

**Innovative Technology Regulation (ITR): February 25, 2016
New Heavy-Duty Engine and Vehicle Certification Public Work Group Meeting
POTENTIAL DRAFT REGULATORY LANGUAGE FOR STAKEHOLDER REVIEW**

This document provides potential draft regulatory language for the innovative new heavy-duty engine technology element of the proposed ITR and is intended for stakeholder review at the February 25, 2016 ITR New Heavy-Duty Engine and Vehicle Certification Public Work Group meeting. This document is only intended to encourage public feedback, is incomplete, and should not be construed as a formal regulatory proposal. Staff comments to facilitate stakeholder review are provided in blue test boxes. This document includes the following potential draft regulatory sections:

- **Section 2208: ITR Purpose, Applicability and Definitions**
- **Section 2208.1: New Heavy-Duty Engine or Vehicle Certification Flexibility.**
This draft language addresses the following potential sections:
 - 1) General Requirements
 - 2) Optional low NOx engine eligibility criteria and flexibility;
 - 3) Heavy-duty hybrid engine eligibility criteria and flexibility; and
 - 4) Other new, potentially transformational heavy-duty engine technology eligibility criteria and flexibility.

Attachment 1 summarizes the potential draft regulatory structure and concepts described in this draft document.

Possible draft emission test procedures for new heavy-duty hybrid engines and vehicles participating in ITR were discussed at the January 27, 2016 ITR Hybrid Technology Interim Emission Test Procedures public work group meeting are also still under development (additional information is available at: <http://www.arb.ca.gov/msprog/itr/meetings.htm>). Potential draft regulatory language for section 2208.2: Medium- and Heavy-Duty Vehicle Hybrid Conversion System Certification Requirements is provided in a separate document (also available for review at: <http://www.arb.ca.gov/msprog/itr/meetings.htm>) for discussion at the February 25, 2016 Hybrid Conversion System public work group meeting.

(a.) Purpose

This regulation sets forth targeted, optional California Air Resources Board (ARB) certification and on-board diagnostics (OBD) approval flexibility to encourage market launch and early deployment of the potentially transformational on-road heavy-duty engine technologies that California needs to meet its long-term air quality, greenhouse gas, and petroleum reduction goals, including engines meeting California's optional low oxide of nitrogen (NOx) emission standards, hybrid engines, and other potentially transformative new heavy-duty engine technology. This regulation also defines protocols for ARB approval of innovative medium- and heavy-duty vehicle hybrid

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conversion systems, in order to encourage California deployment of robust hybrid technology in the existing truck and bus fleet.

(b.) *Applicability*

This regulation applies to the following:

- (1) a 2016 or subsequent model year engine certifying to optional low NO_x emission standards set forth in Title 13, Section 1956.8(a)(2)(A) of the California Code of Regulations (CCR) (13 CCR 1956.8(a)(2)(A) as amended on December 5, 2014). These standards are 0.10 grams per brake-horsepower-hour (g/bhp-hr), 0.05 g/bhp-hr, and 0.02 g/bhp-hr NO_x;
- (2) a 2016 or subsequent model year engine certified for use in a heavy-duty hybrid vehicle (hybrid engine) demonstrates the ability to achieve a minimum ten percent carbon dioxide (CO₂) emission benefit without increasing criteria pollutant emissions, pursuant to the emission testing protocols identified in Attachment A ;

Potential technology (3), below, would include potentially transformative new engine technology that provides significant efficiency improvement relative to existing heavy-duty engine technology. Staff welcomes stakeholder comment regarding appropriate performance based metrics for defining such technology. These could potentially include requiring the engine have the ability to: 1) achieve ~50 percent engine brake thermal efficiency at 65 mph cruise; 2) achieve a 20 percent CO₂ benefit at 65 mph cruise; or 3) meet an optional low NO_x standard and achieve 10 percent CO₂ benefit at 65 mph cruise. Staff anticipates an advanced free piston, opposed piston or camless engine might be ITR eligible pursuant to this section.

- (3) a 2016 or subsequent model year heavy-duty engine certifying to the emission standards set forth in 13 CCR 1956.8(a)(2)(A) that achieves at least X (*tbd, see above*); and
- (4) a hybrid conversion system for a 2007 and subsequent model year (MY) California-certified medium-duty vehicle or a 2010 and subsequent MY heavy-duty vehicle with a California certified 2010 or newer MY engine that demonstrates the ability to achieve a minimum ten percent CO₂ emission benefit without increasing criteria pollutant emissions, pursuant to the emission testing protocols identified in Attachment A.

(c.) *Definitions*

“All-electric range” or “AER” means the total miles driven electrically (with the engine off) before the engine turns on for the first time, after the battery has been fully charged, determined pursuant to the applicable requirements identified in Attachment A.

“Applicant” or “manufacturer” means any person who manufactures an engine, vehicle, or hybrid conversion system for sale in California and requests engine certification flexibility of hybrid conversion system certification pursuant to this regulation.

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“Average” means the arithmetic mean.

“Base vehicle” or “base engine” means the appropriate California certified configuration of a pre-converted or non-hybrid conventional vehicle to be used for comparison with its hybrid counterpart for the purposes of determining the emission impact of the hybrid vehicle’s hybrid system.

Much of ITR is structured to allow a specific “engine family” to comply with gradually increasing certification requirements over time. However, the term “engine family” generally only refers to a specific engine technology in a specific model year. The following model year an identical engine from the same manufacturer would have a new engine family name to reflect the newer model year (as reflected by a new first character in the engine family name). The term “carryover engine family”, below, is intended to identify the same engine family from the same manufacturer in a new model year.

“Carryover engine family” means an engine family that is functionally equivalent to and meets the same durability requirements and emission standards as an engine family certified by ARB in a previous model year. A carryover engine family typically utilizes the same engine family name as the previously certified engine family, with the exception of the first character, which is indicative of the new model year.

“Class 2b vehicle” refers to a vehicle between 8,501 and 10,000 pounds gross vehicle weight rating (GVWR).

“Class 3 vehicle” refers to a vehicle between 10,001 and 14,000 pounds GVWR.

“Class 8 tractor” means a Class 8 motor vehicle with a gross vehicle weight rating of greater than 33,000 pounds GVWR designed to pull a 53-foot or longer semitrailer on a highway by means of a fifth wheel mounted over the rear axle(s).

“Commercial vehicle” means a motor vehicle or combination of motor vehicles as defined in California Vehicle Code, section 260.

“Common ownership or control” means being owned or managed day to day by the same person, corporation, partnership, or association. Entities managed by the same directors, officers, or managers, or by corporations controlled by the same majority stockholders are considered to be under common ownership or control even if their title is held by different business entities.

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

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“Executive Officer” means the Executive Officer of the ARB or the Executive Officer’s designee.

“Gross vehicle weight rating” or “GVWR” means the “GVWR” as defined in California Vehicle Code section 350.

“Heavy-duty vehicle” means any motor vehicle having a manufacturer’s GVWR greater than 14,000 pounds.

“Hybrid vehicle” refers to a vehicle that has both of the following on-vehicle sources of stored energy and can draw propulsion energy from the source mentioned in 2): 1) a consumable fuel and 2) an energy storage device such as a battery, capacitor, pressure reservoir, or flywheel.

“Low NOx engine” or “optional low NOx engine” refers to an on-road heavy-duty engine that is certified to a NOx emissions level of 0.10 g/bhp-hr, 0.05 g/bhp-hr or 0.02 g/bhp-hr pursuant to 13 CCR 1956.8(a)(2)(A) as amended on December 5, 2014.

“Medium-duty vehicle” means a medium-duty vehicle as defined in Section 1900, title 13, CCR.

“Urban bus” means a passenger-carrying vehicle owned or operated by a public transit agency, powered by a heavy heavy-duty engine, or of a type normally powered by a heavy heavy-duty diesel engine, intended primarily for intra-city operation. A bus normally powered by a heavy heavy-duty diesel engine is usually 35 feet or longer, and/or greater than 33,000 pounds GVWR.

§ 2208.1: Certification Flexibility for Innovative Heavy-Duty Engine and Vehicle Technology

(a) Overview

(1) Section 2208.1 of this regulation provides optional, targeted, near-term certification flexibility to help encourage early California certification and market introduction of new heavy-duty engines certified to California’s 0.1 g/bhp-hr, 0.05 g/bhp-hr or 0.02 g/bhp-hr NOx standard, hybrid heavy-duty engines, or more efficient heavy-duty engines capable of achieving *(tbd)* at 65 miles per hour cruise.

(2) A new engine family meeting the eligibility criteria of subsections (c), (d), and (e) is eligible for the subsection’s applicable provisions when certifying the engine for sale in California.

(3) These interim test procedures supplement, and do not replace, California’s general procedures and requirements necessary to certify a heavy-duty engine for sale in California set forth in “California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Diesel Engines and Vehicles”, as

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incorporated in title 13, CCR, §1956.8(b), “California Exhaust Emission Standards and Test Procedures for 2004 and Subsequent Model Heavy-Duty Otto-Cycle Engines”, as incorporated in title 13, CCR §1956.8(d), for testing and compliance of heavy-duty diesel and Otto-cycle engines with exhaust emission standards and “California On-Board Diagnostic System Requirements for 2010 and Newer Model Year Heavy-Duty Engines”, as incorporated in title 13, CCR §1971.1.

(b) *General Requirements*

(1) *Demonstration of Surplus Emission Reductions.* The NO_x and CO₂ emission reductions achieved by a low-NO_x engine or a CO₂ reduction strategy, respectively, receiving certification flexibility pursuant to this regulation must not be required or assumed by any new engine or vehicle emission standard.

(A) *Low-NO_x Heavy-Duty Engine.* The NO_x reductions achieved or assumed by a low-NO_x engine family receiving certification flexibility pursuant to subsection 2208.1(c), or an engine family eligible for certification flexibility pursuant to subsection 2208.1(e) must not be required or assumed by any new engine or vehicle emission standard. Averaging, banking or trading of NO_x emission reductions or credits achieved by any such engine family is also prohibited.

(B) *Other Heavy-Duty Engines.* The CO₂ reductions achieved or assumed by a hybrid engine family receiving certification flexibility pursuant to subsection 2208.1(d) or any engine family eligible for certification flexibility pursuant to subsection 2208.1(e) must not be required or assumed by any new engine or vehicle emission standard. Averaging, banking or trading of CO₂ emission reductions or credits achieved by any such engine family is also prohibited.

(C) Notwithstanding all provisions of this regulation, certification flexibility for any engine family may be revoked if at any time it no longer meets the requirements of subsection 2208.1(a)(1) due to adoption of a rule, regulation or other air quality mandate.

(1.1) Subsection 2208.1(b)(1) is applicable to engine or vehicle manufacturers.

(2) *Anti-Backsliding Provisions.* An engine family or vehicle model shall not be eligible for any certification or OBD flexibility provision of this regulation if the same or a virtually identical engine family has previously met said provision when certified by ARB or the United States Environmental Protection Agency (US EPA) in any model year.

(A) For an engine family subject to subsection 2208.1(d)(2), any deficiency related to a manufacturer being required to meet a provision of subsections 2208.1(d)(2.1) or (d)(2.2) shall be exempt from the specified fines of section 1971.1(k)(2) and the deficiency shall not be included in the determination of the number of deficiencies subject to fines.

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(B) An engine family which is not eligible for provisions of subsections 2208.1(d)(2.1) or (d)(2.2) because of the requirements of subsection 2208.1(b)(2) is exempt from requirements of section 1971.1(k)(4).

(3) *Labeling Requirements.*

(3.1) An engine receiving ITR certification flexibility pursuant to this regulation must be clearly and permanently labeled with the following language in a location where it can be seen by a person viewing the Engine Emission Control Information Label:

This engine has received certification flexibility from the California Air Resources Board based upon being classified as an innovative technology pursuant to California Health and Safety Code 2208.1 and may be subject to alternate durability, diagnostic and other California certification requirements pursuant to section 2208.1, title 13, CCR. Engine Executive Order Number: *insert California Air Resources Board engine Executive Order number here.*

Label text identified above in *italics* is not to be included on the label; this information provides labeling instructions only.

(c) *Certification Flexibility for Early Market Introduction of Low NOx Engines*

As described below, a manufacturer of a SI engine meeting the 0.05 or 0.02 g/bhp-hr NOx standard would be eligible for ITR for up to three MYs, through the 2021 MY, beginning in the first MY it receives ITR certification flexibility for a SI engine meeting one of those two optional NOx standards.

A manufacturer of a CI engine meeting the 0.1, 0.05, or 0.02 g/bhp-hr NOx standard would be eligible for ITR for up to three MYs for engines meeting each of those standards, through the 2024 MY, beginning in the first MY it certifies a CI engine to each low NOx standard utilizing ITR flexibility. For example, if a manufacturer first certifies a 0.1 g/bhp-hr NOx engine in the 2018 MY, all its CI 0.1 g/bhp-hr NOx engines would be ITR-eligible in 2018, 2019, and 2020 MYs. If the same manufacturer first certifies its 0.05 g/bhp-hr NOx engine in 2020, all its CI 0.05 g/bhp-hr NOx engines would be ITR-eligible in the 2020, 2021, and 2022 MYs. ITR flexibility for CI low-NOx engines would sunset after the 2024 MY.

(1) *Eligibility.*

(A) *Spark-ignition Low-NOx Engine Family.* A manufacturer shall be eligible to certify a spark-ignition heavy-duty engine family meeting the 0.05 or the 0.02 g/bhp-hr NOx heavy-duty engine emission standard pursuant to the provisions of subsection 2208.1(c)(2) for up to three MYs.

1. Eligibility of a spark-ignition engine family for said provisions shall sunset in the fourth model year after that manufacturer first certifies a low-NOx spark-ignition engine family to either 0.05 or 0.02 g/bhp-hr NOx emission standard utilizing

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certification flexibility pursuant to subsection 2208.1(c)(2) or (3), or shall sunset as of the 2022 MY, whichever is sooner.

2. A spark-ignition engine family meeting a low-NO_x emission standard shall be ineligible for provisions of subsection 2208.1(c)(3) beginning in the 2020 MY.

(B) *Compression-ignition Low-NO_x Engine Family.* A compression-ignition engine family meeting the 0.10, 0.05 or 0.02 g/bhp-hr NO_x heavy-duty engine emission standard shall be eligible for the provisions of subsection 2208.1(c)(2) for up to three MYs.

1. A manufacturer's eligibility to certify a compression-ignition engine family meeting the 0.10 g/bhp-hr NO_x standard pursuant to subsection 2208.1(c)(2) shall sunset in the fourth model year after that manufacturer first certifies a compression-ignition engine family meeting the 0.10 g/bhp-hr NO_x standard utilizing certification flexibility pursuant to subsection 2208.1(c)(2) or (3), or shall sunset as of the 2025 MY, whichever is sooner.

2. A manufacturer's eligibility to certify a compression-ignition engine family meeting the 0.05 g/bhp-hr NO_x standard pursuant to subsection 2208.1(c)(2) shall sunset in the fourth model year after that manufacturer first certifies a compression-ignition engine family meeting the 0.05 g/bhp-hr NO_x standard utilizing certification flexibility pursuant to subsection 2208.1(c)(2) or (3), or shall sunset as of the 2025 MY, whichever is sooner.

3. A manufacturer's eligibility to certify a compression-ignition engine family meeting the 0.02 g/bhp-hr NO_x standard pursuant to subsection 2208.1(c)(2) shall sunset in the fourth model year after that manufacturer first certifies a compression-ignition engine family meeting the 0.02 g/bhp-hr NO_x standard utilizing certification flexibility pursuant to subsection 2208.1(c)(2) or (3), or shall sunset as of the 2025 MY, whichever is sooner.

(2) *Low NO_x Engines: Certification Flexibility Provisions.* A heavy-duty low-NO_x engine family that meets the requirements of subsection 2208.1(b) and (c)(1) shall be eligible for the following flexibility when certified by ARB.

Assigned Deterioration Factors. Staff welcomes stakeholder comment regarding potential DF flexibility to encourage certification of optional low-NO_x engines (see placeholder section (A), below). One potential concept could be to allow an engine family that utilizes an assigned DF not count towards the maximum of 300 engines sold during ITR-eligible MYs. Staff requests stakeholder comment regarding this concept, and any other stakeholder recommendations regarding potential use of assigned DFs for low-NO_x or other ITR-eligible technologies.

(A) *Assigned Deterioration Factors.* *tbd (see text box, above).*

(B) *OBD System Requirements.* All vehicles are required to comply with the OBD system requirements described in Title 13 California Code of Regulations section 1971.1 (13 CCR 1971.1) and 1971.5 (13 CCR 1971.5), as modified,

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approved and filed on July 31, 2013, except for the allowances described in subsections (c)(3.1)(B)(1) through (5) below.

1. *OBD System Demonstration.*

a. For determining the number of engines for OBD demonstration testing as described in 13 CCR 1971.1 section (i)(2.2.3), five engine families per model year that have been approved by the Executive Officer for low NOx engine Tier 1 certification flexibility will be excluded from calculation of a manufacturer's total number of engine families for the purposes of this subsection (e.g., a manufacturer that includes one approved Tier 1 low NOx engine family out of a total of 11 engine families for a model year would have an adjusted total of 10 engine families for determining the number of OBD demonstration test engines).

2. *Production Engine Evaluation Testing.* For production evaluation testing described in 13 CCR 1971.1 sections (l)(1) through (l)(3), manufacturers shall collect and report the data to ARB within twelve months after the production vehicles were first introduced into commerce.

a. *Verification of Standardized Requirements.* In lieu of the test vehicle selection criteria specified in 13 CCR 1971.1 sections (l)(1.2.1) through (1.2.3), the manufacturer shall test up to two unique production vehicles within an engine family.

b. *Verification and Reporting of In-use Monitoring Performance.* For testing described in 13 CCR 1971.1 section (l)(3), manufacturers shall submit a plan to the Executive Officer for review and approval that details the types and number of production vehicles to be tested, the sampling method, the time line to collect the data, and the reporting format. The Executive Officer shall approve the plan upon determining that it provides for effective collection of data from a sample of vehicles that, at a minimum, is ten percent of the total vehicles produced for sale in California per monitoring performance group, will likely result in the collection and submittal of data within the required time frame, will generate data that are representative of California drivers and exhaust temperatures, and does not, by design, exclude or include specific vehicles in an attempt to collect data only from vehicles with the highest in-use performance ratios.

3. *Calculation of Fines for Deficiencies.* Up to four deficiencies per engine family related to monitoring of a technology needed to meet an engine's low-NOx emission level shall not be included in the count of deficiencies used in 13 CCR 1971.1 section (k)(2) to determine the number of deficiencies subject to fines.

4. *Ordered Remedial Action-Mandatory Recall for Emission Thresholds.* In lieu of the requirements specified in 13 CCR 1971.5 section (d)(3)(A)(ii), for major monitors required to indicate a malfunction before emissions exceed a certain emission threshold, the recall threshold is three times the applicable major monitor malfunction criteria (e.g., if the malfunction criteria is 2.5 times the applicable standard, recall would be required when emissions exceed 7.5 times the applicable standard, or if the malfunction criteria is the PM standard plus 0.02

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g/bhp-hr and the PM standard is 0.01 g/bhp-hr, recall would be required when emissions exceeded 0.09 g-bhp-hr).

Multiple Low-NOx Engine Families (below): This subsection would provide an additional option to encourage manufacturers to bring multiple low-NOx engines to market in a single model year. This would be open only to engine families that had not previously participated in ITR or met full HD OBD. One low-NOx engine could potentially “overcomply” with ITR by meeting full HD OBD in the first year of ITR eligibility (and all subsequent years), in order for a second low-NOx engine to receive greater ITR flexibility for one MY (and then meet full OBD in all subsequent years).

(3) *Multiple Low-NOx Engine Option.*

(A) A manufacturer with two low-NOx engine families that meet the requirements of subsection (c)(1) and have not received ITR certification flexibility in any previous model year may designate one of these engines as an “early compliance” engine family and the other as an “enhanced flexibility” engine family.

1. This early compliance engine family and an enhanced flexibility engine family and any of their carryover or potential carryover engine families shall be ineligible for the provisions of subsection 2208.1 (c)(2) in the current and future model years.

(B) Both the early compliance and the enhanced flexibility engine family shall be deemed as participating in the ITR and shall meet the requirements of subsections 2208.1(b)(1) and (b)(2) for three consecutive model years, beginning with their first year of ITR eligibility.

(C) The “early compliance” engine family is exempt from engine labeling requirements of subsection 2208.1(b)(3).

(D) The “enhanced flexibility” engine family:

1. is exempt from meeting emission threshold monitoring requirements identified in 13 CCR 1971.1 sections (e) through (f) for the current model year.

2. shall comply with engine labeling requirements of subsection 2208.1(b)(3) in the current model year, and is exempt from engine labeling requirements of subsection 2208.1(b)(3) in subsequent model years.

3. shall comply with all requirements of 13 CCR 1971.1 in all subsequent model years.

(d) *Certification Flexibility for Early Market Introduction of Heavy-Duty Hybrid Engines*

As described below, all hybrids would have to demonstrate at least a ten percent CO₂ benefit with no NO_x, CO, or HC increase pursuant to the ITR interim hybrid emission test procedures (Attachment A, under development) to participate in ITR.

A hybrid heavy-duty engine in a vehicle not capable of 35 miles all-electric range (AER) would be eligible for up to two MYs of Tier 1 flexibility and up to two MYs of Tier 2 flexibility, with eligibility sunsetting after the 2021 MY. A hybrid urban bus engine certified for use in an urban bus not capable of at least 35 miles AER would be ineligible for ITR.

A hybrid heavy-duty engine capable of 35 miles AER would be eligible for up to four MYs of Tier 1 flexibility and up to two MYs of Tier 2 flexibility, with eligibility sunsetting after the 2024 MY.

(1) *Eligibility.*

(A) A hybrid heavy-duty engine must demonstrate achievement of at least ten percent CO₂ emission benefit and no increase in key criteria pollutants pursuant to the emission test procedures identified in Attachment A to be eligible for provisions of subsections 2208.1(d)(2.1) and (2.2).

1. *Hybrid with less than 35 miles all-electric range (AER).* A manufacturer of a hybrid heavy-duty engine installed in a vehicle that does not demonstrate achievement of at least 35 miles AER pursuant to the procedures in Attachment A shall be eligible for certification flexibility identified in subsection 2208.1(d)(2.1)(i.e., “Tier 1” flexibility provisions) for a maximum of two consecutive MYs and subsequently eligible for certification flexibility identified in subsection 2208.1(d)(2.2) (i.e., “Tier 2” flexibility provisions) for a maximum of two additional consecutive model years.

a. A hybrid heavy-duty engine intended for use in a vehicle that achieves less than 35 miles AER shall be ineligible for the provisions of subsection 2208.1(d)(2.1) and (2.2) beginning in the 2022 MY.

2. *Hybrid with at least 35 miles AER.* A hybrid heavy-duty or urban bus engine family and its potential carryover engine families certified for use in a vehicle that demonstrates achievement of at least 35 miles AER pursuant to the procedures in Attachment A shall be eligible for the provisions of subsection 2208.1(d)(2.1) for a maximum of four consecutive MYs and subsequently for the provisions of subsection 2208.1(d)(2.2) for a maximum of two additional consecutive model years.

a. A hybrid heavy-duty or urban bus engine family intended for use with a driveline and chassis combination that achieves at least 35 miles AER shall be ineligible for provisions of subsection 2208.1(d)(2.1) or (2.2) beginning in the 2025 MY.

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(2) *ITR Hybrid Technology Certification Flexibility Provisions.* A heavy-duty hybrid engine family that meets the requirements of subsections 2208.1(b) and (d)(1) shall be eligible for the following flexibility when certified in the applicable model year by ARB.

(2.1) *Tier 1 Provisions.*

(A) *Diagnostic System Requirements.* All vehicles that qualify for Tier 1 Certification flexibility are required to implement an Engine Manufacturer's Diagnostic (EMD) system that meets the requirements described in 13 CCR 1971.1 section (d)(7.1.4).

Assigned Deterioration Factors. Staff welcomes stakeholder comment regarding potential flexibility to encourage certification of hybrid heavy-duty engine (see placeholder section (B), below). One potential concept could be to allow an engine family that utilizes an assigned DF not be held to a maximum of 300 engines sold during ITR-eligible MYs. Staff requests stakeholder comment regarding this concept, and any other stakeholder recommendations regarding potential use of assigned DFs for hybrid engines or other ITR-eligible technologies.

(B) *Assigned Deterioration Factors.* *tbd.*

(2.2) *Tier 2 Provisions.*

(A) *OBD System Requirements.* All heavy-duty vehicles are required to implement an OBD system that meets the requirements described in Title 13 California Code of Regulations § 1971.1 (13 CCR 1971.1) and 1971.5 (13 CCR 1971.5), as modified, approved and filed on July 31, 2013, except for the differences described in sections (b)(3.2)(B) (1.) through (5.), below

1. *OBD System Readiness Status Demonstration.* In accordance with SAE J1979/J1939-73 specifications, all heavy-duty hybrid engine families that have been approved for Tier 2 flexibility are required to demonstrate the OBD system can be set to "complete" since the fault memory was last cleared for each of the installed monitored components and systems identified in 13 CCR 1971.1 sections (e)(1) through (f)(9), and (g)(3) except (e)(11) and (f)(4). Similarly, all medium-duty vehicles are required to demonstrate the OBD system can be set to "complete" since the fault memory was last cleared for each of the installed monitored components and systems identified in 13 CCR 1968.2 sections (e)(1) through (e)(8), (e)(13), (e)(15), (f)(1) through (f)(9), (f)(13), and (f)(15).

2. *OBD System Demonstration.*

a. For determining the number of engines for OBD demonstration testing as described in 13 CCR 1971.1 (i)(2.2.3) and 13 CCR 1968.2(h)(2.2), one engine family per model year that has been approved by the Executive Officer hybrid engine Tier 2 certification flexibility will be excluded from calculation of a manufacturer's total number of engine families for the purposes of this section (e.g., a manufacturer that includes

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one approved Tier 2 hybrid engine family out of a total of 11 engine families for a model year would have an adjusted total of 10 engine families for determining the number of OBD demonstration test engines).

b. Except as provided in section (c)(3.2)(A)(iv)(c) below, hybrid vehicles that utilize a base engine in the hybrid vehicle design that has been previously certified to the full HD OBD system monitoring requirements of 13 CCR 1971.1 or OBD II system monitoring requirements of 13 CCR 1968.2, are exempt from the OBD system demonstration testing requirements of 13 CCR 1971.1 section (i)(3) and 13 CCR 1968.2 sections (h)(3) and (h)(4).

c. Any modifications that are made to a previously HD OBD or OBD II certified engine's OBD system will invalidate the OBD system demonstration testing exemptions described in (c)(3.2)(A)(iii)(b) for the monitors impacted by the modifications. The manufacturer may request Executive Officer approval to be exempt from demonstrating the affected monitors. The Executive Officer shall approve the exemption upon the manufacturer submitting data and/or analysis demonstrating that the monitor performance is not negatively impacted by the modifications such that the originally calibrated emission thresholds are likely to be met.

3. *Production Engine Evaluation Testing.* For production evaluation testing described in 13 CCR 1971.1 sections (l)(1) through (l)(3) and 13 CCR 1968.2 sections (j)(1) through (j)(3), manufacturers shall collect and report the data to ARB within twelve months after the production vehicles were first introduced into commerce.

a. *Verification of Standardized Requirements:* In lieu of the test vehicle selection criteria specified in 13 CCR 1971.1 sections (1.2.1) through (1.2.3) for heavy-duty engines, the manufacturer shall test up to five unique production vehicles within an engine family.

b. *Verification and Reporting of In-use Monitoring Performance.* For testing described in section 1971.1 (l)(3), manufacturers shall submit a plan to the Executive Officer for review and approval that details the types and number of production vehicles to be tested, the sampling method, the time line to collect the data, and the reporting format. The Executive Officer shall approve the plan upon determining that it provides for effective collection of data from a sample of vehicles that, at a minimum, is ten percent of the total vehicle produced for sale in California, will likely result in the collection and submittal of data within the required time frame, will generate data that are representative of California drivers and temperatures, and does not, by design, exclude or include specific vehicles in an attempt to collect data only from vehicles with the highest in-use performance ratios.

4. *Calculation of Fines for Deficiencies.* For deficiencies related to issues with the implementation of the hybrid system or of the hybrid system itself on plug-in heavy-duty hybrid vehicles, three additional deficiencies shall be exempt from the specified fines described in 13 CCR 1971.1 section (k)(3)

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and the deficiencies shall not be included in the count of deficiencies used in 13 CCR 1971.1 section (k)(2) to determine the number of deficiencies subject to fines.

(e) *Other Potentially Transformative New Engine and Vehicle Technology*

As mentioned earlier, this potential technology (A), below, would include potentially transformative new engine technology that provides significant efficiency improvement relative to existing heavy-duty engine technology. Staff welcomes stakeholder comment regarding appropriate performance based metrics for defining such technology (see section (2)(A), below). These could potentially include requiring the engine have the ability, at 65 mph cruise, to: 1) achieve ~50 percent engine brake thermal efficiency; 2) achieve a 20 percent CO₂ benefit; or 3) meet an optional low NO_x standard and achieve a specified percent CO₂ benefit. Staff anticipates an advanced free piston, opposed piston or camless engine might be ITR eligible pursuant to this section. Such technology would be subject to an annual California sales limit, tbd.

(1) *Overview.* A potentially transformative new heavy-duty engine family that has potential to achieve significant CO₂ and NO_x emission reductions or zero-emission heavy-duty vehicle enabling technology and has not been deployed in California prior to the 2017 MY is eligible for certification flexibility pursuant to this subsection. Said flexibility is dependent upon whether the technology represents a potentially transformative on-road heavy-duty new engine architecture pursuant to subsection 2208.1(e)(2), or represents a heavy-duty zero-emission enabling technology pursuant to subsection 2208.1(e)(4).

(1.1) *Manufacturer Sales Allowance.* A manufacturer's maximum allowable California sales allowance of all engine families that receive certification flexibility pursuant to subsection 2208.1(e) may not exceed a total of X (*tbd*) engines in a given model year.

(2) *Innovative On-Road Heavy-Duty Engine Eligibility.* A heavy-duty engine technology must meet the performance criteria identified in subsection 2208.1(e)(2)(A) and (B) to be eligible for the provisions of subsection 2208.1(e)(3):

(A) The engine must achieve at least X (*tbd, see discussion of potential performance criteria in text box above*) as a result of a new heavy-duty engine architecture. Such determination shall be based upon the Executive Officer's engineering evaluation of relevant emissions data and other information regarding the applicable technology, whether submitted by the applicant or available to ARB; and

(B) The technology has not been deployed as part of a heavy-duty engine family in a California fleet prior to the 2017 model year.

(3) *Innovative On-Road Heavy-Duty Engine Certification Flexibility.* An engine family and its potential carryover engine families shall be eligible for the provisions of

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subsection 2208.1(d)(3.1) for up to two consecutive MYs followed by the provisions of subsection 2208.1(d)(3.2) for up to two consecutive MYs.

(4) *Zero-Emission Heavy-Duty Vehicle Technology Eligibility.* An engine family that is certified pursuant to subsection 2208.1(e)(4)(A) or (B) and meets the eligibility requirements of subsection 2208.1(e)(4.1) shall be eligible for the certification pathway identified in subsections 2208.1(e)(6).

A zero-emission heavy-duty vehicle enabling technology would refer to a heavy-duty truck that utilizes a light- or medium-duty on-road engine (see (A), below) or an off-road engine (see (B), below) to range extend heavy-duty truck or bus operation beyond 35 miles AER. This engine would have to operate exclusively at steady-state and meet the other criteria identified in section 4.3, below. The truck or bus in which it is installed would have to chassis certify pursuant to ARB's *Hybrid Heavy-Duty Vehicle Test Procedures* (December 2013).

(A) A model year 2017 and later engine family that meets the requirements of subsection (e)(4.3)(A) through (E) and that will be installed in a heavy-duty hybrid vehicle that is certified pursuant to subsections 2208.1(e)(4.3)(F) may meet alternative emission standards as follows:

1. The engine must be of a configuration that is identical to one that is in a light- or medium-duty vehicle certified under CCR, Title 13, section 1961 or 1961.2.
2. The engine must meet all the requirements that apply under section 1961 or 1961.2, as applicable, instead of the comparable requirements of 1956.8. Treat these engines as part of the corresponding engine family under "light- or medium-duty on-road" for compliance purposes such as selective enforcement audits, in-use testing, defect reporting, and recall.
3. The engine must meet the following engine labeling requirements:
 - a. The engine shall meet requirements of 49 CFR section 1036.135.
 - b. The engine label shall include the ARB Executive Order number for the vehicle in which it was originally certified.
 - c. The ARB Hybrid Heavy-Duty Vehicle Executive Order number obtained pursuant to subsection 2208.1(e)(4.3)(F) shall be clearly visible under the vehicle hood.

(B) A model year 2017 and later engine family that meets the requirements of subsection (e)(4.3)(A) through (E) and that will be installed in a heavy-duty hybrid vehicle that is certified pursuant to subsections 2208.1(e)(4.3)(F) may meet alternative emission standards as follows:

1. The engine must be of a configuration that is identical to one that is certified under CCR, Title 13, section 2403, 2423 or 2433.
2. The engine must meet all the requirements that apply under section 2403, 2423 or 2433, as applicable, instead of the comparable requirements of 1956.8. Treat these engines as part of the corresponding engine family under "off-road"

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for compliance purposes such as selective enforcement audits, in-use testing, defect reporting, and recall.

3. The engine must meet Tier 4 off-road engine emission standards.
4. The engine must meet the following engine labeling requirements:
 - a. The engine shall meet requirements of 49 CFR section 1036.135.
 - b. The engine label shall include the ARB Engine Executive Order number.
 - c. The ARB Hybrid Heavy-Duty Vehicle Executive Order number shall be clearly visible under the hood.

(4.1) *Additional Engine Performance Requirements.*

- (A) The engine shall be an electronically-controlled engine with a fully functional electronic control unit (ECU).
- (B) The engine must be calibrated to run at steady state to power a battery or generator, and shall not be capable of directly propelling the vehicle in which it is installed.
- (C) The engine shall be installed in a vehicle capable of achieving at least 35 miles AER pursuant to the applicable criteria in Attachment A.
- (D) The engine must meet the most stringent emission standards for NOx and particulate matter for its size and classification.
- (E) If the engine is a diesel engine, it must be equipped with a certified diesel particulate filter that has been calibrated for steady-state operation.
- (F) The engine must be installed on a hybrid heavy-duty vehicle or urban bus that is chassis-certified pursuant to the *California Interim Certification Procedures for 2004 and Subsequent Model Hybrid-Electric and Other Hybrid Vehicles, in the Urban Bus and Heavy-Duty Vehicle Classes* (December 2013).

Any hybrid engine/vehicle participating in ITR would have to be data logged and provide the following summary information to ARB for three calendar years (see (2) *Data Collection*, below). Such information is intended to help ARB better evaluate hybrid truck and bus performance and emissions (in lieu of diagnostics capability) and inform potential ITR updates and hybrid technology certification procedures.

(5) *Data Collection and Reporting.* Each hybrid engine that receives certification flexibility pursuant to subsection 2208.1 (e)(6) or any vehicle in which such engine is installed, must be equipped to collect the following summary performance data for a minimum of three calendar years from the time that engine or vehicle is first deployed in a California fleet.

- (A) Data shall be presented as the average and mean among all vehicles, shall include a histogram distribution (at ten percent intervals), shall be segregated by calendar year and engine/hybrid drivetrain combination, and shall be up to date as of no more than 90 days prior to each subsequent model year engine certification application date for that hybrid engine family or its potential carryover engine families. The manufacturer shall also provide all data and all raw data supporting the data summaries to the Executive Order within ten days upon ARB request.

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1. Total miles traveled
2. Daily miles traveled (miles/day)
3. Speed without idle (miles/hour)
4. Fuel economy (miles/gallon)
5. Percent idle (vehicles with ePTO only)
6. Percent zero-emission operation (plug-in hybrids only)
7. Miles of continuous zero-emission operation at full charge (i.e., continuous zero-emission range, plug-in hybrids only)

(6) *Zero-Emission Heavy-Duty Vehicle Technology Certification Flexibility.* An engine family and its potential carryover engine families shall be eligible for the provisions of subsection 2208.1(d)(3.1) for up to X (*tbd*) consecutive MYs followed by the provisions of subsection 2208.1(d)(3.2) for up to two MYs.

(A) *Durability.* *tbd*

Heavy-duty diesel engines must demonstrate durability to 110,000, 185,000 or 435,000 miles, for light heavy-duty (LHD), medium-heavy-duty (MHD), or heavy-heavy-duty (HHD) engines, respectively. It may make sense to provide passenger vehicle and off-road engines time to meet durability requirements for this technology, particularly for heavy-heavy duty vehicles. Passenger vehicle engines that were originally certified with to meet light-duty OBD should have an easier time meeting heavy-duty OBD, but could have difficulty demonstrating 435,000 miles durability. On the other hand, an off-road engine might be more able to meet durability requirements but would likely face a greater challenge meeting HD OBD. How might ITR be structured to ensure reasonable progress towards meeting full HD OBD and durability for this potential zero-emission enabling technology?