Possible Elements of a Future Heavy-duty Vehicle Inspection and Maintenance Program

Presentation to the Chinese Ministry of Ecology and Environment
November 27, 2018
Today’s Presentation

• Need for emission reductions
• Current HD inspection programs
• Potential future HD inspection and maintenance (HD I/M) program elements
  • Additional mechanisms to improve program compliance
• Supporting HD I/M Research
• Program contact information
Need for Emission Reductions
California Faces Greatest Air Quality Challenges

2012 PM 2.5 Standard
Primary Annual 12.0 μg/m³

Ozone standard > 0.070 ppm
Reducing Emissions from Heavy-duty Vehicles: Critical for California’s Air Quality Needs

**Emission Year 2019 using EMFAC 2017 Model**

**NOx Emissions by Source 2019**
- Other Mobile Sources (Trains, Aircraft, Off Road etc): 33%
- Stationary Source: 22%
- Heavy Duty Diesel Trucks (14,001+ lbs): 26%
- All Other On Road Vehicles: 19%

**Diesel PM 2.5 by Source 2019**
- Stationary Source: 8%
- All Other On Road Vehicles: 4%
- Other Mobile Sources (Trains, Aircraft, Off Road etc): 69%
- Heavy Duty Diesel Trucks (14,001+ lbs): 19%
Where are On-Road Heavy-duty Emissions Coming From?

- Beyond 2023: Deterioration-related emissions are the largest factor in NOx levels
- Significant reductions needed to meet federal attainment goals
- A HD I/M program could help address these emissions

Based on EMFAC2014, GVWR> 14,000 lbs.
Current Heavy-Duty Vehicle Inspection Programs
Current Inspection Programs

• Heavy-duty Vehicle Inspection Program (HDVIP)
  • Roadside inspections by CARB enforcement staff for excessive smoke and tampering

• Periodic Smoke Inspection Program (PSIP)
  • Annual self-testing for California fleets of two or more vehicles

• Require vehicles to meet opacity limits to operate in California
Board Approved HDVIP and PSIP Amendments

- DPF-equipped vehicles:
  - 5% opacity

- Non DPF-equipped vehicles:
  - 20% - 40% opacity depending on model year and technology

- PSIP voluntary OBD submittal
  - Fleets can choose to submit a vehicle’s OBD data to CARB in lieu of performing annual PSIP smoke opacity test

- Changes effective ~mid-2019
Potential Future HD Inspection and Maintenance (HD I/M) Program Elements
Further Program Improvements Needed

*Properly designed HD I/M program could:*

- Reduce excess NOx emissions not currently addressed in current inspection programs (HDVIP and PSIP)
- Ensure all emissions control systems are functioning properly
  - Exhaust aftertreatment on all modern diesel HDVs: SCR for NOx and DPF for PM
- Ensure proper maintenance practices/timely repairs throughout entire on-road life
Potential Elements of a Future Program

• Periodic scans of the engine’s on-board diagnostic (OBD) system for malfunctions
• Remote sensing devices (RSD) / Plume capture
• OBD and RSD / Plume capture can work together
• Others?
Heavy-duty Vehicle OBD

• HD OBD adopted in 2005 (vehicles > 14,000 lbs.)
  • Initial phase-in
  • Full concept implementation with 2013 MY engines
  • Added lead time for hybrid HD engines (2014 MY) and alt fuel HD engines (2018 MY)

• Ensures against excess emissions caused by malfunctions/deterioration

• Monitors performance of virtually every component/system that can increase emissions when malfunctioning

• Provides for faster identification and repairs
  • Malfunction Indicator Light
  • Valuable diagnostic information for accurate/timely repair
  • Intended as tool for inspection and maintenance
OBD Testing

• OBD scan procedure takes only minutes
  • Minimal downtime for owner/driver
  • Multiple options for OBD scan and data submission
    • Kiosks
    • Dongles
    • Telematics

• Majority of light-duty vehicle inspection and maintenance programs (i.e., Smog Check) are OBD-based
OBD Data Scan and Submission Options
(Currently used in Light-duty Vehicle Programs)

• Kiosks (Ohio, Oregon, Maryland)

• Dongles (Oregon)

• Telematics
  • Fleet/vehicle software subscription service (Oregon, California for government fleets)

• Station-based
  • Currently used in passenger vehicle Smog Check programs in many states (California, Oregon, Maryland)
Remote Sensing and Plume Capture

• Emissions snapshot in real-time

• “Dirty Screen” – identify high emitters when coupled with Automated License Plate Recognition (ALPR)

• Program validation – monitor real-world emissions as program is implemented; gauge program success
Remote Sensing

- Remote Sensing Device – RSD uses light source, light reflection, light signal detection, and signal analysis algorithm to determine emissions
  1. HEAT’s EDAR system (Differential Adsorption LIDAR)
  2. U. Denver’s FEAT system, or similar (IR, UV)

Ropkins et al., STE (2017)

Colorado’s Rapid Screen I&M Program

Colinear IR & UV beams
Plume Capture

- Plume Capture – exhaust is pulled through a sampling inlet to a manifold connected to analytical instruments
  1. PEAQS (CARB in-house system)
  2. OHMS (U. Denver’s HD “tent”)
  3. UC Berkeley’s “overpass” system
Additional Concepts That Could Improve Program Compliance

- Link compliance to vehicle registration
  - Similar to light-duty vehicle Smog Check program

- Certificates of compliance (especially for out-of-state vehicles)

- Include owner-operators in periodic testing (currently exempt from PSIP)

- Establish fee structure to support program administration

Additional authority from the California Legislature would be needed to implement these concepts
HD Vehicle Inspection and Maintenance-Related Research
Research Projects

• UC Riverside HD I/M Research Project – near completion
• Internal CARB Repair Durability Study – ongoing
• $1M HDV Repair Assistance Pilot Program – starts soon in SJV Air Pollution Control District

Planned for 2019 - 2020

• Pilot demo at ports: OBD data submission options
• RSD and plume capture pilot study
• Automatic License Plate Recognition statewide demo – better characterize out-of-state truck traffic coming into California, refine CARB’s emission inventory
Program Development Timeline

• Public workshops in 2019 – 2020

• Potential external workgroup meetings

• Potential Board date: ~2020
Stay Connected to CARB’s HD I/M Program Development Activities

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• New web page under development and coming soon