In-Use Emissions Testing – Engine Manufacturer’s Perspective

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In-Use Emissions testing using PEMS - History

- Heavy-Duty in-use testing came into the regulatory arena in the US as a result of the 1998 EPA Consent Decree which included Not to Exceed (NTE) Standards.

- The manufacturer-run in-use testing program for Heavy-Duty On Highway Diesel Engines and Vehicles program was a result of a cooperative settlement agreement in 2003 between EPA, CARB and EMA on certain provisions of the Not to Exceed Standards.

- The final Rule on In-Use Testing Program for HDOH Diesel Engines and Vehicles program was announced in June 2005.
One of the first PEMS – EPA’s ROVER

From an EPA presentation to GRPE’s Off-Cycle Working Group
September 13, 2005
In-Use Emissions testing using PEMS - History

The Final Rule stipulated that:

- Portable Emissions Measurement Systems (PEMS) will be used to monitor in-use emissions from diesel vehicles with measurement of NOx, HC, CO and PM
- Measurement Accuracy Margins would be established to account for PEMS emissions measurement variability in-use
- A pilot program for both gaseous and PM was established for EPA and engine manufacturers to gain experience using PEMS and generating/submitting data
- EPA will select engine families for in-use testing
- Engine Manufacturers will select vehicles based upon 7 EPA stipulated criteria and screening process – EPA has to approve selection
- Vehicle and family pass/fail criteria need to be met
Engine Manufacturers Association’s response to EPA’s Final Rule on In-Use Emissions Testing

EMA’s president stated:

- The voluntary agreement to develop, conduct and fund a new in-use testing program demonstrates the continued strong commitment of diesel engine manufacturers to produce heavy duty engine systems that reduce emissions and improve air quality in our cities and states.

- The agreement on an in-use testing program with EPA and CARB is truly a milestone for heavy-duty engine manufacturers and cleaner air because it moves emissions testing from the laboratory into real-world operating conditions.

- The program not only will verify that near zero emissions levels measured under laboratory certification conditions are achieved on our streets and highways, but will also provide valuable feedback to engine manufacturers on any need to further improve and enhance emissions control systems.
Measurement Accuracy Margins a.k.a Measurement Allowance (MA)

- Both EPA and EMA understood that in-use measurements were more difficult than Lab measurements and measurement accuracy margins would have to be provided for variability above Lab testing variability.
- EPA offered a flat 5% MA for all regulated emissions species which EMA rejected.
- EMA, EPA and CARB agreed to fund two programs at SwRI that would provide measurement allowances for gaseous and PM that were based on actual test results on PEMS units with verification using CE-CERT’s mobile emissions lab.
- The determination of gaseous emissions MA was initiated first since gaseous emissions PEMS were commercially available.
- PM PEMS were not readily available commercially and had issues even when they were used in determining the MA.
- Finally, after running the data based MA program for PM, EPA and EMA agreed to a MA for PM.
- Both the gaseous and PM MA programs were multi-year programs and cost several millions of dollars with costs shared between EPA, CARB and EMA.
Pilot and Enforceable In-Use Programs

- EPA instituted a 2 year pilot program prior to the enforceable program to provide time for engine manufacturers to become familiar with the program
- 5 vehicles are to be tested under the pilot and 5 to 10 vehicles to be tested in the enforceable parts of the program
- Each pilot or enforceable period is 18 months long for obtaining and reporting in-use data
- The start of the pilot program was based upon the completion of the MA determination per a predetermined schedule
- Delays in the completion of the MA determination delayed the start of the pilot program and hence the start of the enforceable program
- Gaseous emissions pilot program started in May 2006 and the in-use testing program is now in the enforceable part of the program
- PM in-use testing program is still in the pilot phase. Instead of 2 years for a pilot program, due to delays in the PM MA determination, the pilot program covers a 4 year period starting in 2007 with engine manufacturers selecting two years out of the 4 to conduct pilot testing
In-Use Testing for Heavy Duty Non-Road Engines

- So far, in-use testing programs have been established for Heavy Duty On-Highway Diesel Engines
- EPA has been negotiating with EMA regarding in-use test program for non-road engines
- The NPRM for the Non-Road Heavy Duty In-Use Testing has not yet been announced by EPA but is expected sometime soon
- EPA’s GHG NPRM had caused the delay
- EPA does not plan to rerun the Measurement Allowance program but will use information gathered through the HDIUT MA determination with some modifications
The Challenge of In-Use Testing

- Engine design, mapping engine operating surfaces etc. could be challenging in order to satisfy NTE for in-use testing in the NTE zone for events as short as 30 seconds under a variety of engine driving operations and ambient conditions.

- Additionally, actually preparing for and conducting in-use test protocol with customer engines/vehicles and the PEMS is also challenging.

- Engine manufacturers have demonstrated that they are up to the challenge through the work carried out to date.
Impact of In-Use Testing

- Imposes additional burden on engine manufacturers
  - Significant additional cost for equipment, personnel and testing according to the edicts of Part 1065

- It would be useful to determine if there are ways to reduce the impact
  - Do all emissions species need to be measured? Can we do away with not measuring some of the less important ones?
  - Could other regulatory programs be trimmed as being unnecessary with in-use testing in place?

- Will the in-use testing program continue without end or will it sunset sometime in the future?
Customer Vehicle Testing Issues

- Required to work around normal vehicle schedule
  - Results in long irregular work hours
- Difficulty in locating customers
- Fleet schedule variability
  - Vague departure and arrival times
  - Miscommunication common at larger fleets
- First test at a given customer site is always the most difficult
- Test equipment takes up a lot of room
- Large quantities of equipment needed leads to problems – forgotten items
- Must depend on driver to record some information – they just don’t always do it
- Limited or no trouble shooting time
Some Gaseous Emissions PEMS Issues

- Field maintenance and calibration of the analyzers
- THC measurement is cumbersome and expensive. Not sure the benefit or use
- Exhaust systems have been difficult to un-assemble
- Leak checking heated emission line on vertical stack is problematic
- Heated sample line is fragile and expensive to repair
- CFR 1065 linearization requirement is probably too stringent for in-use equipment - esp. CO
Lessons Learned

- Single MPS PPMD with remote dilution provides most versatility and ease of use for compliance testing.
- Weather too difficult to predict. Most installations require concern for rain. Remote dilution allows for PPMD to be installed in the cab.
- Perform crystal greasing and sample flow and other checks the day before testing (reduces installation time).
- Have adequate computing resources for on site data processing.
- Carefully consider shipping options when shipping PPMD.
Lessons Learned

- Start customer ID process as early as possible
- Communicate regularly with field network to speed up customer location
- Solicit multiple customers
- Verify ESN, vehicle numbers and truck mileage early in the ID process
- Carry spare parts
- Visit customer before test date to develop installation plan
Gaseous and PM analyzers are in the cab in place of the passenger’s seat (removed for test).

Weather Station (Temp, RH)

Exhaust Flow Meter

Flexible Exhaust Transport

PM sample line

Remote Dilutor for PM sampling
Custom Crane Chassis
Single MPS PPMD with Remote Dilution
Thank-you. Any Questions?