

Workgroup Discussion Paper:
Heavy-Duty Vehicle Inspection and Maintenance

BACKGROUND

In California, heavy-duty diesel vehicles with a gross vehicle weight rating over 14,000 pounds represent one of the largest sources of mobile air pollution in California. Even with modern emissions controls and on-board diagnostics (OBD) monitoring systems, 2019 estimates indicate that these vehicles contribute approximately 58 percent of the statewide on-road mobile source oxides of nitrogen (NO_x) emissions and about 82 percent of the statewide on-road mobile source particulate matter (PM 2.5) emissions¹. Some of these emissions are attributed to broken or failing emissions-related equipment. Currently, there is no smog check-type program for heavy-duty vehicles to ensure their emissions control systems are functioning properly and repaired in a timely manner.

CARB's existing heavy-duty inspection programs rely on random field inspections by CARB staff and annual self-inspections by truck owners to test for smoke opacity levels. However, these programs do not ensure that vehicle owners are regularly inspecting and repairing their vehicles' broken emissions controls. A well-designed heavy-duty vehicle inspection and maintenance (HD I/M) program that creates minimal operational disruption for owners could help ensure that vehicles' emissions control systems are operating as designed to meet California's public health protection goals. As an ancillary benefit, keeping vehicles tuned up and properly maintained may result in better fuel economy and less operational downtime.

Through this HD I/M Workgroup, CARB staff is seeking input on a comprehensive strategy for implementing a cost effective and feasible HD I/M program. Such a program could be designed to incentivize vehicle owner and driver behavior that will ensure that heavy-duty vehicles are well maintained and properly repaired. A well-designed program will include mechanisms to measure program performance and effectiveness, and possibly offer compliance assistance.

The Workgroup will discuss potential concepts for a program that ensures heavy-duty vehicles are inspected and maintained. Discussion topics could include, among other things:

- Remote OBD data submission methods;
- OBD data submission security and fraud prevention strategies;
- How fleets use OBD data;
- Testing methods for non-OBD heavy-duty vehicles;

¹ CARB's on-road motor vehicle emissions inventory model, EMFAC2017, for calendar year 2019. <https://www.arb.ca.gov/msei/categories.htm#emfac2017>.

- Testing methods for alternative-fuel heavy-duty vehicles;
- Exhaust aftertreatment (selective catalytic reduction systems, diesel particulate filters) repair durability;
- The use of remote sensing and plume capture technology to identify high emitters and validate program effectiveness;
- Methods to enforce the program for in-state and out-of-state vehicles;
- CARB's HD I/M data collection study; and
- Preventive maintenance, and fleet education and training.

PROGRAM DESIGN CONSIDERATIONS

VEHICLE APPLICABILITY

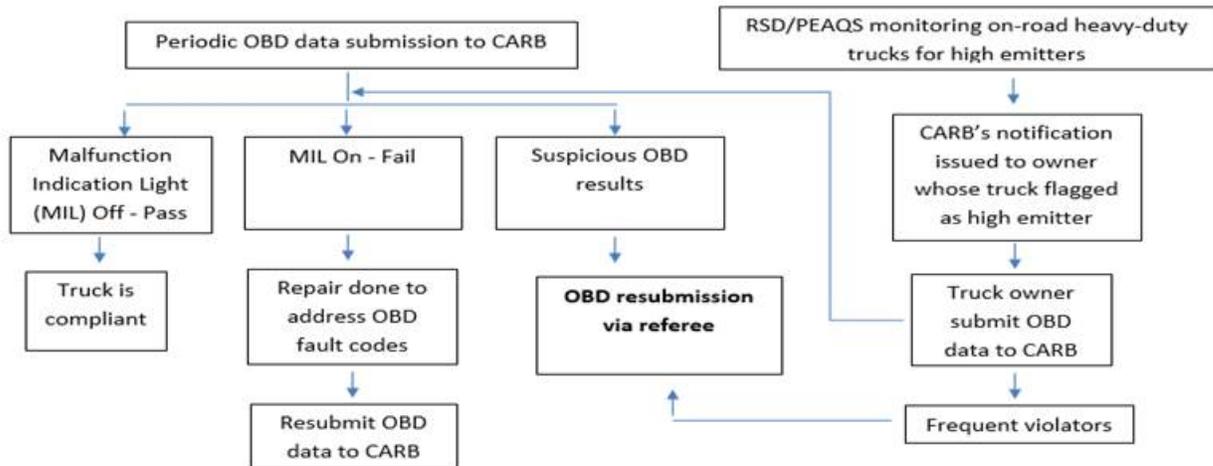
- All on-road heavy-duty vehicles (non-gasoline)² with gross vehicle weight ratings (GVWR) over 14,000 pounds operating in California could be subject to such a program.
 - Includes all in-state, out-of-state, and out-of-country vehicles that operate in California.
 - About 25 percent of heavy-duty vehicle miles traveled in California are from vehicles (over 14,000 pounds GVWR) that are registered out of state.

VEHICLE TESTING AND COMPLIANCE DEMONSTRATION

- *Vehicle Testing*: There a variety of ways to check heavy-duty vehicles to ensure they are properly maintained and repaired in a timely manner. One potential HD I/M program design concept couples periodic OBD system checks as the primary test method with on-road emissions monitoring using remote sensing devices (RSD) and plume capture systems (CARB's Portable Emissions Acquisition System [PEAQS]) to identify high emitters and verify program effectiveness. Together, these complementary test methods have the potential to ensure that emissions control systems are properly functioning, even between periodic OBD checks. RSD and PEAQS could also be important for flagging potential high emitters for additional follow-up testing, as necessary. Figure 1 below illustrates how these two testing mechanisms could work together in a future HD I/M program.
 - A HD I/M program does not have to follow the station-based model of the light-duty Smog Check program. Instead, the program concept could be based on the use of telematics and other data collection and submission tools to enable the inspection process from the vehicle's location.

² BAR's Smog Check Program includes gasoline heavy-duty vehicles with gross vehicle weight ratings over 14,000 pounds.

Figure 1



- The program should be designed to ensure both in-state and out-of-state vehicles have adequate methods to demonstrate compliance with program requirements.
 - These requirements should be as unobtrusive as possible.
 - For heavy-duty diesel vehicles equipped with 2013 and newer model year engines: OBD data could be periodically submitted to CARB in a variety of ways.
 - Data submittals could be done through telematics providers, third-party testers, or fleets; using a variety of methods, such as telematics, dongles, tablets/kiosk-type systems, handheld scan tools, repair facilities, and/or third party mobile inspectors.
 - The potential HD I/M OBD data parameters to be collected and submitted to CARB could be the data required to be accessible under CARB's HD OBD regulation in sections 1971.1 and 1971.5, Title 13, California Code of Regulations³.
 - Fraud prevention and detection of testing data is important to ensure program effectiveness.
 - For heavy-duty diesel vehicles equipped with non-OBD engines: Alternative inspection methods could be developed for engines (pre-2013 model years) that do not have OBD systems. The inspection methods could be new, or the existing SAE J1667 smoke opacity test protocol.
 - For alternative-fuel heavy-duty vehicles: OBD systems are standard on alternative fuel engines starting with the 2018 model year. Alternative

³ Heavy-Duty OBD Regulatory Documents. <https://ww3.arb.ca.gov/msprog/obdprog/hdobdreg.htm>.

inspection methods could be evaluated for engines that do not have OBD systems (pre-2018 model years).

- *Repair*: Vehicles with broken emissions-related components would need to be repaired in a timely manner.
 - The program should encourage durable and timely repairs to help vehicles remain in revenue service with minimal downtime, and to reduce harmful emissions.
- *Compliance Verification*: After demonstrating compliance with the HD I/M program requirements, owners could be issued a Certificate of Compliance for their vehicle(s). A valid certification of compliance could be required to operate legally in California.

PROGRAM IMPLEMENTATION AND ENFORCEMENT

- The program should be designed in a way that is enforceable and encourages compliance.
- The program should have a funding source to ensure resources are available for implementation and enforcement.
- To ensure a level the playing field, the program must include enforcement strategies for all vehicles operating in California.
- Potential tools for ensuring compliance could include:
 - For California-registered vehicles, DMV registration could be linked to demonstrated compliance (similar to the light-duty Smog Check program).
 - Certificate of Compliance renewal could be denied to any vehicle not meeting program requirements.
 - CARB enforcement and CHP could have ability to check for valid Certificate of Compliance during inspections and cite non-compliant vehicles.
- Remote sensing and/or plume capture technologies can be used to screen for potential high emitters between periodic OBD data inspection cycles.
 - Systems could be deployed strategically in disadvantaged communities, along high-volume trucking routes, and in known traffic corridors where out-of-state vehicles frequently travel.
 - Data could be used to target high emitters for enforcement.
- Automated license plate recognition (ALPR) cameras could be useful in identifying vehicles, especially out-of-state vehicles operating in California, that have not submitted HD I/M test data to CARB.
 - Vehicles that have not submitted HD I/M test data to CARB could be considered non-compliant and cited.

COMPLIANCE ASSISTANCE

- A compliance assistance program could help encourage program participation, especially among smaller fleets. Such a program might:

- Encourage or incentivize participation in a telematics-based preventive maintenance program that helps minimize downtime and provide information to comply with OBD reporting requirements.
- Establish a HD I/M repair assistance program for low-income vehicle owners who need financial assistance getting their vehicles inspected and repaired.

PROGRAM VALIDATION

- The program should include mechanisms for tracking program performance.
 - OBD data can be a powerful tool.
 - If provided through telematics, OBD data can assess the frequency of OBD fault codes. The frequency of fault code triggers might decrease over time.
 - If provided regularly, OBD data could be used to monitor the frequency of OBD test failures and can help detect patterns of failure. This can lead to better repair strategies overall and could lead to manufacturer recalls in some instances.
 - RSD and PEAQS can have important an important role in verifying program effectiveness by monitoring emissions while vehicles are in operation and during the intervals between periodic data submissions.

PREVENTIVE MAINTENANCE

- Making training available to vehicle owners and operators on the value and importance of preventive maintenance could encourage owners to keep vehicles repaired. Preventive maintenance can reduce unexpected downtime and other repair costs.

SUMMARY

A program is needed to ensure heavy-duty vehicles are properly maintained in order to minimize air pollutant emissions during operation. A well-designed HD I/M program that creates minimal operational disruption for owners could help ensure that vehicles' emissions control systems are operating as designed to meet California's public health protection goals. CARB staff is seeking input on a comprehensive strategy for implementing a cost effective and feasible HD I/M program. A well-designed program would also include mechanisms to measure program performance and effectiveness, and possibly offer compliance assistance.