

## *Presentation to EPCA on 14<sup>th</sup> August 2004*

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## *Contents of the Presentation*

- Concerns of EPCA/CSE
- Views of international experts
- Summary of Current International Status for NOx and PM measurement
- Feasible available options for loaded mode test on in-use vehicles
- Suggestions for loaded mode emission test

## *CSE Concerns – CNG Buses*

- Rising NOx levels in Delhi and the possibility that the CNG vehicles might be emitting high NOx on account of poor maintenance
- Delaying ignition timing and leaning Air Fuel mixture for reducing CO and HC emission can increase NOx
- Catalytic converters in many buses have crossed their certified life of 80,000 km and are not functioning
- To link replacement of cat converters with effective screening of buses
- Heavy duty dyno test for in use heavy duty spark ignition engines have already been developed in the US and Mexico

## *CSE Concerns – In-use Diesel vehicles*

- High emissions of particulates and NOx emissions from in-use diesel vehicles.
- Parson Advance Technologies Inc. in Australia have shown that the Free acceleration smoke test is inappropriate for monitoring particulate emissions.
- Free Acceleration test is vulnerable to manipulation and easy to cheat. Also not effective in monitoring fine particulate emissions from diesel vehicles that don't belch thick black smoke

## *CSE Concerns – In-use Diesel vehicles*

- Develop short dyno test procedure for in-use diesel vehicles in which both smoke and particulate matters are measured
- Draw lessons from the work that is in progress in the US, Australia and now in Bangkok on measuring PM from diesel vehicles
- Develop a loaded mode test for immediate implementation

## *Views of International experts*

## *Experts Contacted*

- Mr. Lennart Erlandson, AVL – MTC, Sweden
- Mr. Micheal Walsh, International Consultant, USA
- Mr. Kong Kha, Hong Kong EPA
- Mr. Allan Llyods / Mr. Shankar Prasad, / Mr. Harold Mace / Mr. Don Chernich / Ms. Sylvia Morrow – California Air Resources Board (CARB), California
- Mr. Joe Pedrosa, Bureau of Automotive Repairs (BAR), California
- Mr. Peter Anyon, Air Quality Technologies Pty Ltd, Australia

## *Response from Mr. Michael Walsh, USA*

- I/M tests for emissions should be loaded tests for all vehicle categories as that is the only way to measure NO<sub>x</sub> and in case of diesel vehicles, PM
- There are detailed issues that will require further work on your part but the loaded testing should be planned for.
- In measuring PM from diesel, there remain issues associated with PM measuring equipment.
- In short term I would measure smoke opacity at full and ½ load and plan on moving directly to PM when the equipment becomes available probably next year

*Response from Mr. Lennart Erlandson, Sweden*

- Given his initial reactions on which a number of queries raised
- Reply awaited as he is on vacation

*Response from EPA, Hong Kong*

- Our loaded mode test for diesel is a lug down test which only measures smoke opacity
- It is my understanding that Mr. Peter Anyon is doing work on diesel I/M test that would measure PM and NOx

*Response from CARB*

- The steady state loaded mode ASM test is required on all gasoline vehicles under 10,000 lbs.(4500kg).
- Gasoline vehicles 10,000 lbs (4500kg) above are required to be tested using the two speed idle test for smog check
- For diesel vehicles over 6000 lbs (2700 kg), the snap idle test is mandatory. The snap idle test is more of a diagnostic test rather an emissions measurement test

*Response from CARB*

- State law requires fleets to annually conduct a snap idle test on their diesel vehicles. If there is excessive smoke, the vehicles are required to be repaired and retested.
- The fleet is required to keep record which are audited by ARB Staff
- Not aware of any device that measures NOx and PM from in service diesel vehicle here or in other countries
- Currently, ARB is not considering adding diesel vehicles to the smog check inspection program.

### *Response from CARB*

- The loaded mode Inspection/Maintenance program for gasoline vehicles is administered by the Bureau of Automotive Repair (BAR)
- The BAR staff writes the loaded mode equipment testing specifications and procedures
- Mr. Joe Pedrosa from BAR explains that the information requested is not readily obtained at BAR website
- BAR has no information to provide on ARB programs (e.g diesel PM and NO<sub>x</sub>) or those of other states
- BAR does not test diesel vehicles. They are exempt from smog check

### *Response from Mr. Peter Anyon*

- Laser Light Scattering Photometry (LLSP) provides excellent correlation with laboratory instruments at a fraction of cost
- Appropriate sample preconditioning is to be employed in order to minimise the potential for measurement errors
- The cost of LLSP instrument range from US \$5,000 – US\$ 15,000 depending on the sample preconditioning requirement
- Over the coming years some instruments designed specifically for diesel PM testing will become available

### *Response from Mr. Peter Anyon*

- For the initial Phase-in loaded diesel emission test, Australian Government is exploring a simple free acceleration test that will measure both PM and smoke opacity
- There is some evidence that directly measuring PM in such a test may in fact be quite effective and has advantage of being extremely quick, with low cost equipment
- Working on to produce a “brief case” system that will integrate exhaust mass flow measurement, PM, NO<sub>x</sub>, and smoke opacity
- Above system will be suitable for on-board measurement of emissions from vehicles while being driven on road or chassis dynamometer

## *Summary of Current International Status for NO<sub>x</sub> and PM measurement*

## *NOx Measurement*

- NOx measurement in loaded mode is done only upto gasoline light duty vehicles
- For diesel vehicles only smoke is measured under lug down test
- Various NOx measurement options are tried out in Australia
- For measurement of NOx from CNG Buses, there is no worldwide experience available

## *PM Measurement*

- The existing international practice for heavy duty vehicle is lug down test which measures only smoke but **not PM**
- The test method for measurement of PM is under development in Australia
- Mr. Peter Anyon is working on a current world bank / CAI-Asia diesel project in Bangkok which is about to commence evaluation of two other short transient test that may be suitable for implementation in Asian cities
- The Bangkok DIESEL project will continue though the end of next year

## *Feasible Available Options For Loaded Mode Emission Test On In-use Vehicles*

### *Loaded mode emission test – CNG Buses*

- **Option 1:** The existing international test methods used for gasoline vehicles could be adopted by
  - Modifying the test cycle to reflect Indian conditions
  - Develop the pass / fail cut points
- **Option 2:** Alternatively, the ARAI developed test method for 2 Wheelers which measures emissions on mass basis can be modified for NOx measurement from CNG Buses

### *Loaded mode emission test – CNG Buses: Option 1*

- Adoption of existing international testing methods for gasoline vehicles
  - The existing loaded test method cannot be directly adopted due to
    - Indian road conditions
    - Indian Low powered diesel / CNG engines
    - Pass / Fail Cut points not relevant to Indian vehicles

### *Loaded mode emission test – CNG Buses: Option 2*

- The ARAI developed 2Wheeler test methodology can be suitably applied for CNG Buses
  - Fixed inertia rollers can be used to load dyno ( low cost )
  - Only NOx analyser needs to be added to the proposed emission equipment
  - Data to be collected on in-use vehicles
  - Software to be developed for calculating the emissions on mass basis

## *Suggestions for loaded mode emission test*

ESP [Presentation](#)

## *Summary*

- There is no readymade solution available internationally for measurement of NOx and PM from heavy duty CNG / Diesel vehicles
- For measurement of NOx from CNG buses, one has to develop a local solution for India
- The PM measurement from in-use diesel vehicle is under development and not matured
- A pilot project for development of loaded mode emission test for NOx and PM may be initiated



THANK YOU

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25

