



2024 Truck and Engine Manufacturers Association Compliance Workshop

General Compliance Session – In Use Programs Topics

April 24, 2024

Agenda



Heavy Duty In-Use Testing (HDIUT) Program

- Data Reporting and Submission



Heavy Duty Off-Road In-Use Compliance (ORIUC)

- Program Updates



Mobile Hydraulic Dynamometer (MoHyD)

- Details and Advantages



Omnibus Proposals

HDIUT Program

New Data Reporting Methodology to CARB



- HDIUT data reporting/submittal to both U.S. EPA & CARB
 - Following [What in-use testing information must I report to EPA?](#) (40 CFR § 86.1920) along with EPA's [HDIUT reporting guidance document \(CISD-06-011\)](#)
- HDIUT data submittal to EPA
 - (U.S. EPA's) EV-CIS
- HDIUT data submittal to CARB
 - Current: Electronic media by mail or email attachment
 - Upcoming: Web-based reporting through a submittal portal at HDIUT Manufacturer Submit (HMS) system: <https://ssl.arb.ca.gov/hms>
 - Similar to CARB's eFILE system

HDIUT Program

New Data Submittal through HMS



- Workshop to explain and discuss how to submit HDIUT data through HMS
 - Tentative for late June
 - Step-by-step guidance and Q&As
 - How to create an HMS account and submit HDIUT data through HMS
- New HDIUT data reporting/submittal implementation through HMS
 - Direct submission for 2023 and later test orders (TOs) right after the workshop
 - Indirect submission option with assistance from CARB staff until December 31, 2024
 - OEMs to CARB staff; HDIUT data through HMS by CARB staff; any messages from HMS back to OEMs – either successful (submission) or errors
 - With errors, the same process is repeated after fixing errors by OEMs, as necessary

HDIUT Program

Concerns – Late Submittal



- Testing completion and/or reporting delay beyond 18 months
 - Late Submittal: 1 week ~ about 2.5 months (without extension requests)
 - Extension requests: 3 ~ 12 months (including multiple requests)
- Delayed submittal: Mainly, due to lack of recruiting efforts
 - 2015 ~ 2018 TOs: 20% (33 tests out of 161)
 - 2019 TOs: 86% (31 tests out of 36) – Due to pandemic
 - 2021 & 2022 TOs: 26% (26 tests out of 100)

HDIUT Program

Concerns – Data Quality

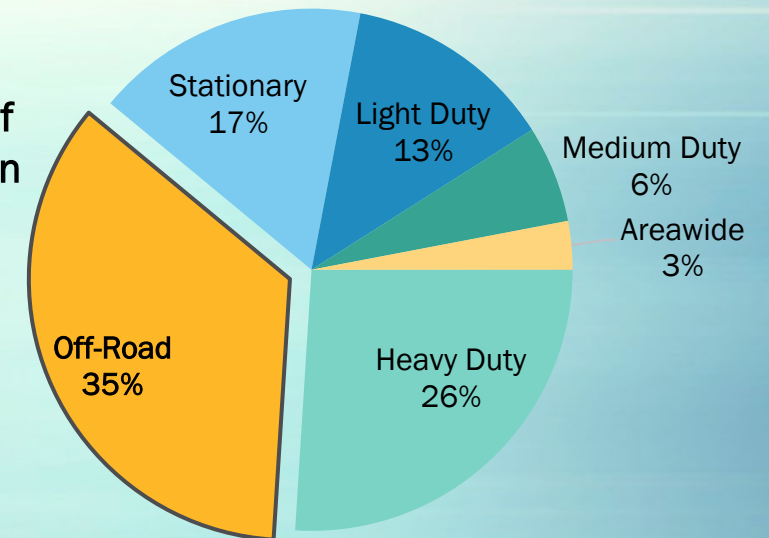


- Overall: Better with less errors and mistakes due to continuous discussions between OEMs and CARB/EPA (since 2016), but still concerns, including clerical errors
- Major concern: data drop-outs (a few seconds ~ over one hour)
 - Engine operating parameters, GPS data, NTE flags, exclusion indicators, etc.

Why Off-Road In-Use Compliance?

Mobile Source NOx Emissions

Off-Road is the largest source of NOx emissions in



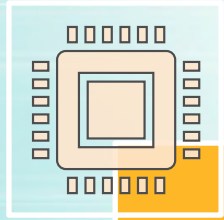
2020 Mobile Source Strategy – October Workshop Presentation

HD ORIUC Program Implementation

- Off-road equipment tested using Portable Emission Measurement Systems (PEMS) in operation to assess if they comply with the Not-to-Exceed (NTE) standard
 - NTE results determine if the engine families are emission compliant throughout their useful life
 - Additional testing as necessary to verify inducement strategies and AECDs
- Target one manufacturer and engine family per test plan
 - Any engine family certified by CARB
- Currently have an active test plan
 - Tentative start in Fall 2024
 - Not ready to show any results



HD ORIUC Program Challenges



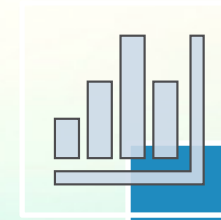
Measuring OBD channels

- No standardization
- Tier 5 will help resolve some issues



Setup / Installation

- Seasonal limitations
- Varied setup for equipment
- Dust, vibrations, center of gravity, vision, etc.



Binned-MAW Processing

- Currently not experimenting with MAW post processing
- Waiting for rule making finalization

HD ORIUC Program

Alternative Testing

- Engine dyno and alternative test methods can also be pursued
- Following the applicable regulations (40 CFR 1039.501, 1039.505, 1039.510, and 1065.514), engines can be tested on an engine dynamometer with applicable certified duty cycles
 - Transient testing (e.g. NRTC)
 - Steady State testing (e.g. RMC and/or NTE operation)
 - Alternative Test Methods
- **Pass/Fail Criteria:** All test results will be compared with the engine manufacturer's certification documents

TABLE 2 OF § 1065.514—DEFAULT STATISTICAL CRITERIA FOR VALIDATING DUTY CYCLES

Parameter	Speed	Torque	Power
Slope, a_1	$0.950 \leq a_1 \leq 1.030$	$0.830 \leq a_1 \leq 1.030$	$0.830 \leq a_1 \leq 1.030$.
Absolute value of intercept, $ a_0 $	$\leq 10\%$ of warm idle	$\leq 2\%$ of maximum mapped torque.	$\leq 2\%$ of maximum mapped power.
Standard error of estimate, <i>SEE</i> .	$\leq 5\%$ of maximum test speed	$\leq 10\%$ of maximum mapped torque.	$\leq 10\%$ of maximum mapped power.
Coefficient of determination, r^2	≥ 0.970	≥ 0.850	≥ 0.910 .

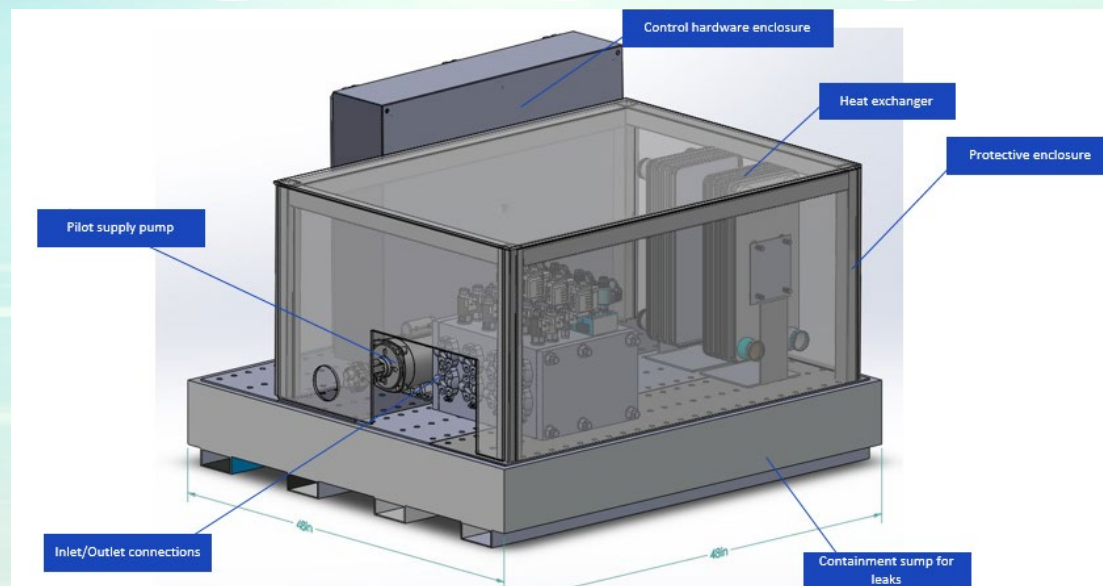
MoHyD

Mobile Hydraulic Dynamometer

In-field
testing

MoHyD

Engine
dyno
testing



- Standalone instrument
 - Connects to the hydraulic system of the equipment
- Capable of loading and operating the engines without removing the engines from the equipment
- Mimics the operation of an engine dynamometer
 - Non-Road Transient Cycle (NRTC)
 - Ramped Modal Cycle (RMC)

MoHyD

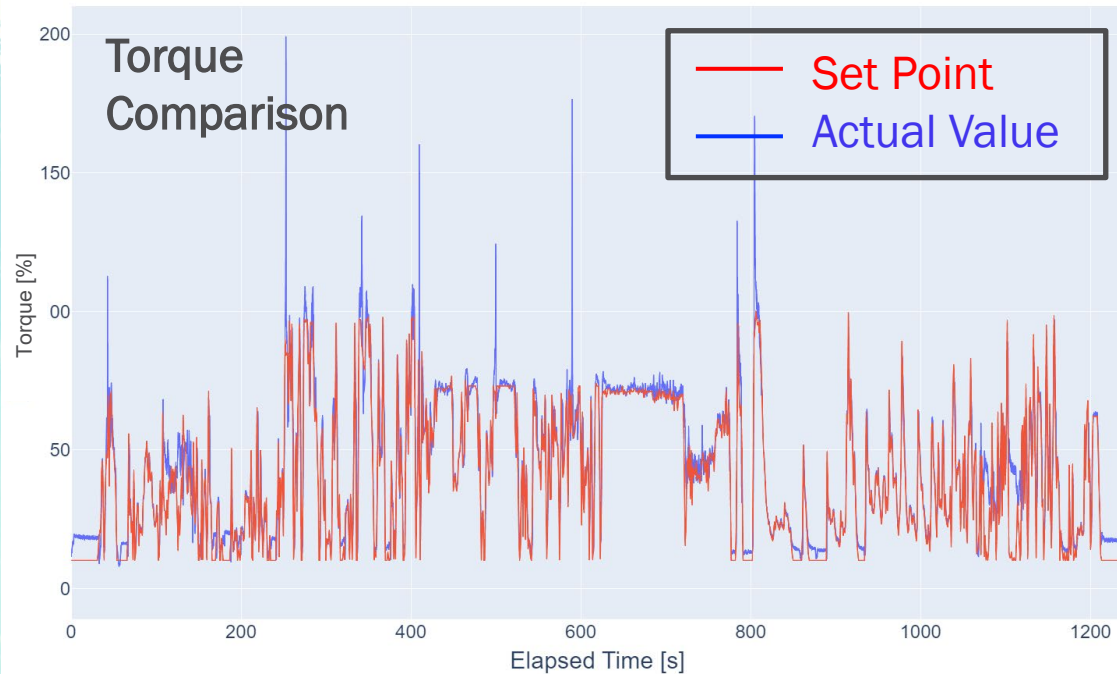
Advantages

- Simulate any duty cycle from the field
- Perform PEMS testing at any location
- Dirt-free conditions
- No seasonal limitation for testing equipment
- Cost effective

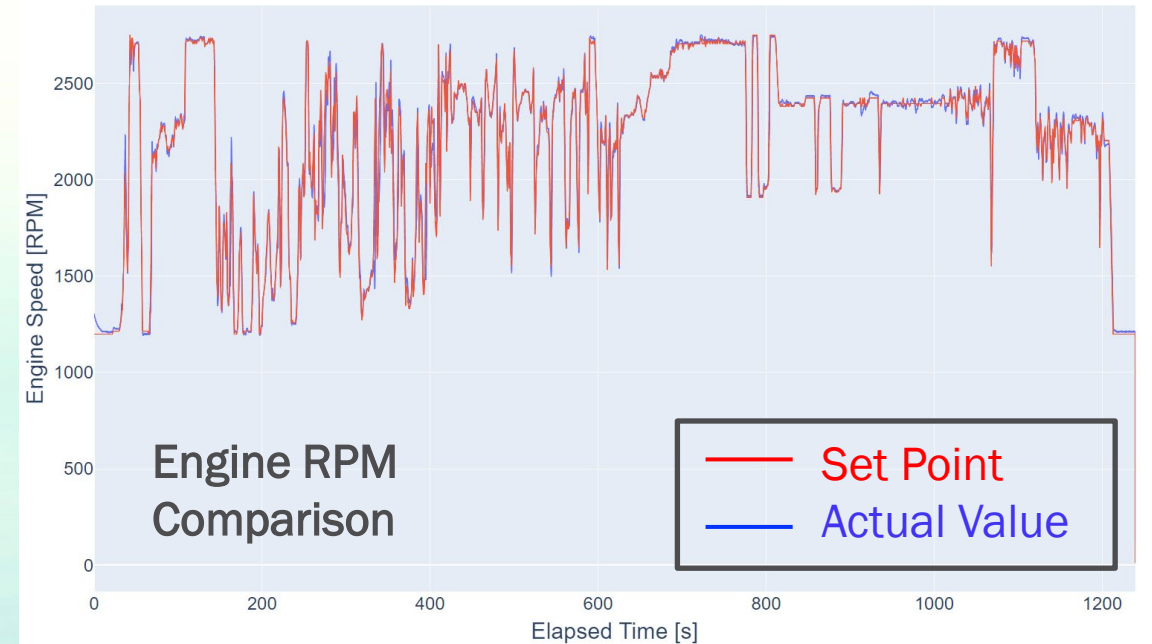


MoHyD

NRTC Trace (Skid Steer)



Slope: 0.955 (Validation Target >0.83)
 R^2 : 0.970 (Validation Target >0.85)



Slope: 0.994 (Validation Target >0.95)
 R^2 : 0.989 (Validation Target >0.97)

Omnibus Proposals



In-Use Testing Program Harmonization

Overview

- Among in-use test program discrepancies between EPA's CTP and CARB's Omnibus regulations, CARB staff is proposing to align with EPA's CTP regulations with a few exceptions outlined below:
 - Use of commercially available (biodiesel) fuel for In-Use testing as in Omnibus regulation – PART 86 II. Subpart T. 86.1910.A.2.2(ii) and 2.3(ii)
 - Compliance determination criteria based on the number of pass/fail tests (in addition to the average SOS emission) when three or more vehicles fail the same pollutant and same bin as in Omnibus regulation – PART 86 II. Subpart T. 86.1915.B.3.1 (same as CCR § 2140(c))
 - Use of Portable Emissions Measurement Systems (PEMS) or chassis dynamometer for in-use compliance (IUC) testing for idling emissions per Omnibus regulation – PART 86 II. Subpart N. 86.1370.B.7

In-Use Testing Program Harmonization

Overview

- Staff is proposing to align CARB's Omnibus regulations with EPA's CTP regulations for HDIUT with a few

1	Use of commercially available (biodiesel) fuel for In-Use Testing as in Omnibus regulation	40 CFR Part 86 II. Subpart T. 86.1910.A.2.2(ii) and 2.3(ii)
2	Compliance determination criteria based on the number of pass/fail tests (in addition to the average SOS emission) when three or more vehicles fail the same pollutant and same bin as in Omnibus regulation	40 CFR Part 86II. Subpart T. 86.1915.B.3.1 (same as CCR § 2140(c))
3	Use of Portable Emissions Measurement Systems (PEMS) or chassis dynamometer for in-use compliance (IUC) testing for idling emissions per Omnibus regulation	40 CFR Part 86 II. Subpart N. 86.1370.B.7

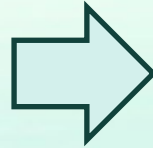
1. Use of Commercially Available (Biodiesel) Fuel

- EPA understands that manufacturers have little control over quality of fuel over years of in-use operation.
- CARB staff believes the in-use testing program is intended to reflect real-world emissions with real-world fuel.
- Current analysis of commercially available biodiesel fuels does not indicate any concerns with fuel contaminants that would harm or degrade the engine's emission control systems, which EPA agreed in part.
- Ensure manufacturers do not prohibit the use of CARB-approved commercial fuel in a statement in the manufacturer's maintenance instructions in the owner's manual nor deny warranty based on the use of such fuels

1. Use of Commercially Available (Biodiesel) Fuel (cont'd)

- **40 CFR § 1036.415(c)(1)**

“... You may use any commercially available biodiesel fuel blend that meets the specifications for ASTM D975 or ASTM D7467 (incorporated by reference in § 1036.810) that is either expressly allowed or not otherwise indicated as an unacceptable fuel in the vehicle's owner or operator manual or in the engine manufacturer's published fuel recommendations. ...”



- **Part 86 II. Subpart T. 86.1910.A.2.2(ii)**

“For 2024 and subsequent model year engines, you may use any commercially available biodiesel fuel blend.”

- **Part 86 II. Subpart T. 86.1910.A.2.3(ii)**

“... you may drain a prospective test vehicle's fuel tank(s) and refill the tank(s) with diesel fuel conforming to ASTM D 975 specifications or commercially available biodiesel ...”

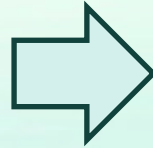
2. Compliance Determination Criteria Based on the Number of Pass/Fail Tests

- When two or more engines do not comply fully with the off-cycle bin standards, EPA CTP requires ten engines to be tested.
- When ten engines are tested, the compliance determination per EPA CTP is based on the arithmetic mean of the bin emissions from the ten engine tests for each pollutant.
- CARB's proposal will add the following criteria: if three or more engines do not comply the off-road bin standards for the same pollutant and same bin, the tested engine family is non-compliant.
- This would protect against outlier data points pulling the average down.

2. Compliance Determination Criteria Based on the Number of Pass/Fail Tests (cont'd)

- 40 CFR § 1036.425
Pass criteria for engine families

“(c) If two or more engines teste ... do not comply fully with the off-cycle bin standards, test additional engines until you have tested a total of ten engines. Calculate the arithmetic mean of the bin emissions from the ten engine tests ... for each pollutant. If the mean values are at or below the off-cycle bin standards, the engine family passes. If the mean value for any pollutant is above an off-cycle bin standard, the engine family fails.”



- PART 86 II. Subpart T.
86.1915.B.3

“... the engine family is deemed to be noncompliant if the Phase 1 testing meets any of the following criteria:”

- PART 86 II. Subpart T.
86.1915.B.3.1

“The sum-over-sum emissions of the same pollutant and same bin exceed the in-use threshold (86.1370.B.6) for three or more tests.”

- PART 86 II. Subpart T.
86.1915.B.3.2

“Any of the average SOS values exceed the applicable in-use emission threshold defined in (86.1370.B.6.) The average SOS value is calculated from the arithmetic mean of 10 vehicles from Phase 1 testing for each of pollutants (NMHC, CO, NOx, and PM) and for each of the bins ...”

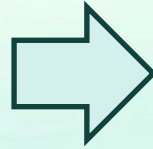
3. Use of PEMS or Chassis Dynamometer for IUC Testing for Idling Emissions

- EPA CTP requirements allow heavy-duty diesel engines to be optionally certified to the Clean Idle NO_x emission standards (30.0 g/h for model years 2024 through 2026, and 10.0 g/h for model year 2027 and later).
- EPA CTP test procedures are based on engine dynamometer testing.
- CARB's proposal would add the provision to allow uses of PEMS or chassis dynamometer for IUC testing for the optional idling emissions.

3. Use of PEMS or Chassis Dynamometer for IUC Testing for Idling Emissions (cont'd)

- **40 CFR § 1036.525 Clean Idle Test**

“Measure emissions using the procedures described in this section to determine whether engines and hybrid powertrains meet the clean idle emission standards ...”



- **PART 86 II. Subpart N. 86.1370.B.7 In-Use Compliance Testing for Idling Emissions**

- “... the Executive Officer may conduct in-use compliance emissions testing to determine whether the engine complies with the idling NOx emission standard to which the engine is certified. The Executive Officer may follow the following procedure specified in this subparagraph 7 to determine compliance:”
- PART 86 II. Subpart N. 86.1370.B.7.1
 - “In-use compliance emission testing may be conducted using chassis dynamometer in the laboratory or using an on-board PEMS.”

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Questions?