ENVIRONMENT POLLUTION (PREVENTION & CONTROL) AUTHORITY
for the National Capital Region

Dr Bhure Lal
Chairman

EPCA-R/2017/L-39
September 18 2017

To:

The Registrar General
Hon'ble Supreme Court of India
New Delhi

Sub: Submission of Report on pollution under control (PUC) programme in Delhi and NCR.

Dear Sir,

This is with reference to the Hon'ble Supreme Court Order dated August 10 ,2017 in W. P. (C) No 13029 of 1985 M. C. Mehta v/s UoI & Others.

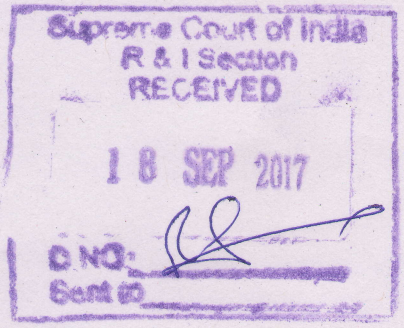
I am hereby enclosing the **Report No.75 of the Environment Pollution (Prevention & Control) Authority for the National Capital Region (EPCA).On the assessment of pollution under control (PUC) programme in Delhi and NCR.**

Kindly arrange to place the report before the Hon'ble Court.

With kind regards,

Yours faithfully,

(Bhure Lal)
Chairman, EPCA



Central Pollution Control Board
Parivesh Bhawan, East Arjun Nagar, Near Karkardooma Courts, Shahdara, Delhi 110 032
Tel/Fax: 22301955 (CPCB), Tel: 24623060 (R)-Dr. Bhure Lal, Chairman

EPCA Report No: 75

Supplementary Report to Report No 73 on assessment of Pollution Under Control (PUC) Programme in Delhi and NCR: Recommendations for improvement to ensure pollution from in-use vehicles is under control. This supplementary report is filed in compliance with Hon'ble Supreme Court order dated August 10, 2017

This supplementary report is based on discussions and final meeting with all stakeholders, including Ministry of Road Transport and Highways (MoRTH), Society of Indian Automobile Manufacturers (SIAM) and Transport Department to finalise recommendations to the Hon'ble Supreme Court on the 3 issues that need final directions based on order dated August 10, 2017

September 18, 2017

Environment Pollution (Prevention & Control) Authority For the National Capital Region

1. Background

The Hon'ble Supreme Court in its orders dated January 17, 2017, and February 6, 2017 in the matter of W.P. (Civil) 13029 M.C. Mehta vs Union of India & others, directed the Environment Pollution (Prevention and Control) Authority for Delhi NCR (EPCA) to inspect Pollution Under Control (PUC) Centers located in the NCT of Delhi and also those in the districts of the NCR.

In compliance with the directives of the Hon'ble Supreme Court, EPCA carried out physical inspection of PUC centers and reviewed the effectiveness of the programme and submitted its final report *(Report no. 73: Report of assessment of Pollution Under Control (PUC) Programme in Delhi and NCR: Recommendations for improvement to ensure pollution from in-use vehicles is under control)* in the Hon'ble Court on April 24, 2017.

The Hon'ble court in its order dated August 10, 2017, passed several directions. These included the introduction of automatic online network to link PUC data centers, directions that no insurance will be granted to a vehicle without valid PUC certificates, mandating pre-payment of PUC fees for proper recording of tests, introduction of well-equipped mobile test centers and a programme to check visibly polluting vehicles; enforcement of stringent penalty for PUC centers for non-compliance and malpractices, making Lambda test for petrol cars mandatory across NCR etc.

The Hon'ble court has also asked to further hear the matter on September 21, 2017to focus on the following recommendations on which there was no agreement:

i) Integration of OBD with the PUC programme;
ii) Tightening of the limit value for pre-BS-IV vehicles
iii) Strategy for advanced Real World Driving Emissions (RDE) monitoring of new generation vehicles to come with BSVI emissions standards in 2020

The directive of the Hon'ble Supreme Court dated August 10, 2017 on the relevant EPCA recommendations

S. No.	Recommendations of EPCA	Response of the Ministry	Direction
1	(i) Tighten the PUC Emissions norms for pre-Bharat Stage IV vehicles; (ii) Overall emissions	(i) The vehicles are manufactured to comply with a predefined emission standard. It is not possible for vehicle owners to improve the emission	This will be considered on a later occasion.

	tests and tighten norms for diesel vehicles.	levels at a later stage. Bharat Stage IV vehicles are already mandated to meet stringent emission norms. (ii) Strengthening of PUC certification process is expected to ensure better compliance.	
2	Integrate On Board Diagnostics (OBD) with inspection and maintenance programme	Present PUC test procedure as per Rule 115 of Central Motor Vehicles Rules, 1989 specifies verification of a malfunction indication lamp (MIL) of OBD before carrying out PUC test. If MIL is 'ON' i.e. there is engine/ emission system fault, then the vehicle owner is required to get the vehicle serviced at the service centre for rectification of the fault. A detailed analysis of the OBD fault will be carried out using scanning tool at the service centre.	Learned *Amicus* says that EPCA would like to reconsider this.
3	Detail out the strategy for advanced real driving emissions monitoring of new generation vehicles to come with BSVI emissions standards in 2020	Real driving emission measurements is a detailed and comprehensive emission measurement process and is slated for implementation along with BS VI norms from 2020 at the time of new model type approval. Further, verification of real driving performance of vehicles at the time of conformity of production test will be carried out.	This will be considered on a later occasion.

2. EPCA meeting to discuss recommendations to Hon'ble Court

On September 14, 2017, EPCA convened a meeting to discuss these three specific recommendations. A draft report was circulated and discussed at the meeting and this supplementary report is based on the final consensus that emerged in the meeting (Minutes of the meeting are attached in Annexure 1).

The meeting was attended by all key stakeholders, including the representative of the Ministry of Road Transport and Highways, Delhi Transport Commissioner, Joint CP Police and SIAM.

This is a consensus supplementary report from EPCA.

SIAM placed its point of view and has agreed with these recommendations.

Item 1: EPCA report on 73 had recommended integration of OBD (On-Board-Diagnostic) with vehicle inspection and maintenance programme.

EPCA had recommended integration of OBD II in four wheeled vehicles manufactured as on and after April 2013 with the PUC programme. OBD in two-wheelers will be introduced only in 2023.

OBD II is designed to inform the car-owner about any mal-function, including any problems with brake or with the emission control system. The Ministry of Road Transport and Highways (MoRTH) has already directed transport departments to ensure that the centres must check if the malfunction light (MIL) is on (red), then the vehicle should be sent back to the manufacturer for detailed check and repair at the workshop**.**

What EPCA is asking for in this recommendation is to do a further check to make sure that the OBD is working. Therefore, the aim of integrating OBD II with the PUC is to ensure that the OBD itself is functioning and to check if the information from the memory of the OBD has not been tampered with or erased.

It has been noted from experience in the US, Europe and other countries that the OBD can be tampered with and its can be memory erased. Therefore, what we require is a simple check, using a uniform scanner, to verify that the OBD II is operational. In case, there is a mal-function as indicated by the malfunctioning light, or memory of the OBD has been erased or OBD is not scanning all regulated components – then the PUC centre reject giving a certificate. This will require the owner to get the vehicle tested and repaired in a workshop.

EPCA has checked and found that ISO specification for scanners are already in place in India that can be used on all models. However, MORTH would have to notify the use of the scanner and the protocol for application in the PUC centre. (See Annexure 2: OBD Integration with PUC).

Final Recommendation based on the September 14, 2017 meeting:

The Hon'ble Court may direct the Ministry of Road Transport and Highways (MoRTH) to develop the protocol for OBD II integration with PUC programme, which will require checking if the OBD is functioning and specify the type of scanner and computer software to pass and fail a vehicle.

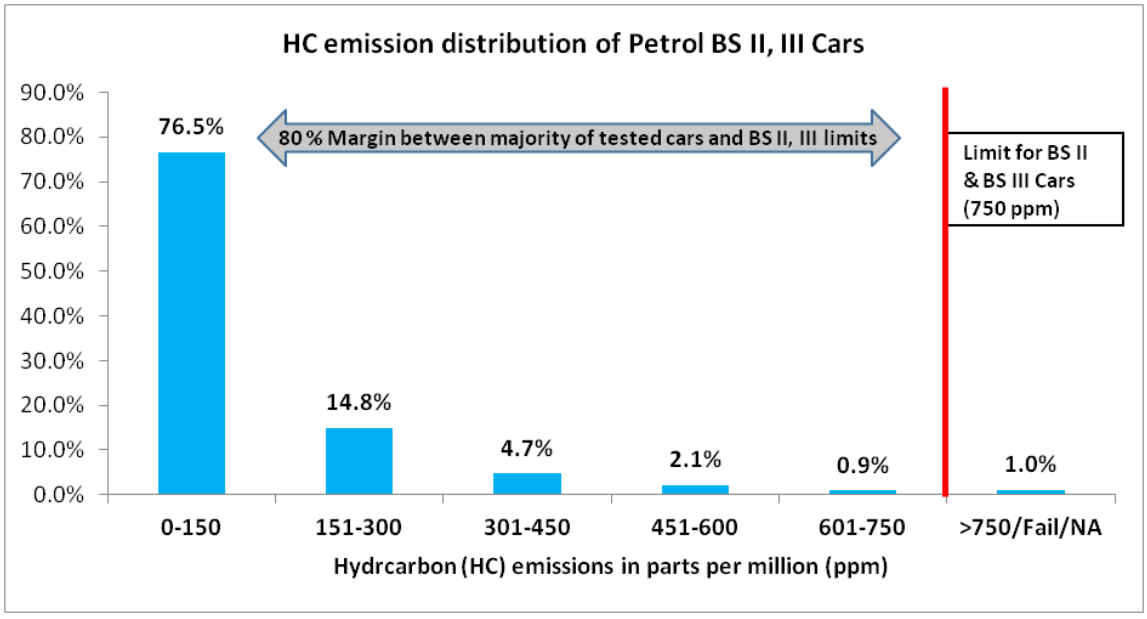
Item 2: Tightening of PUC limit value for pre-BS-IV vehicles

While evaluating the PUC programme under the direction of the Hon'ble Court EPCA had analysed the PUC test results for different categories of vehicles in Delhi and NCR submitted by the transport departments in NCR. One critical observation ***was the very poor failure rate of vehicles*** at the PUC centres -- on an average not more than 2 per cent were found to fail the tests.

While corruption and poor testing procedures contribute towards poor failure rate, analysis also shows a very wide margin of difference between the test results and the limit values for large majority of vehicles (See graph 1: Hydrocarbon emissions from petrol cars and graph 2: Smoke density levels in diesel cars). For example, the limit of 750 ppm hydrocarbon concentration for BSII and BSIII petrol cars equipped with multi-point fuel injection system, three way catalytic converter, and lambda control is very high compared to the average emissions performance.

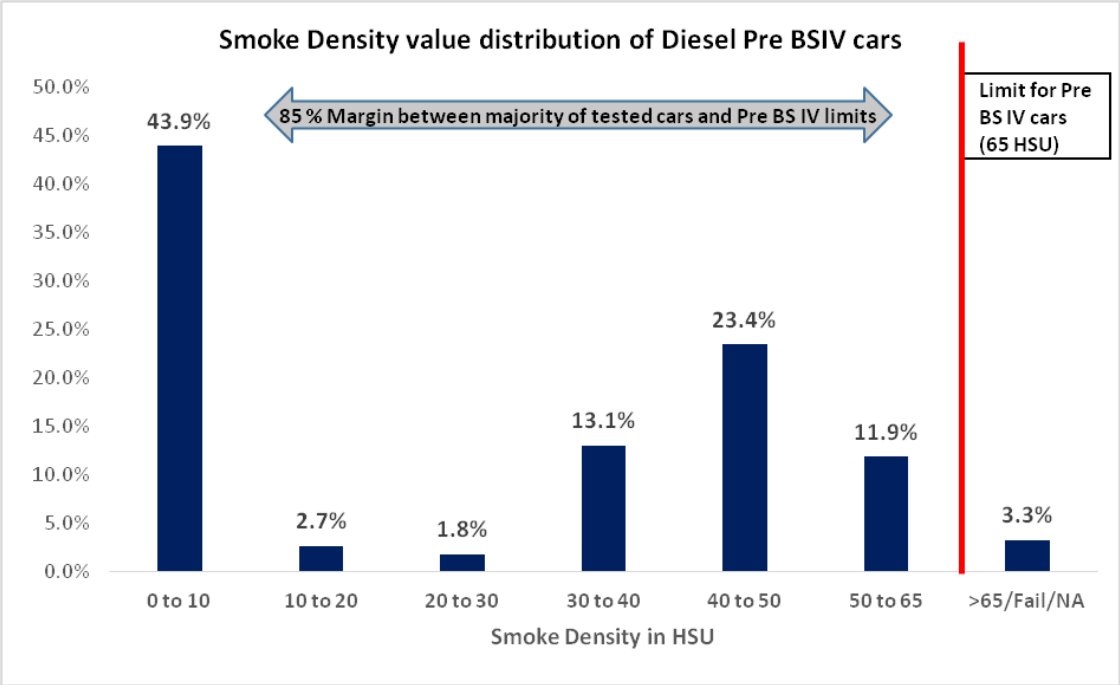
If the pass benchmark for pre-BSIV vehicles remains so high, it cannot effectively identify substantial number of grossly polluting vehicles on road and will have no impact on air quality. PUC limit for BSIV vehicles however have been tightened.

Graph 1: Hydrocarbon emissions from pre-BS IV petrol cars



Source: Data provided by the Transport Dept, Govt. of Uttar Pradesh and the Ministry of Road Transport and Highways, Analysis by EPCA.

Graph 2: Smoke density levels in diesel cars



Source: Data provided by the Transport Dept, Govt. of Uttar Pradesh and the Ministry of Road Transport and Highways, Analysis by EPCA

EPCA has also pointed out that visible smoke – that is currently tested in diesel vehicles -- is not a proxy for tiny particles. Very high emissions of tiny particles are possible from modern diesel engines that are not visible and cannot be captured through smoke density tests. While tightening norms for pre-BSIV vehicles it is also important to improve the test procedures for smoke density tests. Globally, as in China, Hong Kong, the US etc, smoke tests have been upgraded to be done on chassis dynamometer to make the test more rigorous and effective. Such upgraded test procedures may be introduced for phase in for commercial vehicles in centralised inspection centres like Burari on a priority basis.

The Ministry in its affidavit to EPCA's report no 73 had taken the position that it is not possible to undertake retrospective revision of PUC norms for these vehicles, which were manufactured many years ago, based on certain performance criterion.

However, this position is not accurate, as PUC norms for on-road vehicles have been changed retrospectively from time to time since 2004 by the Ministry (see Annexure 3: Retrospective tightening of PUC norms for pre-BSIV vehicles).

Such revision does not mean that vehicle users will have to improve engine emissions, as the ministry affidavit has mentioned. Instead, they would need to

ensure that key components that affect emissions are functioning well and undertake repair and replacement of components as needed. The vehicle owner will also benefit from such maintenance as otherwise high idling emissions can increase fuel consumption and associated costs.

This issue was discussed at the EPCA meeting with the representatives of MoRTH and SIAM and a consensus emerged that it was possible to tighten pre-BS IV PUC limits so that the tests conducted will ensure pollution control.

Final Recommendation based on the September 14, 2017 meeting

The Hon'ble Court may direct the Ministry of Road Transport and Highways to review and upgrade the PUC norms for pre-BSIV vehicles and also upgrade test procedure for smoke density tests for commercial vehicles.

Item 3: EPCA report No 73 has recommended that steps are needed to detail out the Real World Driving Emissions (RDE) that have been notified for BSVI emissions standards to be implemented in 2020

EPCA had recommended in report No 73, that MoRTH should be directed that adequate advance planning is done to ensure that when BS VI vehicles are rolled out in 2020, there is a clear protocol to monitor emissions on roads in real world conditions with the use of portable devices.

EPCA is stressing on this, particularly, as the country will make huge investments in improvement of fuel quality to meet BS VI emission standards.If randomized Real-World Driving tests are conducted on a regular basis, then it would ensure emission control systems are working optimally on road and on-road emissions are under control.

The MoRTH notification mandating tests for BS VI vehicles (see Annexure 4: Issues related to real-world driving emissions (RDE) monitoring) provides for Real-World Driving Emissions measurements with the portable emissions monitoring system. Even for type approval RDE test will be done on road. However, the notification does not explicitly mention that these tests will be conducted on road for light-duty vehicles like cars and SUVs as it has done in the case of heavy-duty vehicles. To avoid any misinterpretation in the future MORTH must make it explicit that real world driving emissions tests with portable emission measurement system will be carried out on road for type

approval and conformity of production for vehicle certification as well as for in-service compliance after vehicles have been sold.

This is being recommended given the experience of European and other countries, which have found huge variation between the emissions at the time of type-approval and what is found in real world driving. The EPCA report no 73 has provided detailed information on how Euro VI (equivalent to BS VI) vehicles fail on key parameters in real world (See pages 13-14 and 40-41 of EPCA Report No. 73). This is also the basis of the Volkswagen scandal.

This issue was clarified at length during the meeting held by EPCA to representatives of MoRTH and SIAM. After discussions, it was accepted that this tests should be specified for Real-World conditions – that is when vehicles are on the road.

Final Recommendation based on the September 14, 2017 meeting:

The Hon'ble Supreme Court may be requested to direct MoRTH to specify that real world emissions would be tested, when vehicles are on roads using portable emission monitoring devices. This would be done for both light duty and heavy duty BS VI vehicles. The protocol for these tests would be laid down in advance so that transport regulators and vehicle manufacturers and are aware of requirements and can ensure compliance.

Annex 1: EPCA Minutes of the Meeting held on September 14, 2017

Minutes of the meeting of EPCA held under the Chairmanship of Shri Bhure Lal at 3:00 pm on 14.9.2017 in the office of Supreme Court Monitoring Committee, Core 6A, Third Floor, India Habitat Centre

Agenda item: Finalization of supplementary report to EPCA report No. 75 regarding Delhi-NCR PUC centers performance assessment in compliance of the Hon' ble Supreme Court order dated August 10, 2017 in W.P. (C) 13029 of 1985 M.C. Mehta Vs Union of India & Ors.

In attendance:
Chairman and Members EPCA

1. Dr. Bhure Lal, Chairman, EPCA
2. Ms. Varsha Joshi, IAS, Commissioner, Transport Department, Delhi
3. Ms. Garima Bhatnagar, IPS, Joint CP (Traffic), Delhi Traffic Police
4. Mr. Anil Kumar Sharma, SE, SDMC
5. Mr. Manoj Kumar, EE, NDMC
6. Mr. Atanu Ganguli, Sr. Director, SIAM

Representative of Concerned Agencies

1. Mr. K.K. Dahiya, Special Commissioner, Transport Department, Delhi
2. Ms Anumita RoyChowdhury, CSE
3. Mr. Priyank Bharti, Director, MoRTH
4. Mr. Vikas Gupta, Transport Commissioner, Haryana
5. Mr. V.K. Singh, Addl. Transport Commissioner, U.P.
6. Mr. Bhanwar Lal, RTO (Alwar), Transport Department, Rajasthan
7. Mr. V.K. Saraswat, PCO, Transport Department, Delhi
8. Mr. Ravinder Soni, ACP, Delhi Traffic Police
9. Mr. A.K. Gupta, SE, NDMC
10. Mr. S.K. Garg, EE (Civil), DEMS
11. Mr. Sanjeev Kumar, AE, NDMC

EPCA convened this meeting to discuss the draft report no 75, which had been circulated to all members and stakeholders. Chairman, EPCA informed the meeting that the August order of the Hon'ble court has listed the following

recommendations of the EPCA report No. 73 for hearing on September 21, 2017:

i) Integration of OBD with the PUC programme;
ii) Tightening of the limit value for pre-BS-IV vehicles;
iii) Strategy for advanced Real World Driving Emissions (RDE) monitoring of new generation vehicles to come with BSVI emissions standards in 2020.

EPCA circulated the draft supplementary report elaborating these recommendations through e-mail on September 12, 2017.

The report was then discussed with all stakeholders.

Item 1: Integration of OBD with the PUC programme

Chairman EPCA explained that the issue was not to check the reasons for malfunction, but to check if the OBD was functioning. This, he explained, was necessary as experience from other countries shows that the OBD could be disabled, or its memory erased. He also explained that based on the query raised by the Hon'ble Supreme Court, EPCA has done research to identify if universal scanners are available to do this check. He said it was possible to get these scanners, which can be used on all vehicles of all makes, to check if the OBD is functioning.

After deliberations, all representatives, including MoRTH and SIAM representatives said that they agree with EPCA's views on integration of OBD testing in PUC.

Item 2: Tightening of the limit value for pre-BS-IV vehicles

Chairman EPCA provided clarification and asked members to once again, check the annexure, which provided detailed information of how the emission standards had been revised over time. Therefore, he said, that it was possible to revise these standards retrospectively. He once again stressed the need to ensure that the tests adequately check pollution and that this was not possible, unless the limits were revised upwards and more vehicles failed (if not meeting the standards set). This would ensure that vehicle owners would improve the up-keep of the vehicle to keep emissions under check.

All representatives, including MoRTH and SIAM representatives said that they agreed with this recommendation.

Item 3: Strategy for advanced Real World Driving Emissions (RDE) monitoring of new generation vehicles to come with BSVI emissions standards in 2020

Chairman EPCA explained the importance of this recommendation so that vehicles on-road, in real-driving conditions would be monitored to ensure that emissions are under control. The draft report includes the recent study *Laboratory and On-Road Emission Testing of In-use Passenger Vehicles in India* -- done by the International Centre for Automotive Technology (ICAT), the Indian vehicle testing agency, and the International Council on Clean Transportation (ICCT), a body which was responsible for exposing the Volkswagen scandal in the US. This joint study tested BS-IV compliant models - a 2015 model of petrol car (Hyundai i20), diesel car (Hyundai i20 diesel), and a diesel SUV (Mahindra XUV500 W8). These cars were tested first in the laboratory and then with portable emission monitoring equipment while being driven on road. Real world NOx emissions from a small Hyundai i20 diesel car were found to be 3-6 times the standard, but a huge 9-12 times the Hyundai i20 petrol NOx levels. As expected, NOx emissions from a petrol car are much lower -- about 0.5-0.7 times the BS-IV standard.

The report also found that real-world NOx emissions from diesel SUV are 4-6 times higher than its already weak NOx standard which, in turn, is 5 times higher than the petrol NOx standard. Thus, NOx emissions from Mahindra's XUV diesel SUV are 25 to 65 times higher than that from an i20 petrol. This virtually means that in terms of NOx emissions, adding one XUV diesel SUV to the city's car fleet is equal to adding 25 to 65 small petrol cars. The study also found that the on-board diagnostic system failed to diagnose emissions anomalies**.**

This study has revealed that the OBD in BS-IV diesel cars is unable to detect problems with several aspects of emissions control system. For instance, in BS-IV vehicles, in-cylinder NOx emissions are controlled by using cooled exhaust gas recirculation (EGR) system. The test has found a mechanical failure (punctured rubber hose) in the EGR in diesel cars, leading to three times more

emissions than the fixed limit. But the OBD systems in the car could not detect this.

There was detailed discussion on this study.

SIAM representative informed that vide letter dated 14.9.2017 SIAM has officially submitted its comments to EPCA on this item.

SIAM holds the strong view that there is no need to cite the study by the US based International Council on Clean Transportation (ICCT) done with the International Centre for Automotive Technology (ICAT) on real-world emissions from Indian vehicles. According to SIAM this study was independently done by ICCT at ICAT facilities and ICAT has stated, in writing that it has no role to play in the said study. It asked for reference to this study to be removed from the supplementary report.

SIAM representative, however, said that they are of the view that Real Driving Emissions (RDE) for BS VI vehicles should be tested on the road instead of undertaking this test in the laboratory. Therefore, there is no difference of opinion with EPCA on the need to recommend these tests. It just did not want the ICAT-ICCT study included in the report.

Chairman, EPCA, decided that given that there is no difference between SIAM and EPCA on the need to include Real-Driving Emission tests on vehicle on road using portable devices, they would drop reference to the ICAT-ICCT study in the report submitted to the Hon'ble Supreme Court.

EPCA observed that there is no other comment from any member or stakeholder on the supplementary report. EPCA decided to file its report after giving consideration to the request made by SIAM for deleting the reference of ICAT-ICCT report.

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Annex 2: OBD Integration with PUC

The steps needed in PUC centres to conduct OBD tests

Step 1: **A visual check of the dashboard display function and status of MIL**: If the MIL light is ON ask the vehicle owner to go for test and repair in workshops. This requires visual examination of the dash board to see if the MIL illuminates briefly when the ignition key is turned to the "Key on, engine off" position. A brief illumination of the MIL at start up is normal and helps confirm the bulb is in proper operating condition. If the MIL remains illuminated then it fails.

Step 2: **An electronic examination of the OBD computer itself**. This is needed to know if the data has been erased from its memory at the time of servicing or before coming for tests. This could also happen if someone on purpose cleaned out the codes etc. If there is no stored data OBD cannot be used for inspection. The vehicle will have to be asked to go back and will have to be driven normally for up to a week to collect sufficient data to allow OBD detect features.

Ensure that the MIL is commanded off by connecting to a OBD tool. In other words the software can read there is nothing out of range. This is needed to ensure that OBD is reading and monitoring all the required certified components related to emissions. With the scan tool in the generic OBD mode follow the protocol to determine vehicle readiness status; MIL status (whether commanded on or off) and diagnostic trouble codes for those vehicles with MIL commanded on.

ii. Need protocol to pass and fail vehicle based on OBDT II tests

Vehicle passes if: MIL check OK and or MIL lit while engine running and MIL not commanded on for any diagnostic trouble code and all readiness codesare set.

Vehicle fails If: MIL check-not OK and or MIL is lit while engine running and/or MIL commanded on for any diagnostic trouble codeand or data link connectoris missing, tampered or inoperable.

Vehicle rejected If: More unset readiness codes are foundthan allowed based on vehicle model year and/or data link connector cannot be located or is inaccessible.

iii. India has specifications for scanning instruments

Already, specifications are available for single universal scanners needed for vehicle inspection. These are ISO 15031-4:2014. This specifies a set of standard OBD services. ISO 15031-4:2014 specifies set of facilities to be provided by external test equipment, which will include scan tool facilities. These facilities provide complete, efficient, and safe access to all on-board diagnosis services on any vehicle, which is compliant with ISO 15031-4:2014. The ISO 15031-4:2014 specifies

- means of establishing communications between an OBD-equipped vehicle and external test equipment, and
- set of diagnostic services to be provided by the external test equipment in order to exercise the services defined in ISO 15031-5.

In fact, the following protocolsare to be used for all BSIV 4W vehicles:

- Passenger cars: ISO 15031
- Bus or trucks: ISO 15031 or J1939

Test equipment and diagnostic tools needed to communicate with OBD systems must meet or exceed the functional specification given in ISO 15031-4 or SAE J1939-73 section 5.2.2.1

iv. Capacity to be built in PUC centres

The PUC centres will have to be equipped with scanner tool and a computer to read the vehicle and issue certificate. The PUC inspectors will need training in handling of the equipment. But the results for pass and fail will not depend on the interpretation of the complex data set by the inspectors. Software will determine pass/fail. The inspector operates the tests and responds to prompts given by the computer. Therefore, the inspector must understand how to operate the computer and software, to link the computer to the vehicle and prepare it for testing, and to understand the administrative procedures of testing. This is the training required.

Currently, all manufacturers have created their respective scanners to read their make and model vehicles for use in their workshop. Their respective workshops have been given detailed manual and trained personnel to read the OBD to identify the repairs needed. However, for vehicle inspection programme – as it is practices in other countries such as the US –scanners meeting uniform specifications, are used across inspection centres and for all vehicles.

v. Manufacturers of OBD scan tool:

The key suppliers are Silver Scan, BOSCH, and Actron

vi. Cost of OBD scanning facility

According to the available information the average cost of the scanning facility is expected to be about Rs 1.9 lakh. Given the volume of tests involved this can be easily recovered from the tests.

vii. Periodicity of OBD tests

Global review shows that the OBD test is done once a year. As these tests will be valid only for BSIV vehicles produced since 2013, the volume of tests required initially will be manageable.

viii. OBD test makes emissions inspection more rigorous.

Currently, under PUC it is not possible to monitor particulate matter and nitrogen oxides from vehicles that are pollutants of concern. But OBD can sense the operative conditions within the vehicle that is needed to control both engine out and exhaust emissions for all key pollutants. There is an inbuilt emissions threshold limit that has been specified for OBD inspection. OBD senses the components to see if the levels are within the threshold level. If it senses the levels are exceeding these limits it will red flag – in fact even before it reaches the threshold (See Table 1: OBD threshold limits for BS IV vehicles).

Table 1: OBD threshold limits for BS IV vehicles

Category	Class	Reference Mass (RM) (kg)	CO (g/km)		HC (g/km)		NOX (g/km)		PM* (g/km)
			Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Diesel
M** (GVW <= 2500 or upto 6 seater)		All	3.20	3.20	0.40	0.40	0.60	1.20	0.18
N1 & M*** (GVW>2500 or above 6 seater)	I	RM<= 1305	3.20	3.20	0.40	0.40	0.60	1.20	0.18
	II	1305<RM<=1760	5.80	4.00	0.50	0.50	0.70	1.60	0.23
	III	1760<RM	7.30	4.80	0.60	0.60	0.80	1.90	0.28

Source: BS IV Notification, 2010

*For diesel engines

**These limits are not applicable for vehicles designed to carry more than six occupants including driver or vehicles whose maximum mass exceeds 2500kg

***These limits are applicable for vehicles designed to carry more than six occupants including driver or vehicles whose maximum mass exceeds 2500 kg

Comparison of OBD threshold limits with the mass emission standards indicates the following:

- The OBD threshold values of CO for petrol vehicles are 3.2 times higher than the mass emission norms for all categories of vehicles. In diesel vehicles, the threshold limits are 6.4 times higher than the emission norms
- In case of HC emissions, the OBD threshold limits are 3.8 – 4 times higher than the emission norms for gasoline vehicles
- The NOx OBD threshold limits for petrol vehicles is 7-– 7.5 times higher than the emission norms whereas 4.8 times higher for diesel vehicles.
- The PM OBD threshold limits for diesel vehicles is 4.7—7.2 times higher than the mass emission standard

The threshold values are normally deliberately high in order to detect malfunctions, which are easily detected with these conservative thresholds. OBD's primary function is to warn the driver that something is wrong with the vehicle and to alert the PUC centre. A vehicle with a malfunction can be clearly identified with these threshold values. The highest emitters (the top 20 percent) can account for the majority of emissions in the fleet. So the key is to detect those high emitters and have them serviced. Emphasis must be placed on getting those malfunctioning vehicles off the road and repaired. OBD makes the functioning of the whole testing and servicing regime efficient.

ix. Combine OBD tests with physical inspection under PUC:

There are several advantages when OBD tests are done along with physical tests under PUC. It is possible for an individual component to malfunction without leading to an immediate increase in tailpipe emissions. Because of its ability to monitor individual components and operative conditions, OBD is able to give motorists an "early warning" that repairs are needed; it is because of this "early warning" capability that OBD will sometimes fail vehicles that would otherwise pass a tailpipe test. OBD also monitors for leaks and other malfunctions in the fuel system—problems that traditional tailpipe tests were not designed to identify.

OBD checks are a simpler, faster process than emissions testing, and can improve vehicle owners' satisfaction with the PUC program.

Specifications for OBDII for emission monitoring

According to the notification[1] of the Ministry of Road Transport and Highways the OBD system monitors variety of function related to emissions, safety and performance. From the perspective of emissions inspection the following is monitored:

Table: Monitoring items in OBD II for petrol and diesel vehicles, applicable since 1st April 2013 in India

Petrol vehicles	• Catalyst • Misfire • Oxygen sensor • Secondary air system (if provided) • Coolant temperature • Exhaust Gas Recirculation system • Fuel tank leakage and evaporation

[1]The Gazette of India, Extraordinary
http://morth.nic.in/writereaddata/sublinkimages/GE522774676141.pdf

	• Fuel system • Emission control system and components • Circuit continuity for all emission related powertrain components • Distance travelled since (MIL) Malfunction indicator lamp was ON
Diesel vehicles	• Catalyst • Fuel injection system • Particulate trap (if provided) • Coolant temperature • EGR (if provided) • Fuel system • Emission control systems/components • Circuit continuity for all emission related powertrain components • Distance travelled since MIL was ON

Source: The Gazette of India, Extraordinary
http://morth.nic.in/writereaddata/sublinkimages/GE522774676141.pdf

ANNEX 3: Tightening of limit value for pre-BS-IV vehicles

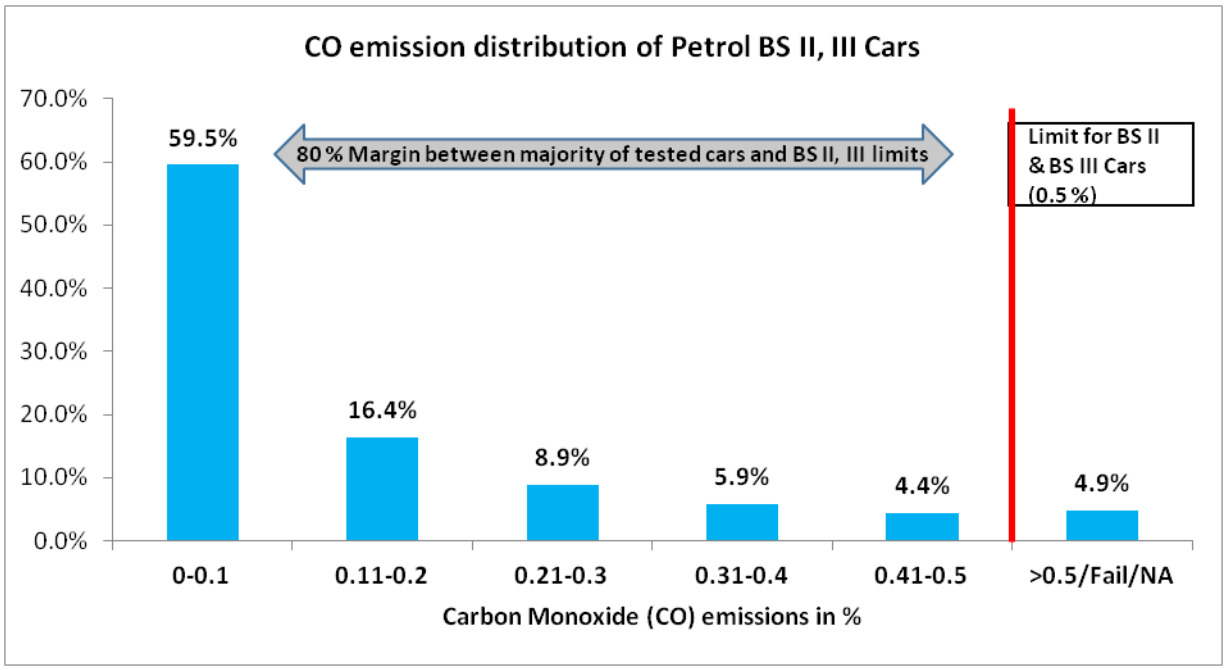
Assessment of PUC data from Delhi NCR

While evaluating the PUC programme EPCA has reviewed the available results for pre-BSIV vehicles from PUC testing. This shows very wide margin of difference between the actual result and the limit value. This indicates the scope of further tightening if the objective of the PUC programme is to identify at least 20 per cent top emitting vehicles on the road – as is the global best practice.

Carbon monoxide from BS II & BS III petrol cars

- The CO emission limit for BS II and BS III petrol cars is 0.5 % CO content.
- The CO emission distribution of 1660 BS II and BS III cars shows that 59.5% cars have tested emission values in the first quintile, easily meeting the appropriate standards by an 80% margin.

Graph 1: Distribution of tested Carbon Monoxide Emissions in BS II & BS III Petrol cars

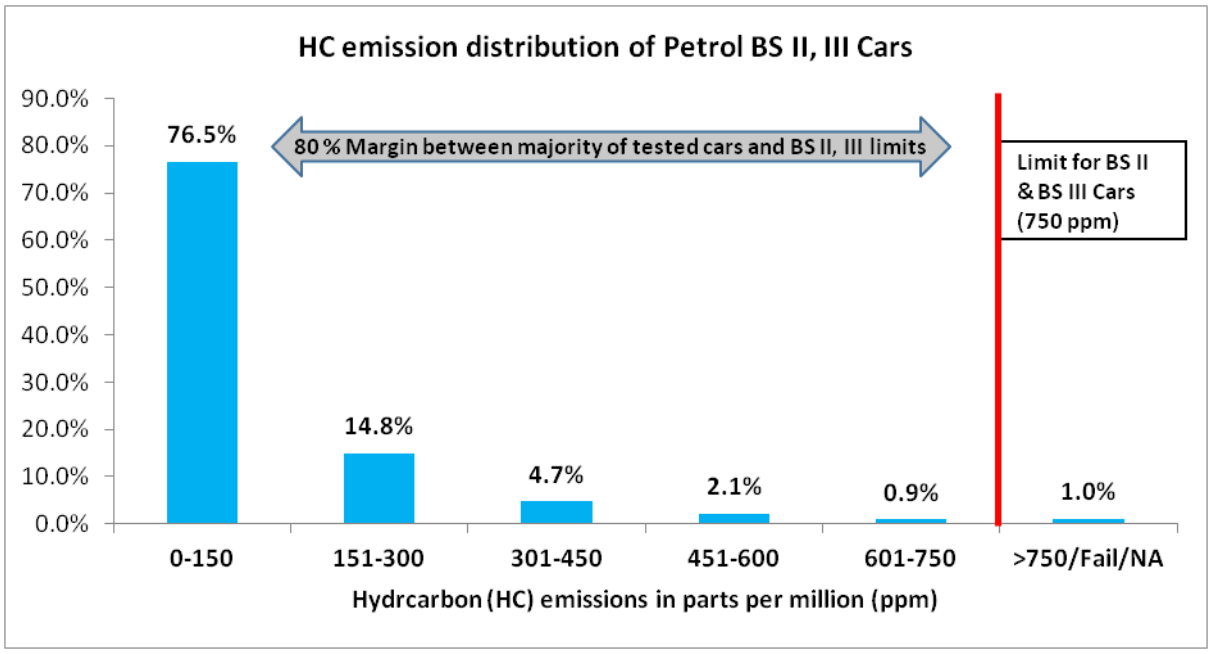


Source: Data provided by the Transport Dept, Govt. of Uttar Pradesh and the Ministry of Road Transport and Highways, Analysis by CSE.

Hydrocarbon emissions from BS II & BS III cars

- Hydrocarbon emissions limit for BS II & BS III cars is 750 ppm.
- The HC emission distribution of 1660 vehicles BS II and BS III cars shows that 76.5% cars have tested emission values in the first quintile, easily meeting the appropriate standards by an 80% margin.

Graph 2: Distribution of tested Hydrocarbon Emissions in BS II & BS III Petrol cars

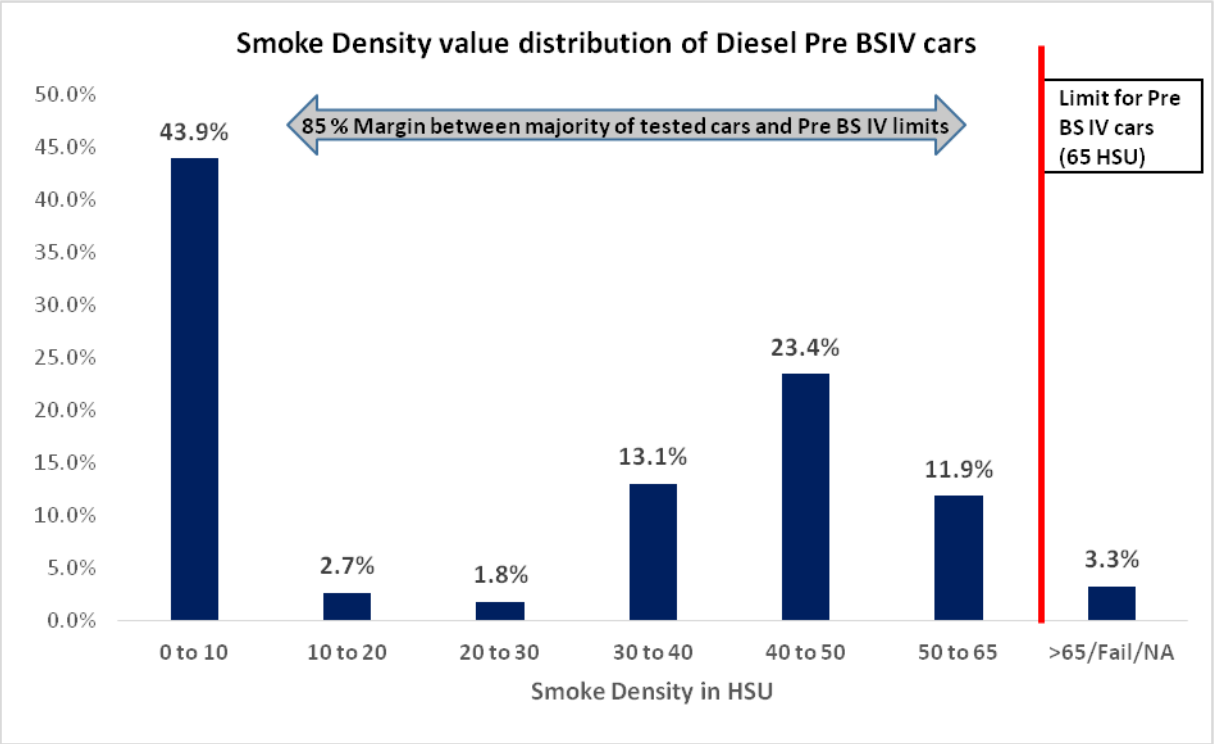


Source: Data provided by the Transport Dept, Govt. of Uttar Pradesh and the Ministry of Road Transport and Highways, Analysis by CSE.

Smoke density from pre-BSIV diesel cars

- The smoke density norm for pre-BSIV diesel vehicles is 65 HSU. Distribution of Smoke Density values of 337 Pre BS IV vehicles show 43.9% have values in the first quintile, easily meeting the appropriate standards by an 85% margin.

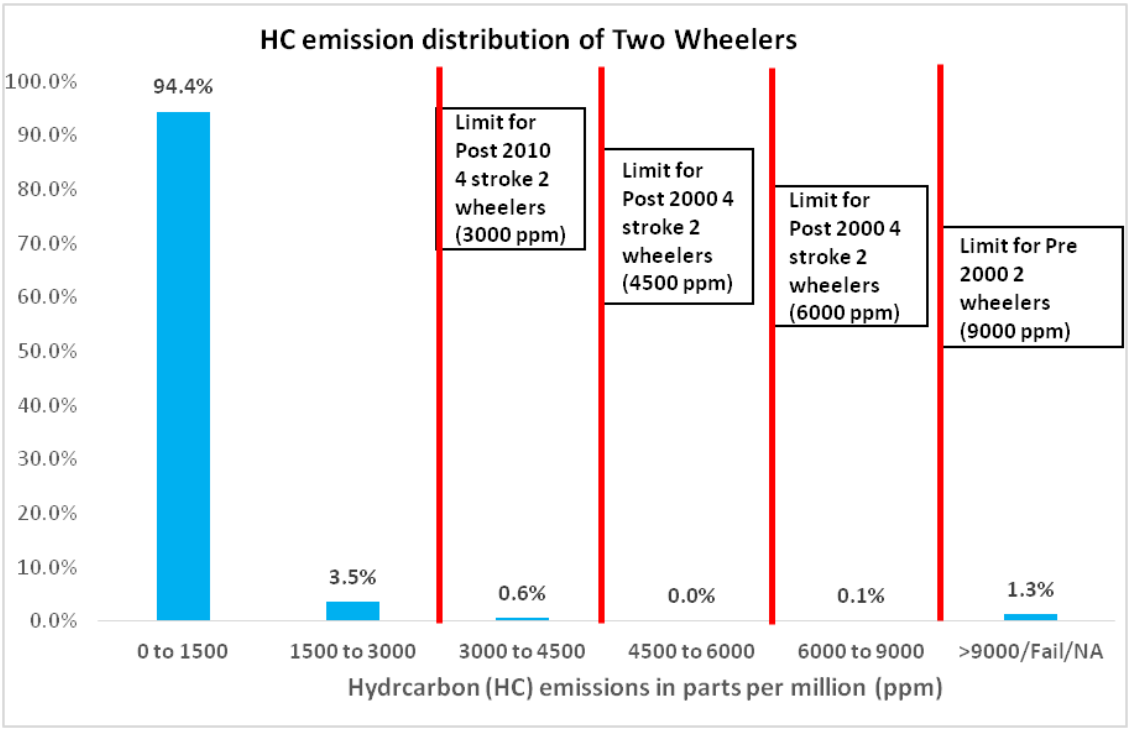
Graph 3: Distribution of tested Smoke Density of emissions in Pre BS-IV Diesel cars



Source: Data provided by the Transport Dept, Govt. of Uttar Pradesh and the Ministry of Road Transport and Highways, Analysis by CSE

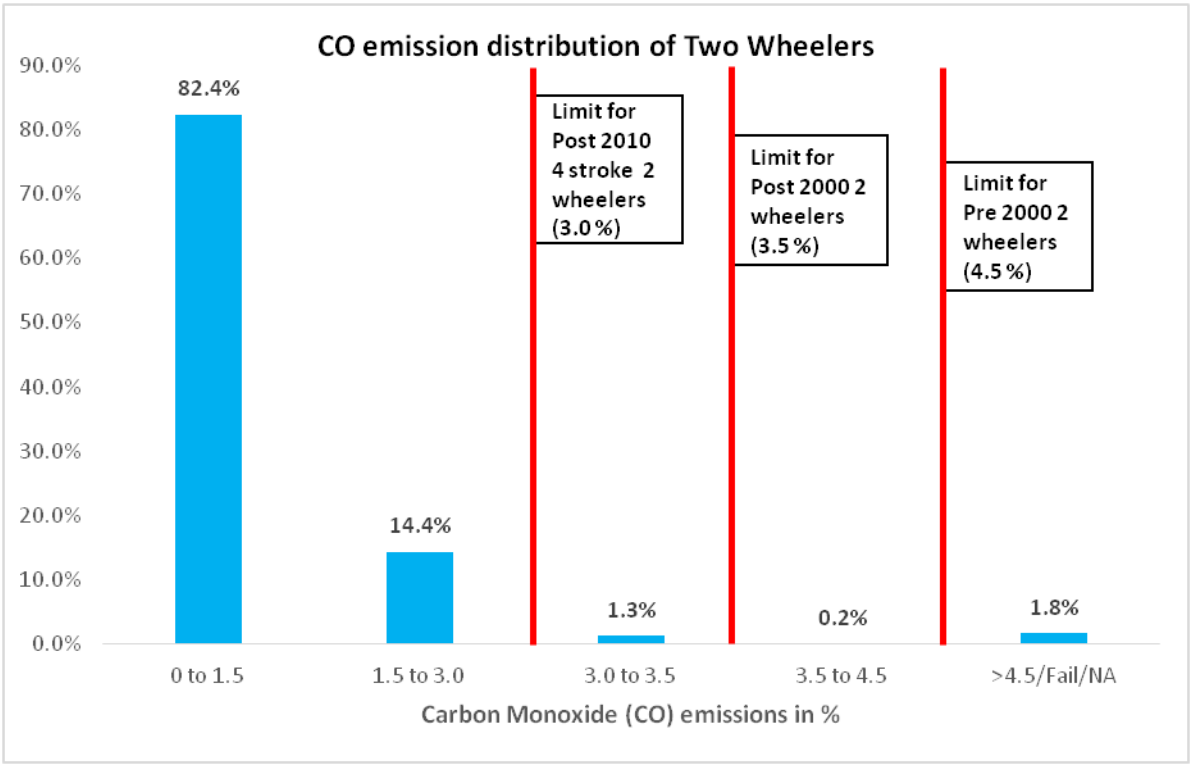
Distribution of tested Hydrocarbon Emissions in all Petrol 2 wheelers

- About 98% of the 6395 sample vehicles – 49 out of every 50 vehicles, have tested HC emission values within the most stringent limits. Almost 95% have tested HC emissions less than one-third of the most stringent limits.



Source: Data provided by the Transport Dept, Govt. of Uttar Pradesh and the Ministry of Road Transport and Highways, Analysis by CSE.

Graph 5: Distribution of tested Carbon Monoxide Emissions in all Petrol 2 wheelers



- From the distribution of tested CO emission values, we see that 97% of the 6395 sample vehicles– 49 out of every 50 vehicles have tested CO emission values within the most stringent limits. Huge majority of the vehicles – almost 83%, have tested CO emissions roughly less than half of the most stringent limits.

There is already a precedence where the Ministry of Road Transport and Highways has tightened and revised PUC norms in 2004 for all vehicles retrospectively

Retroactive implementation of idle emission norms

In 1989, the Union Govt. introduced the Central Motor Vehicle Rules, 1989, which brought into effect the first emission regulations in India. These were idle emission limits, which were subsequently supplemented by mass emission norms for petrol and diesel. While the mass emission norms were gradually tightened through the 90's before the Bharat Standard (BS) was introduced in 1999, the idle emission limits remained the unaltered, until the following changes were made:

2004[2]

- Introduction of Idle emission norms for Hydrocarbon Emissions for all categories of vehicles
- Addition of new fuels – Liquefied Petroleum Gas (LPG) and Compressed Natural gas (CNG) to idle emission regulations
- Introduction of categories of limits for 2, 3 and 4 Wheelers, such as "Manufactured before 31st March 2000", "Manufactured after 31st March 2000" and "Pre Bharat Stage II Norms" and "Bharat Stage II norms"
- Reduction of permissible CO emission limits for the categories "Two wheelers, three wheelers and quadricycles (2-4 stroke)(Vehicles manufactured after 31st March 2000)" from 4.5 % by volume to 3.5% by volume
- Reduction of permissible CO emission limits for the category "4-wheelers manufactured as per Bharat Stage-II or later norms" from 3.0 % by volume to 0.5% by volume.
- Introduction of optional (subject to State Govt./UT's approval) measurement of "LAMBDA(dimensionless value representing burning

[2]G.S.R. 111(E), dated 10th February 2004

efficiency of an engine in terms of air/fuel ratio the exhaust gases" and tighter emission norms for in-use vehicles

- Reduction of permissible maximum Smoke Density for diesel driven vehicles other than agricultural tractors "Full load at 60 to 70% of maximum engine-rated RPM declared by the manufacturer" from 75 HSU to 65 HSU (Change made to the mode of acceleration to allow only free acceleration)
- Introduction of conditions for free acceleration during Smoke Density tests for diesel vehicles, which include parameters of engine oil temperature, RPM and depth of probe insertion

2007[3]

- Introduction of categories of limits for 2, 3 and 4 Wheelers, such as "Manufactured after 31st March 2010", and "Bharat Stage III emission norms"

2012[4]

- Introduction of Idle emission norms for "Compressed Natural Gas/Liquefied Petroleum Gas/Petrol driven 4-wheelers manufactured as per Bharat Stage-IV norms", which reduced maximum permissible CO and HC limits to 0.3% CO by volume and 200 ppm HC respectively.
- Introduction of mandatory Lambda testing for petrol driven BS IV cars

2014[5]

- Reduction of permissible CO and HC emission limits for "Two wheelers (2 stroke) (manufactured after 31st March 2010)" from 3.5 % CO by volume and 6000 ppm HC to 3.0 % CO by volume and 4000 ppm HC and for "Two wheelers (4 stroke) (manufactured after 31st March 2010)" from 3.5 % CO by volume and 4500 ppm HC to 3.0 % CO by volume and 3000 ppm HC.

2015[6]-

- Modification of conditions for free acceleration during Smoke Density tests for diesel vehicles, which include parameters of engine oil temperature, RPM and flushing cycles, making it more "lax"/"simplified".

[3] G.S.R. 276(E), dated 10th April 2007
[4] G.S.R. 103(E), dated 23rd February 2012
[5] G.S.R. 277(E), dated 11th April 2014
[6] G.S.R. 498 (E) dated 16th June 2015

Diesel vehicles need tighter norms and test procedures

Under the current PUC regime only smoke density test is possible in diesel vehicles. No other pollutant can be monitored. Visible smoke test is inappropriate as visible smoke does not have direct correlation with particulate matter emissions. In fact, invisible emissions from diesel vehicles can have higher tiny particles.

Globally governments are improving the test procedure for the smoke tests. The free acceleration smoke test is now being carried out on chassis rollers to simulate speed to exert load on the vehicle. This makes the test more rigorous and relevant. Such Lug-down loaded test is done in the US and Hong Kong in which the vehicle is operated on chassis dynamometer at a fixed speed while the dynamometer load is increased to the point where the vehicle is running at full throttle. The dynamometer load is then gradually increased to reduce the engine speed until the engine is labouring or lugging. US, Hong Kong, China have introduced such tests. Heavy-duty diesel vehicles are subjected to On-road Heavy Duty Vehicle Emission Monitoring Systems or Lug down testing for diesel vehicles.

Even petrol vehicles in the US and Canada have been put on advanced testing procedure like Acceleration Simulation mode. In ASM loaded test, the vehicles are accelerated with the load applied on it and it is usually tested by placing on the chassis dynamometer. It has higher accuracy than the PUC tests in India. This has also been implemented in China. In fact in improved the ASM or IM240 loaded test instead of just acceleration, the vehicle follows a test cycle on a chassis dynamometer. Loaded mode testing is a better indicator of actual emissions since it involves simulation of actual driving conditions; in addition, simulation has the capability to provide better diagnostic information to mechanic in terms of actual engine maladjustments and malfunctions.

Such upgraded tests procedures may be reviewed and adopted for commercial vehicles that are tested in centralised testing centres.

Annex 4: Issues related to the Real World Driving Emissions (RDE) under BSVI emissions standards

Provisions of RDE regulations in BSVI notification of 2016

BSVI regulations as notified by the Ministry of Road Transport and Highways in September 2016 have provided for Real Driving Emissions (RDE) monitoring as follow:

Light duty vehicles: (GVR<3500 kg)

a) During type approval and Conformity of Production applicable from 1st April, 2020, real world driving cycle emission measurement using PEMS shall be carried out for data collection and from 1st April, 2023 real world driving cycle emission conformity shall be applicable. The detailed procedure to be laid down in AIS137 and as amended from time to time.

b) In service compliance of vehicles shall be as per procedure laid down in AIS137 and as amended time to time. (Page 29)

Heavy duty vehicles: (GVW >3500 kg)

During type approval and conformity of production applicable from 1st April, 2020, emission measurement on vehicles using PEMS shall be carried out on road for data collection and from1st April, 2023 in-service conformity factor shall be applicable. The detailed procedure is laid down in AIS137 and as amended from time to time. The type approval vehicle used for the PEMS demonstration test shall be representative for the vehicle category intended for the installation of the engine system. The vehicle may be a prototype vehicle or an adapted production vehicle. For PEMS demonstration test at type approval, vehicle shall meet the requirements of in-service compliance from 1st April 2023.This has been laid down (Page 31).

PEMS testing is done by placing the equipment in the vehicle and recoding emissions as it is being driven. This second by second data is processed and evaluated for conformity against a set of emission limit. As in Europe, India should implement these tests for both type approval and conformity of production as well as well as for in-service compliance on road.

Europe has already implemented RDE for type approval of new vehicles as of September 2017. The RDE for in-use compliance for heavy duty vehicles is

already in place. For light duty vehicles the rules in-service conformity are being framed to be adopted in 2018.

However, the critical point here is that the requirement of RDE tests with portable emissions monitors (PEMS) on roads in real world conditions has been prescribed for heavy duty vehicles and not for light duty vehicles. This needs to be rectified and made clear through notification that RDE test should be done on road and not be substituted by a lab test.

It is important to note that in Europe heavy duty vehicles like trucks and buses have not faced the same problem as the light duty diesel cars in terms of very high on road emissions. This is mainly because of early adoption of tighter in-use compliance test procedures for heavy duty vehicles that were not adopted for light duty vehicles or cars.

European Commission has amended Regulation (EU) No 582/2011 and 64/2012 for In-Service Conformity Testing of heavy-duty engines. This has already provided for mandatory testing with portable emission measurement systems (PEMS) as part of the type approval legislation in order to check the conformity of heavy-duty engines with emissions certification standards during the normal life of those engines: this is the “In Service Conformity” (ISC) requirements. HDVs in Europe are tested for In-service conformity with PEMS testing, which is equivalent to RDE.

HDV vehicles are required to undergo off-cycle emissions testing requirements that cannot always be captured on a defined driving emissions testing in labs. This testing requires the not-to-exceed limit which means under any driving condition on road the emissions cannot exceed the specified limit. The rigor of all these test procedures has ensured better on-road emissions performance of HDVs than cars.

India has also adopted the same provisions for heavy duty vehicles that require off cycle emissions testing and Not to Exceed Standards that help to capture emissions from a much broader range of operations as well as in-service compliance with PEMS.