CALIFORNIA
AIR RESOURCES BOARD

Tier 5 Rulemaking Workgroup: Potential Off-Road On-Board Diagnostics (OBD) Concepts

December 14, 2022

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OBD Discussion Outline

- Potential Off-Road OBD Concept
  - Objective
  - Standardization Requirements Overview
  - Diagnostic Requirements
  - Certification Requirements
  - Applicability

Potential Off-Road OBD Concept Objective

- To support manufacturer-run Off-Road In-Use Testing (ORIUT) and CARB-Run In-Use Compliance Program
  - Off-Road Real Emissions Assessment Logging (OR-REAL) data and standardized communication
- To facilitate emission-related repairs
- To ensure emission-related components are repaired during the warranty period
- To provide information to enable emission control inspections

Potential Standardization Requirements Overview

- ❑ Communication protocols (J1939 and J1979-2)
- ❑ OBD data link connector (shape, pins, location and identification)
- ❑ Fault codes
- ❑ Fault code handling
- ❑ Warning indicator lamp (e.g., dedicated Malfunction Indicator Light (MIL))
- ❑ Data stream
- ❑ Tracking
- ❑ Freeze frame
- ❑ Software Calibration Identification Number (CAL ID) and Software Calibration Verification Number (CVN)

Potential Standardization Requirements (cont'd)

- Data stream
  - Parameters to support Portable Emissions Measurement Systems (PEMS) testing
  - All Comprehensive Component Monitor (CCM) input/output components
  - Calculated and modeled parameters that support OR-REAL and select major monitors (e.g., Oxides of Nitrogen (NOx) mass emission rate, exhaust mass flow rate, and ammonia storage)

- Tracking Data
  - Monitoring frequency
  - Diesel Particulate Filter (DPF) operation and malfunction history (e.g., regeneration counter and cumulative time malfunction is detected)
  - OR-REAL

Potential Standardization Requirements (cont'd)

- OR-REAL concept

CE-CERT NOx Parameters Contract

% Rated Power	> 0 ≤64	0	> 0 ≤16	> 16 ≤40	> 40 ≤64	> 64
≤ 25%	bin 1	bin 2	bin 3	bin 4	bin 5	bin 6
>25 % ≤50%	bin 1	bin 2	bin 7	bin 8	bin 9	bin 10
>50 %	bin 1	bin 2	bin 11	bin 12	bin 13	bin 14

NTE Bin 15
Regen Bin 16
MIL Bin 17

3B-MAW In-use bins

Bin A
Bin B
Bin C

- This table is a modified example of the on-road REAL bin structure
- Bins A, B, C represent the three major operation categories for the off-road screening and for conducting a PEMS test/analysis

REAL = Real Emissions Assessment Logging
3B-MAW = Three-Bin Moving Average Window
Regen = Regeneration
MIL = Malfunction Indicator Light

Potential Diagnostic Requirements

- Performance-based OBD monitoring only for limited **major** emission control components
  - DPF (e.g., PM sensor-based filtration efficiency)
  - Exhaust Gas Recirculation (EGR) system (e.g., low flow)
  - Selective Catalytic Reduction (SCR) catalyst (e.g., NOx conversion efficiency)
  - Reductant dosing system (e.g., reductant delivery performance)
  - NOx sensors (e.g., performance)
- **Seeking feedback on malfunction criteria and monitoring frequency**

Potential Diagnostic Requirements (cont'd)

- Full CCM diagnostics include:
  - Input components: circuit continuity, out-of-range, and rationality
  - Output components: circuit continuity and functionality

- Applicable to all input/output components related to:
  - Major monitors (described in previous slide)
  - Auxiliary Emission Control Devices (AECDs)
  - OR-REAL (e.g., Intake Manifold Temperature, Manifold Air Pressure, NOx sensors, EGR flow, and engine speed)

Potential Diagnostic Requirements (cont'd)

- Partial CCM diagnostics include:
  - Input components: circuit continuity, out of range, and simple rationality (e.g., stuck in range)
  - Output components: circuit continuity and functionality
- Diagnostics applicable to all input/output components not covered under full CCM and related to:
  - Engine
  - Emission control components

Other Potential Diagnostic Requirements

- Standardize fault codes for manufacturer "enhanced" diagnostics of emission control components that go beyond this proposal (e.g., component protection monitors, other performance-based monitors)
- Standardize default action fault code and warning light requirements (e.g., for torque derates, EGR valve disablement, and reductant dosing shut-off)

Potential Certification Requirements

- ❑ Annual submission of OBD application

- ❑ Reduced demonstration testing relative to on-road OBD
  - Alternative to Full Useful Life engine testing (e.g., align with tailpipe certification durability requirements)
  - Allow one test engine to cover a broader range of engines
    - **Seeking feedback on how to group engines**

- ❑ Scope of production engine/vehicle evaluation testing
  - Verification of standardized requirements (e.g., L1* from on-road heavy-duty OBD regulation)
  - **Seeking feedback on verification of OR-REAL data**

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* Production engine/vehicle evaluation testing to verify proper communication of required emission-related messages to an SAE J1978/J1939 scan tool.

Potential Off-Road OBD Applicability

- 56-560 kilowatt at a minimum (Proposed Manufacturer-run Off-Road In-Use Testing program)

- Requirements for other power rating categories
  - CARB-run In-Use Compliance program needs standardized connectors and protocols
  - Other requirements – To Be Determined

- **Seeking feedback on phase-in schedule and requirements for other power rating categories**

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Questions?