

## Approach towards development of effective in-use vehicle emission inspection for India

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## Motor Vehicle Emission Control Program in India

- ◆ Ensure appropriate emission control technologies through vehicle design
  - Type Approval (TA).
- ◆ Compliance at production level quality
  - Conformity of Production (COP).
- ◆ Exhaust emission ( PUC certificate)
  - Idle CO Emission Test for gasoline vehicles
  - Free Acceleration Smoke test for Diesel vehicles

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## Lacunae in the Present System

- ◆ Test procedures and norms have not changed since introduction
- ◆ Proper test procedure not followed
- ◆ Equipment not maintained / calibrated
- ◆ PUC Center operators are not trained
- ◆ No auditing of PUC Center
- ◆ Lack of centralized agency for co-ordination
- ◆ The number of vehicles undergoing PUC test is very small due to absence of control mechanism to identify vehicles escaping PUC
- ◆ No centralised system of data collection
- ◆ Existing system is prone to tampering

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## Issues with Idle CO Testing

### Idle CO check :

- Proper extension pipes especially for 2&3 wheeler vehicles are not used
- Chances of leakages in the system leading to low emission values



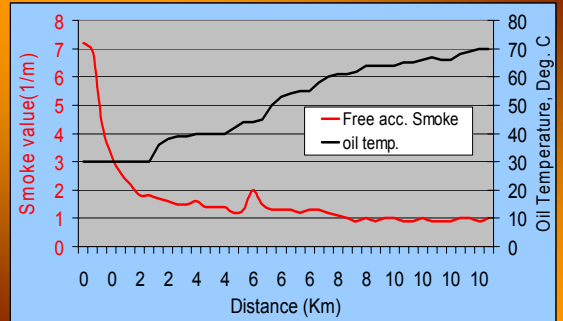
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### Issues with Free Acceleration Smoke Test

- Smoke readings differ with warming up of the vehicle. Difficulty was experienced in the field to achieve the specified 10 km warming up to get consistent readings.
- The smoke readings may vary depending on the way the accelerator pedal is pressed by various operators during the test.
- The smoke readings at different PUC centers does not match.

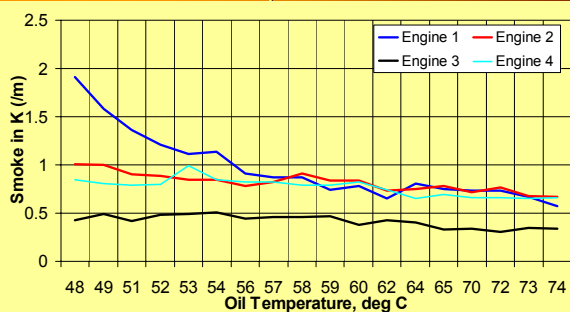
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### Free Acceleration Smoke Vs Oil temp & Warm up distance



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### Free Acceleration Smoke Vs Oil Temperature



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### Enhanced PUC system

- Revision in Idle emission norms based on the year of vehicle manufacture.
- Introduction of idle HC emission standards
- Introduction of idle CO and HC emission norms for CNG / LPG vehicles
- Will have improved test methods for gasoline and diesel vehicles
- Four gas analyzer for better accuracy
- Measurement of Engine oil temperature and engine rpm for repeatable and consistent smoke readings
- Improved equipment operating conditions
- Compulsory AMC for min 5 yrs.
- Annual renewal based on AMC verification
- Training of PUC center operators by equipment suppliers and institutionalise the complete system
- Calibration of equipment three times per year
- Communication capability with computer for data transfer and storage

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Revised PUC norms effective from 1<sup>st</sup> October 2004

Sr. No	Vehicle Type	Present Norms		Revised Norms		Analyser Required
		CO %	HC ppm	CO %	HC* (n-hexane equivalent) ppm	
1	2 & 3-wheeler (2/4 – stroke) (vehicles manufactured on or before 31 <sup>st</sup> March 2000)	4.5	-	4.5	9000	2 Gas
2	2 & 3-Wheelers (2-stroke) (Vehicles Manufactured after 31 <sup>st</sup> March 2000)	4.5	-	3.5	6000	2 Gas
3	2 & 3 wheelers (4-stroke) (vehicles manufactured after 31 <sup>st</sup> March 2000)	4.5	-	3.5	4500	2 Gas
4	4-Wheelers other than Bharat Stage-II compliant	3.0	-	3.0	1500	2 Gas
5	Bharat Stage II compliant 4-wheelers	3.0	-	0.5	750	4 Gas

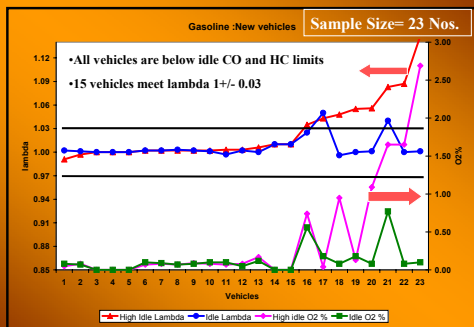
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Lambda measurement from in use vehicles

- ◆ To contain increasing NOx levels in Delhi, EPCA suggested implementation of lambda measurement on CNG Busses
- ◆ Lambda measurement is not done worldwide on CNG vehicles
- ◆ Lambda value can give an indication of malfunctioning of catalytic converters or the engine
- ◆ ARAI collected data on in-use Bharat Stage II compliant CNG vehicles in Delhi

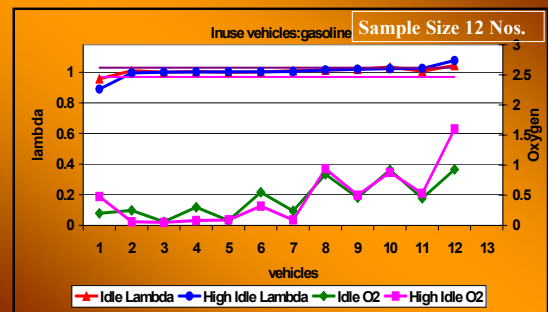
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Lambda data: New Gasoline Vehicles



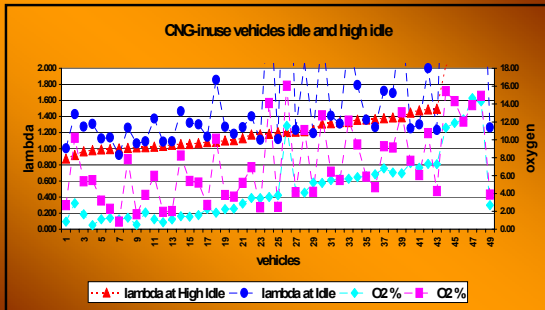
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Lambda data: In-use gasoline vehicles



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### Lambda data: In-use CNG vehicles



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### Effect of exhaust dilution on lambda

Test Condition	RPM	CO %	HC ppm	CO <sub>2</sub> %	O <sub>2</sub> %	Lambda
	850	0.13	50	3.2	16.14	4.258
	2200	0.38	55	9.3	7.06	1.476
	860	0	22	14.4	0.74	1.034
	2200	0.02	26	14.7	0.34	1.014

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### What does the field data show?

- ❖ In-use gasoline vehicles
  - Idle and high idle lambda follow each other
  - Out of total 12 vehicles, 10 vehicles meet the requirement of Lambda @ high idle within 1 +/- 0.03
- ❖ In-use CNG vehicles
  - Most of the in-use vehicles have the exhaust leakage
  - Excess oxygen is noted in exhaust. This could be due to exhaust leakage
  - For CNG vehicles, data validity is poor and hence, difficult to establish any relationship.

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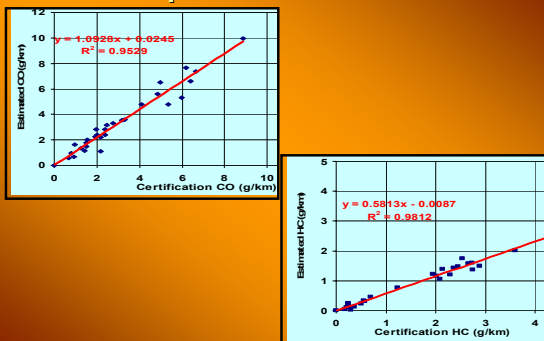
### ARAI developed loaded mode test method for 2 Wheeler vehicles

- ❖ This test method was reviewed by Dr. R.A. Mashelkar in auto fuel policy report and recommended for dovetailing with the PUC system
- ❖ This system was appreciated by international experts - Mr. Micheal Walsh and Dr. John Rogers
- ❖ Can be extended to light duty gasoline and CNG buses



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## Comparison of Results



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## Summary

- ❖ The enhanced PUC system with administrative mechanism would be effective for the present technology of vehicles
- ❖ Lambda measurement in idle/high idle along with the exhaust emission did not reveal the working condition of Cat. Converters / vehicle / engine due to the condition of the vehicle exhaust system
- ❖ With some development efforts the ARAI Developed loaded mode emission test for 2 Wheelers could be extended for CNG vehicles
- ❖ In-use diesel vehicle PM measurement system is being tried out in Australia and the lessons learnt could provide a local solution for India

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# THANK YOU

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