Future of Vehicle Emissions Inspections

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Introduction

- Inspection/Maintenance (I/M) programs must be implemented in most areas that exceed National Ambient Air Quality Standards for ozone.
  - Ozone is caused by photochemical reactions between HC and NOx. I/M programs aim to reduce these emissions.
- Most vehicles built since 1996 are equipped with On-board Diagnostic (OBD) systems.
- Inspecting OBD equipped vehicles is much easier than inspecting 1995 and older models.
- This paper talks about the best way to inspect future vehicle fleets.
Paper Summary

• Do vehicle emissions tests work?
• What tests should be done on future vehicles fleets? Can a program drop tailpipe tests?
• What’s the best way to prevent fraudulent OBD tests?
Do Vehicle Emission Tests Reduce Emissions?

- Do vehicles failing tailpipe and OBD tests have high emissions?
- Do OBD tests reduce the incidence of illuminated malfunction indicator lights (MILs)?
Remote Sensing Data

- Data from Remote Sensing Devices (RSD) can be used to estimate the emission benefits of tailpipe and OBD tests.
- RSD measures emissions by passing a light source across a highway to a source detector.
  - From these measurements, exhaust concentrations of HC, CO, and NO in the undiluted exhaust are calculated.
RSD Set-Up

CO and HC Remote Sensing

Computer → Calibration

Detector

IR Source

Video

UNIVERSITY of DENVER
RSD HC and NOx vs. OBD Result

OBD Pass/Fail Based on MIL-On
RSD HC and NOx (ppm) vs. Two-Speed Idle (TSI) Result
Impact of I/M on MIL-On Rates

• The MIL indicates if a vehicle has an emission related malfunction.
• Vehicles with illuminated MILs generally have much higher emissions than vehicles with MILs off.
• Data from independent OBD tests indicate that MIL-On rates are much higher in states that do not have I/M programs.
  – Remote OBD tests
  – Roadside surveys
Remote OBD – Use of Telematics to Continuously Monitor OBD Systems

- Insurance companies are using telematics (typically cellular systems) to track driver behavior and adjust insurance rates.
- Telematic systems also track the status of the vehicle’s OBD system, including MIL-On status. This technology is referred to as Remote OBD.
- Remote OBD offers provides real-time data on MIL-On rates in I/M and non-I/M areas.
- Remote OBD also could be used to verify compliance with I/M OBD test requirements.
Location of Vehicles Equipped with Remote OBD Systems
MIL-On Rates in I/M vs. Non I/M Areas Based on Telematics

- I/M areas: 5% to 7%
- Non I/M areas: 15% to 22%
MIL-On Rates in I/M vs. Non I/M Areas Based on Roadside Tests

- Oregon Department of Environmental Quality (DEQ) conducts random roadside OBD tests in and outside of I/M areas.

- MIL-On rates:
  - I/M areas: 5%
  - Non I/M areas: 22%
Conclusions: Impact of I/M on Emissions

- Vehicles that fail I/M tests, particularly OBD tests, have much higher HC and NOx emissions than those that fail.
- Motorists are more likely respond to illuminated MILs if they reside in an area with an I/M program.
How Should States Conduct Emission Tests in the Future?

• OBD Tests?
  – Easy to perform. Requires inexpensive equipment; hood does not have to be opened.

• Tailpipe Emission Tests?
  – Only emission test option for 1995 and older models.
  – Loaded-mode (ASM, IM240) are very expensive to perform. Only tailpipe option that measures NOx.
  – Two-speed idle (TSI) and idle test are cheaper, but they are ineffective on NOx. TSI requires hoods to be opened.
Emission Benefits of OBD vs. TSI Tests – 2013 Delaware Data

<table>
<thead>
<tr>
<th>Test Type</th>
<th># of Failures</th>
<th>% of Failures</th>
<th>Average Annual Mileage</th>
<th>% of Failures Adjusted for Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSI</td>
<td>3,383</td>
<td>23%</td>
<td>6,358</td>
<td>12%</td>
</tr>
<tr>
<td>OBD</td>
<td>11,471</td>
<td>77%</td>
<td>13,982</td>
<td>88%</td>
</tr>
</tbody>
</table>

- TSI only measures HC. There are no NOx benefits from TSI testing. OBD tests reduce HC and NOx.
Conclusions: Future Emission Tests

- In a program that performs TSI and OBD tests, OBD tests are responsible for at least 88% of the HC emission reductions and 100% of the NOx emission reductions.
  - The benefits from TSI tests will approach 0% in the future.
- Future I/M programs should only perform OBD tests.
- Many states already have transitioned to OBD-Only tests. Examples: MA, NY, IL, MO
Preventing Fraudulent OBD Tests

- Motorists and/or technicians can get a vehicle to pass an OBD test by testing a fault free vehicle, instead of the registered vehicle. This is termed clean-scanning.
- Traditionally, fraud has been detected by performing covert and overt audits. These audits are not effective in detecting clean scanning.
- Clean scanning can be effectively deterred electronically by running real-time trigger reports.
Real-Time Triggers

- OBD inspections allow states to implement “Real-Time” Triggers to identify potential clean scanning occurrences.
- Real-Time Triggers use information collected during an OBDII inspection to flag potential cases of fraud as it’s occurring.
- When this happens, the inspection is stopped until it’s determined that a valid inspection is being done.
  - The station supervisor and/or State/Provincial Auditor can review results and look at the vehicle to determine if it’s the one that should be inspected.
- Real-Time Triggers must avoid false trigger hits:
  - You do not want to stop too many valid inspections.
Possible Real-Time Triggers

- Mismatches between OBD-VIN and VIN entered for the vehicle under test (VUT).
- Other OBD parameter mismatches:
  - Mismatches between expected test parameters and parameters recorded for VUT. Retest parameters should match initial test parameters.
  - Short-time between initial failing test and passing retest.
Conclusion: Real-Time Triggers

• Real-time triggers can assure that most tests are done correctly.

• Traditional auditing methods are not effective with OBD inspections.
Conclusions

• I/M reduces emissions:
  – Vehicles that fail I/M tests, particularly OBD tests, have much higher HC and NOx emissions than those that fail.
  – Motorists are more likely respond to illuminated MILs if they reside in an area with an I/M program.

• Future I/M programs should only perform OBD inspections.

• Fraud can be easily detected in an OBD-Only I/M program by running trigger reports.