amend Title 13, CCR, Chapter 9, Article 4.8, Section 2449 to read as follows:

**§ 2449. General Requirements for In-Use Off-Road Diesel-Fueled Fleets.**

\* \* \* \* \*

(d) *Performance Requirements* -

\* \* \* \* \*

(6) *Adding Vehicles* - With the exception noted below for fleets owned by lessors of vehicles, the requirements in (A) through (H) below apply to all fleets. Fleets owned by lessors are not subject to (A) through (H) for vehicles owned by the lessor and returned to the lessor fleet at the end of a lease if the vehicles were included in the fleet of the lessee for the compliance year in question. Vehicles returned to a lessor fleet must, however, be included in the lessor fleet's fleet average demonstration on subsequent compliance dates. For the purposes of this requirement, a vehicle may be assumed to meet the engine emission standard tier in effect for the model year of the engine.

\* \* \* \* \*

(l) Ban on adding vehicles that are not California-certified - Beginning January 1, 2029, for large, medium, and small fleets, a fleet shall not add a model year 2029 or later vehicle with an engine that is not certified to the requirements in title 13, CCR, division 3, chapter 9, article 4, regardless of the number of hours on the engine's hour-meter, with the exception of:

1. Federally certified engines that fall within the scope of Section 209(e)(1) of the Federal Clean Air Act (42 U.S.C. § 7543(e)(1)) and as defined by regulation of the U.S. EPA;

2. Federally certified engines that do not fall within the scope of Section 209(e)(1) of the Federal Clean Air Act (42 U.S.C. § 7543(e)(1)) that have been certified to exhaust emission standards that are at least as stringent as the applicable standards in title 13, CCR, division 3, chapter 9, article 4. The existing prohibitions for adding vehicles to fleets in this section 2449(d) continue to apply.

3. New replacement engines produced under the federal provisions in 40 CFR Part 1068.240 to replace 2029 and subsequent model year engines that have the same physical and performance characteristics of the engines being replaced, and which do not fall within the scope of Section 209(e)(1) of the Federal Clean Air Act (42 U.S.C. § 7543(e)(1)).

\* \* \* \* \*

NOTE: Authority cited: Sections 39002, 39003, 39515, 39516, 39600, 39601, 39602, 39602.5, 39650, 39656, 39658, 39659, 39665, 39667, 39674, 39675, 39730.8(c), 40000, 41511, 42400, 42400.1, 42400.2, 42400.3.5, 42402, 42402.1, 42402.2, 42402.4, 42403, 43000, 43000.5, 43013, 43016, 43018, 43018.2 and 43600, Health and Safety Code. Reference: Sections 39000, 39002, 39003, 39515, 39516, 39600, 39601, 39602, 39602.5, 39650, 39656, 39657, 39658, 39659, 39665, 39667, 39674, 39675, 39730.8(c), 40000, 41511, 42400, 42400.1, 42400.2, 42402.2, 43000, 43000.5, 43013, 43016, 43018, 43018.2, 43154, 43600, 43865 and 43866, Health and Safety Code.