

Advanced Emission Inspections



Orientation Conclave

Air Quality Management: Building Strategies for Clean Air

04th June 2019, Bhubaneswar



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Automotive Research Association of India (ARAI)

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ARAI - An Overview



Regulatory Scenario – Emissions



Inspection & Certification Program



On Board Diagnostics (OBD)



Remote Sensing Device (RSD)



Summary

The Automotive Research Association of India



Corporate Office
ARAI, Kothrud, Pune



Forging Industry Division
ARAI-FID, Chakan, Pune



Homologation & Technology Centre
ARAI-HTC, Chakan, Pune

- Established in 1966 at Pune, India
- Human Resource of 730+
- Facilities & Infrastructure: Rs.773.44 Crore (USD 100 Mn)
- Affiliates in China & Korea
- Accredited with
 - ISO 9001, 14001
 - OHSAS 18001
 - NABL (ISO/IEC 17025)

Laboratories:

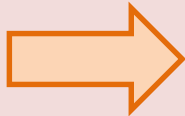
- Powertrain, Emissions, Passive Safety, Safety & Homologation, Vehicle Evaluation, Materials, Automotive Electronics, Structural Dynamics, NVH, CAE, Calibration
- Academy
- Forging Industry Division
- Homologation and Technology Centre
- Regional Centre South Chennai

Journey and Service Portfolio

Journey

1970

Testing House



2010 Onwards

Testing + R&D House

Research

Technology
Development

Knowledge

Beyond 2010

Testing
Competency

Expertise

1991 – 2010

Experience

1981 – 1990

Facility
Establishment

Tools

1966 – 1980

Service Portfolio

Education &
Training

Certification Testing /
Homologation

Consulting
Services

Assisting GOI – Standards
Formulation & Regulations
Harmonization

R&D – National
Interest, Industry and
Internal R&D Projects



- ***Celebrating Golden Jubilee Year***
- ***Golden Peacock Environment Management Award 2016***
- ***'Best Corporate Award' by SAEINDIA Foundation***
- ***Numerous Technical Papers awarded***
- ***'Recognized Overseas Test Lab' by LTA and NEA) Singapore***
- ***Appointed as 'Technical Service Provider' by RDW, Netherlands for CoP verification audits***
- ***Recognition by Department of Infrastructure, Australia to provide Test Reports in compliance to ADRs***

R&D Roadmap

Major R&D Drivers



Low Carbon
Footprints
/ Improving Fuel
Economy / Power
Train engineering



Pedestrian &
Passenger
Safety



Light
Weight
Materials/
structures



Green
Technologies



Sustainable/
Smart
mobility

ARAI's Involvement in technology introduction

Examples:

- **Alternate Fuels:** CNG, LPG, Ethanol, biodiesel, H2, etc.
- **E-Mobility**
- **Safety Regulations:** ABS, ESC, Vehicular Crash
- **I&C Programs:** Model centres, scaling up
- **End of Life Regulations**
- **ITS Roadmap**
- **Source Apportionment Studies**



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Indian Auto Industry: Highlights

- 2nd largest bus manufacturer
- 3rd largest heavy trucks manufacturer
- 6th largest passenger vehicle manufacturer
- Largest – two wheeler market
- Fifth largest - passenger vehicle market
- Fifth largest -commercial vehicle market

Total Production

Segment	2015-16*	2016-17*
Passenger Vehicles	3.46	3.79
Commercial Vehicles	0.78	0.81
Three Wheelers	0.93	0.78
Two wheelers	18.83	19.92
Grand Total	24.02	25.31

* In Million

India – Highly Underpenetrated

Segment	Vehicle per 1000 persons
Passenger Vehicles	20
Two-wheelers	108
Buses	0.11

***High Headroom
for Growth***

Source: SIAM, ACMA, TMA, IMAcS Analysis

Regulatory Scenario – Emissions



- Emission norms for Catalytic Vehicles
- BS-I (Country)
- BS-II (Metros)

Vehicle Emissions

- BS-III (Country)
- BS -IV (13 Cities)

1991 to 2000

2001 to 2005

2006 to 2010

By 2017

By 2020

- BS-II (Country)
- BS-III (11 Cities)

- Entire country for BS IV

- BS-VI for all category vehicles



Diesel Sulphur Reduction

- Sulphur 2500 ppm for entire Country

- Sulphur 50 ppm (13 Cities) & 350 ppm for entire Country

1991 to 2000

2001 to 2005

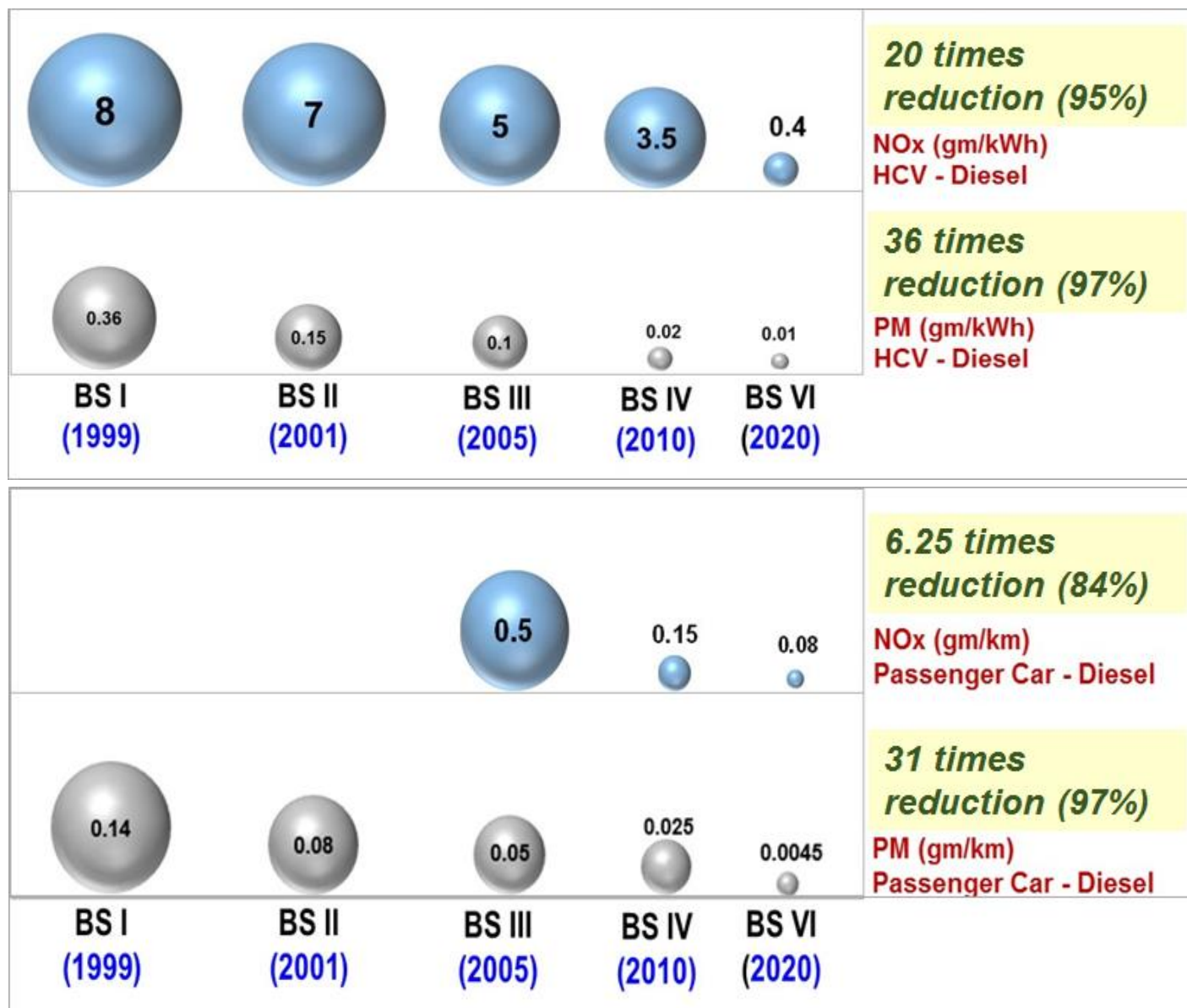
2006 to 2010

2020

- Sulphur 500 ppm for entire Country & 350 ppm (11 Cities)

- Sulphur 10 ppm

Progressive tightening of Vehicle emission standards



In use vehicles

Current Legal Framework



CMVR Rule # 62

Fitness Certificate mandatory for all Transport vehicles. (Buses, Trucks, Taxis and Auto-Rickshaws)

New Transport vehicle

Fitness certificate valid for Initial Two years
Thereafter Renewal of Fitness Certificate -
Every year

Non Transport vehicles

Initial registration is valid for a period of 15 years

Pollution Under Control (PUC)

Gasoline vehicles are tested for Idle CO /HC emissions

Diesel vehicles are tested for Free acceleration smoke

Type Approval and CoP Regulations

- Strong Type Approval System
- Very strong CoP System
- Weak Inspection and Maintenance Mechanism



Type Approval

- Notifying agencies: MoRTH, MoEF, etc.
- TA certificates: Issued by Testing Agencies
- Very Similar to UN-ECE regulations
- Extensive laboratory testing

CoP

- Third Party Conformity
- Safety Components are covered in CoP
- Vehicle level CoP-Emission Tests by Test Agencies
- Random Selection of samples

Annual Fitness Check

- Visual Inspection
- Pollution under Control (PuC) test at authorized garages
- Document verification by Transport Departments

Emissions from Vehicle : Mitigation Strategies



Increase share of public transport



Banning of 10 year old commercial vehicles



Restrict entry of commercial vehicles inside cities



ITS and Traffic Management



Periodical Technical Inspection (PTI)- I&C Centers



Enhancing Driver Skills



Use of CNG for new Public transport buses



Advancement of Emission norms- BS VI



Bio-Fuels
E-Mobility

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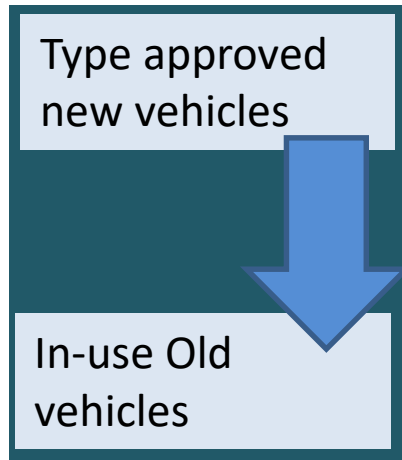
Remote Sensing Device (RSD)



Summary

I&C for Roadworthiness

Need of Inspection & Certification practices



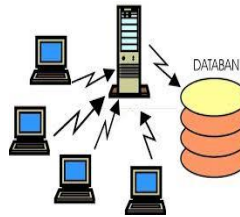
Factors affecting...

- Fuel Quality
- Driving Habits
- Maintenance Practices
- Infrastructure
- The aging factor



Concerns

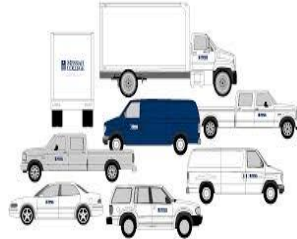
Safety & Emissions



Test Data
Generation



To overcome the
difficulties faced
during fitness
checks with
existing
infrastructure



More no. vehicles can
be tested



Reduces burden on the
inspector

Benefits of I&C Program

- Road Accidents
- Atmospheric pollutions from vehicles
- Noise Emissions
- Fuel Consumption

- Live database
- Centre / Person based analysis
- control of quality
- Input for ELV & recyclability initiatives

Reduction in

**Networking &
Data**

- Awareness of
- Increased life of vehicles
- Improvement in maintenance culture
- Avoidance of unnecessary repairs
- Improvement in quality of garages
- Continuous renewal of the vehicle fleet

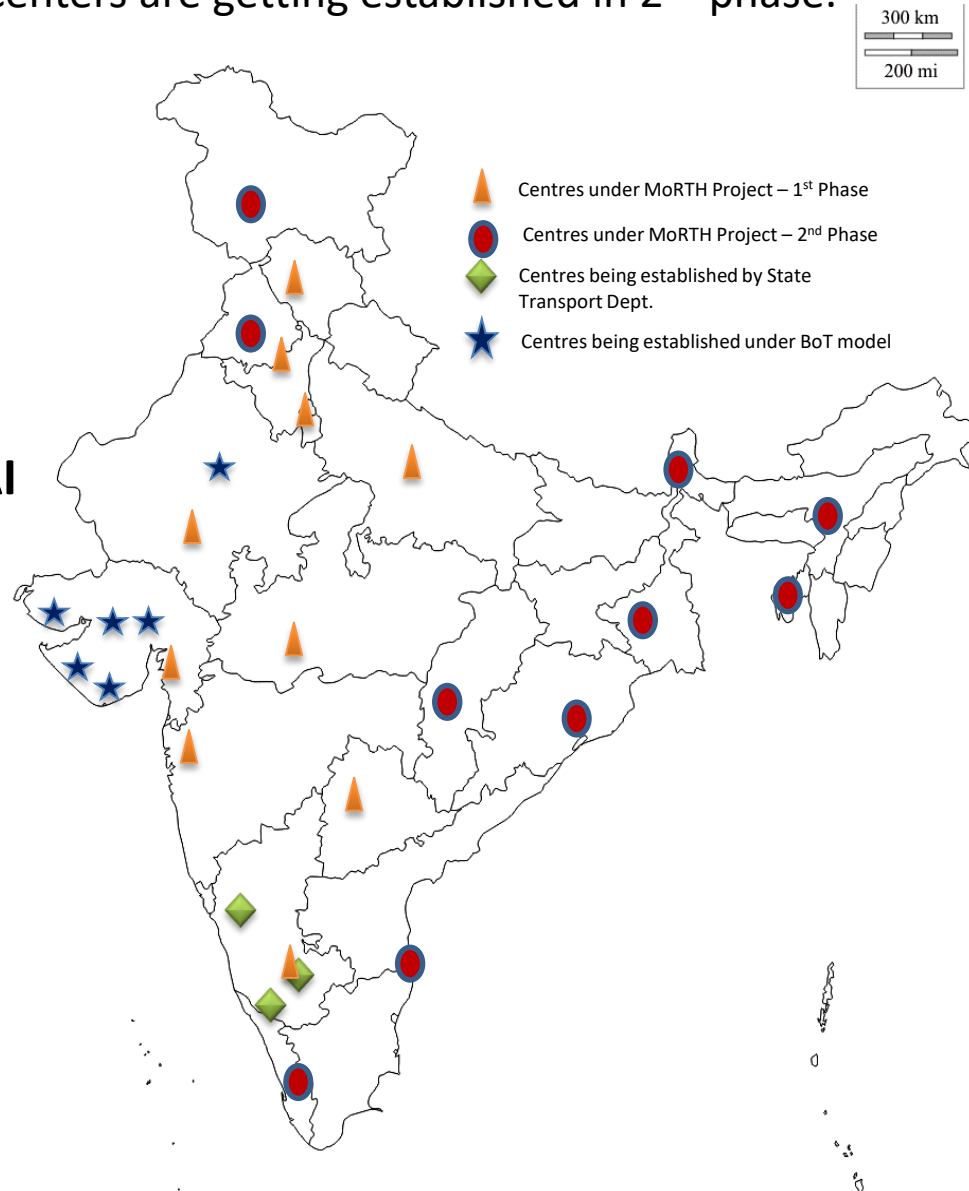
Other Aspects

Establishment of Inspection & Certification Centers in India

- ❖ 10 Model I&C Test Centers being established in 1st phase.
- ❖ Another 10 Model I&C Test Centers are getting established in 2nd phase.

Centres facilitated by ARAI under MoRTH Project

- Nasik, Maharashtra
- Bengaluru, Karnataka
- Railmagra, Rajasthan
- Hyderabad, Telangana
- Surat, Gujarat
- Cuttack, Odisha
- Cochin, Kerala
- Puducherry



I&C Test Center – MoRTH Project

NASIK, MAHARASHTRA



BENGALURU, KARNATAKA



RAILMAGRA, RAJASTHAN



HYDERABAD, TELANGANA



SURAT, GUJARAT



CUTTACK, ODISHA



I&C Test Center

- Required test equipment are laid out in such a way that vehicles are tested one after the other
- Automated test report generation for following vehicle tests: Safety, Emission, Visual Inspection



Tests Carried out in I&C centre



Emission Test



Head Light Test



Front axle service brake test.

Brake Test



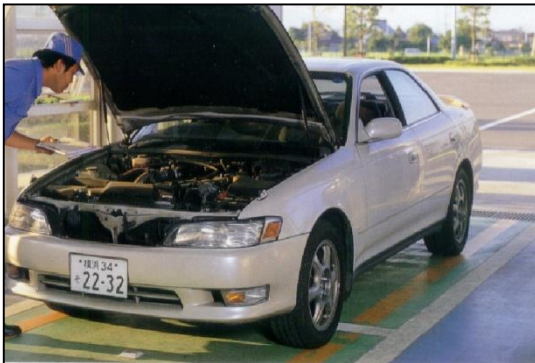
Speedometer Test



Suspension Test



Side Slip Test



Visual Inspection



Under Body Inspection



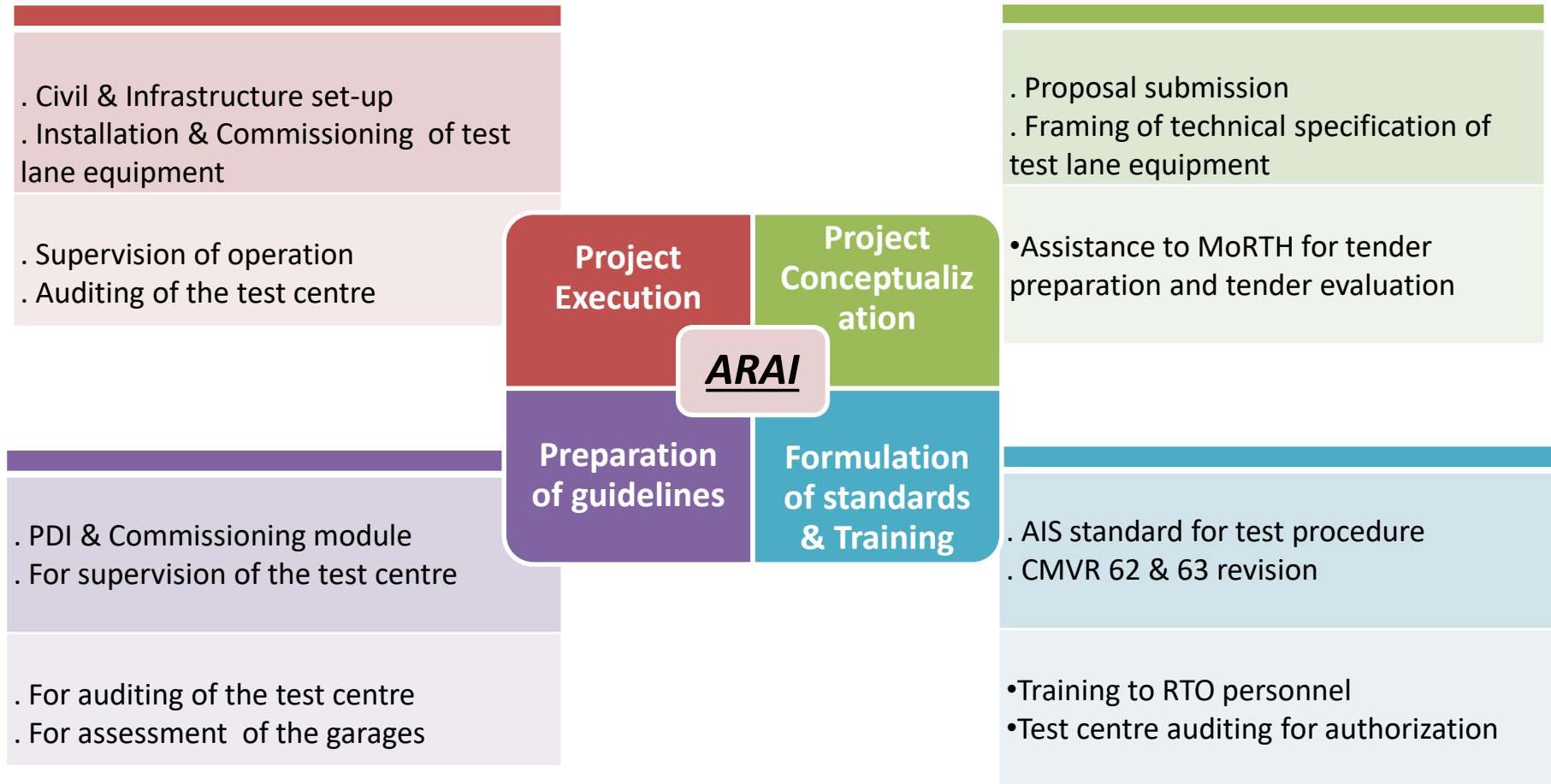
Joint Play Test

Current practices for fitness checks of in use vehicles

Tests under CMVR Rule 62

- The following safety and emission tests are conducted using appropriate equipment
 - Headlamp beam (Beam focus)
 - Brakes (Measure Stopping distance on road)
 - Exhaust emission (or PUC test)
 - Idle Emission Test for gasoline vehicles
 - Free Acceleration Smoke test for Diesel vehicles

ARAI role in setting up I&C test centres in the country



I & C Regime in India: Capacity Requirement

Commercial Vehicles



LCV +HCV = **33 million** vehicles
No. of Lanes reqd.= **1662**
Centres reqd.= **416**

LCV +HCV = **85 million** vehicles
No. of Lanes reqd.= **4311**
Centres reqd.= **1078**

Passenger Vehicles



Population= **63 million** vehicles
No. of lanes reqd.= **2392**
Centres reqd.= **598**

Population= **163 million** vehicles
No. of lanes reqd.= **6204**
Centres reqd.= **1551**

2 Wheeler



Population= **258 million** vehicles
No. of lanes reqd.= **6523**
Centres reqd.= **1631**

Population= **670 million** vehicles
No. of lanes reqd.= **16918**
Centres reqd.= **4230**

2020

2035

Above lane requirements are based on following assumptions:

- 2 shift operation
- 275 working days in one year.

Based on the vehicle population data available from year 2013 by MoRTH- Provisional (10% vehicle growth for every year is considered.)

Source: MoRTH Transport Wing

I&C: International Scenario

United Kingdom



- **Applicability**
 - For both Private & Transport vehicles
- **No. of Vehicles**
 - 519 motor vehicles per 1000 people
- **No. of I&C Centers**
 - 18300 MoT Garages

Japan



- **Applicability**
 - For both Private & Transport vehicles
- **No. of Vehicles**
 - 588 motor vehicles per 1000 people
- **No. of I&C Centers**
 - 27000 inspection centers

Germany



- **Applicability**
 - For both Private & Transport vehicles
- **No. of Vehicles**
 - 588 motor vehicles per 1000 people
- **26.6 million vehicles inspected in 2013**

I&C: Proposed Phase- Wise Approach

Phase 1

- In the first phase, cities with significant transport vehicles should introduce a modern Inspection and Certification regime
- In these cities, a modern inspection regime should be first introduced for commercial vehicles
- It may then be extended to rest of India for commercial vehicle category

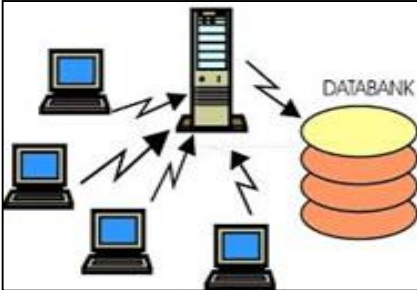
Phase 2

- Introduce the I & C regime to private vehicles including 2 wheelers
- Start initially with older vehicles (more than 9 years old)

Phase 3

- Extend the regime to newer fleet in private vehicles category (3-9 year old)

Challenges: Enforcement of I&C regulations



- Limited capability of inspection facilities to cater inspection of vehicles according to CMVR rules
- Increasing vehicle volumes in major cities
- Awareness of this programme to the society
- Integration of test lanes with central data base
- Record & analysis of available Test data
- Establishing the impact assessment of I & C system on air quality & Road safety

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Summary

On Board Diagnostics (OBD)

OBD is a computer based system for storing and detecting codes which identify operational malfunctions within the engine and emission control systems.

The purpose of OBD is to inform the driver when an emissions- related system or component malfunctions or deteriorates beyond agreed thresholds.

OBD Monitors

Positive Ignition Vehicles

- Monitoring Reduction in the efficiency of Catalyst –With respect to emissions of THC
- O2 (Oxygen Sensor)
- Secondary Air System
- Coolant Temperature
- EGR (Exhaust Gas Recirculation)
- Fuel Tank leakage and evaporation
- Fuel system
- Emission control system / components
- Circuit continuity for all emission related power train components
- Distance traveled since MIL (Malfunction Indicator Lamp) ON

Compression Ignition Vehicles

- Reduction in the efficiency of the Catalyst
- Electronic Fuel Injection system
- Particulate Trap (If provided)
- Coolant Temperature
- EGR (Exhaust Gas Recirculation)
- Fuel system
- Emission control system / components
- Circuit continuity for all emission related power train components
- Distance traveled since MIL (Malfunction Indicator Lamp) ON

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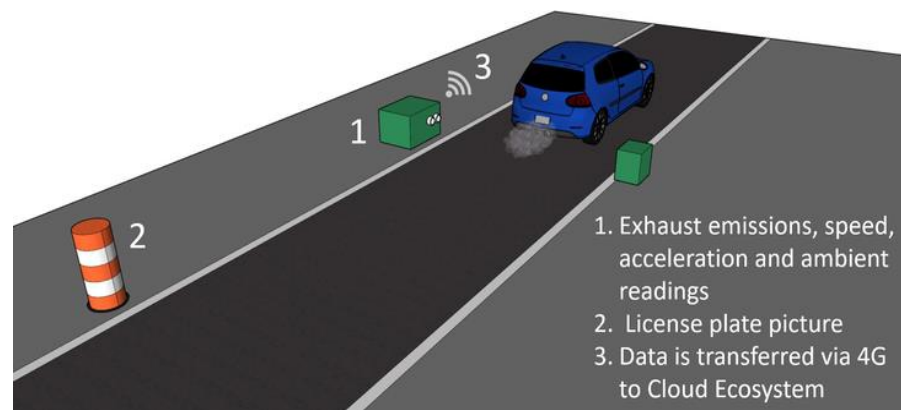
Summary

RSD - How does it work?

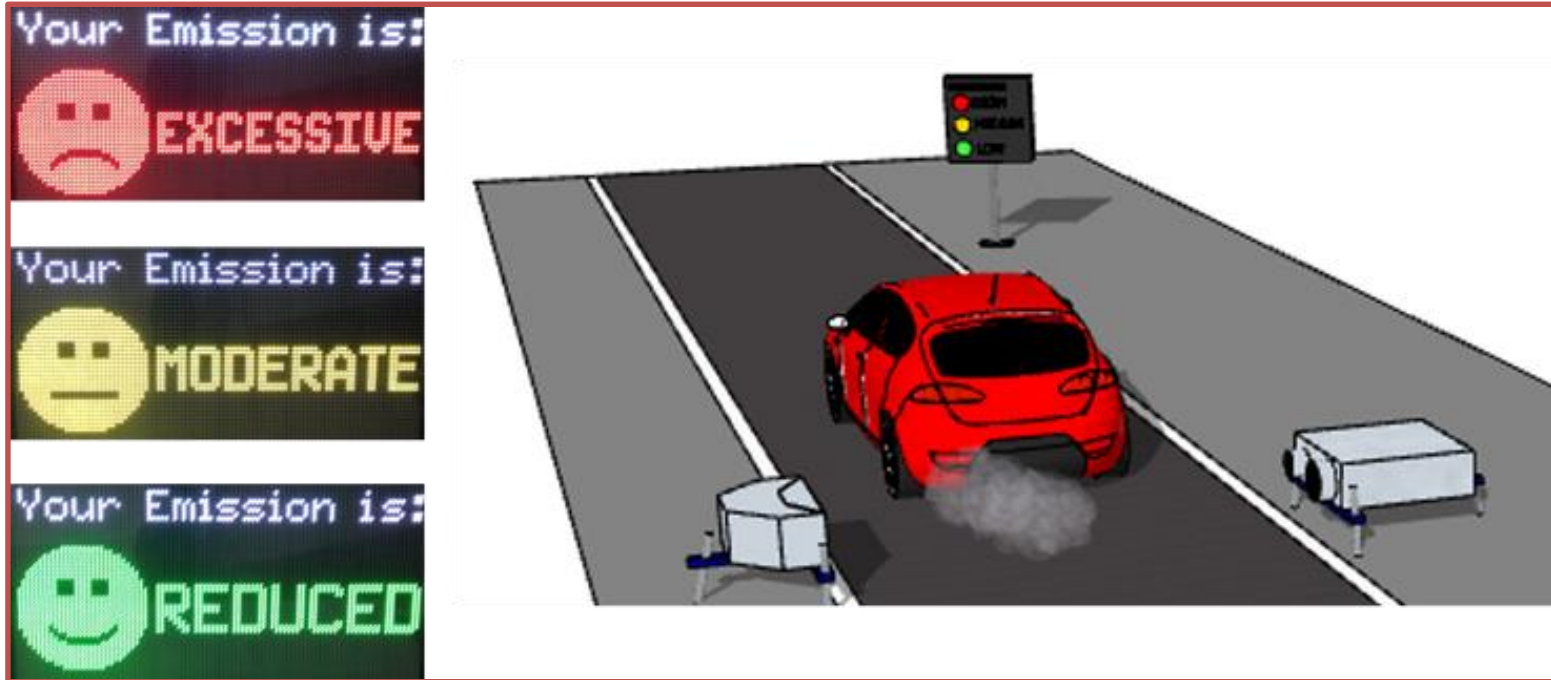
Remote Sensing Device (RSD) is able to measure vehicles emissions circulating under **real driving conditions**. It is a mobile system that can be deployed easily in strategical locations as required.

- The RSD detects and measures vehicle emissions as the **vehicle drives by**.
- When the vehicle breaks the **infrared (IR) and ultraviolet (UV) beam** sent across and back a single lane road
- Since it can obtain a complete record in less than a second, these devices are designed to obtain **large quantities of data**.
- Also, since it is a non-intrusive technique, the RSD audits circulating vehicles **without interfering with the traffic flow**.

The RSD (Remote Sensing Device) is the only technology able to measure **all traffic emissions (CO, CO₂, HC, NO_x, PM)** as well as provide kinetic conditions and license plate picture of every vehicle driving by, all non-intrusively and instantly.



Result



"THE ENTIRE PROCESS IS COMPLETED IN LESS THAN 1 SEC"

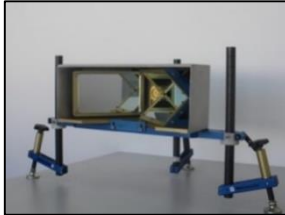
Key components of the RSD

Emissions module

Source Detector Module



Corner Cube Mirror



Speed / Acceleration bar



CCTV Camera



Weather Station



- **Source detector module(SDM)** houses two internal modules: the Source and the detector. Source emits a beam of infrared and ultra violet (IR/UV) light. The Detector detects the vehicle emissions gases via the reflected IR/ UV light beam
- The **Corner Cube Mirror (CCM)** is a simple reflector that returns the IR/UV beams. The CCM returns the IR/UV back to the SDM.
- **Speed / Acceleration Bar** : The Emitter/Detector are mounted to the bar. Each Emitter/ Detector contains a laser and detector. The Laser beam is broken by the tires of the vehicle and the detector send the information for processing.
- The **CCTV Camera** captures a digital image of the vehicles. This image is intended to be used as a visual vehicle identification.
- The RSD monitors environment conditions i.e. temperature, pressure relative humidity through **Weather Station**.

RSD: Advantages & Benefits

Real data

- Real emissions data for any individual vehicle
- It does not relies on projections or models

Accuracy

- RSD correlate with other analytical devices such as PEMS and OBS by 85-95%

Effectiveness

- High emitting vehicles must to be individually identified since 5% of the fleet contributes with over 50% of total emission

Closing the gap

- Current emission control is not performed under real driving conditions, not even tested for NOx or HC

Quick checks

- Vehicles are measured continuously within 0.6 seconds; not only in the periodical statutory emission tests

Usability

- Practical, quick to deploy at strategic locations (mobile units) and very easy to operate

RSD: Challenges

Policymakers have struggled to integrate such systems into mandatory enforcement programs, or to use them to replace I/M programs.

Absence of regulatory framework for emissions remote sensing.

Defining detailed cut-points for different vehicle categories and pollutants.

Location of measurement

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Summing up.... Integrated Approach for Clean Air

Auto Industry

- Adoption of Advanced Technology (Electric, Hybrid...)
- Fuel Efficient Vehicles

- Leap frogging to BS-VI
- Alternate fuels- (safety, materials, performance)



Policy Makers

- Policy Framework
- Transport Management
- I & M Regime

- Significant investments
- Infrastructure
- Implementation
- Studies on air quality on continuous basis

Vehicle Owners

- Good Maintenance Practices (Acceptability for I&M)
- Better Driving Habits

- Adequate I & M centres
- Use of advanced emission measurement techniques

Oil Industry

- Provision of Clean Fuel

- Providing specified Fuel nationwide
- Availability of uniform quality throughout India
- Huge investments



Thank You



Initiatives to control emissions...

Fuel Efficiency Regulation

- India has planned the introduction of progressive fuel efficiency regulation from year 2015 to 2020.
- Fuel economy standards for passenger cars are being made applicable from April 2017 and next stage norms from the year 2021, as per S.O. 1072 (E) dated 23rd April 2015.
- Fuel economy standards for heavy commercial vehicles are being worked out by PCRA.

Promotion of Bio - CNG

- Final notifications for Bio-CNG is released vide G.S.R. No. 498 (E) dated 16th June 2015.

Improvisation of driving habits through setting up of Driver Training Schools:

- Under 10th plan, MoRTH has sanctioned 13 Institute of Driving Training and Research (IDTR).
- Under 11th Plan , MoRTH has approved 8 IDTR on PPP basis

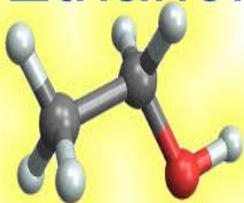
Initiatives to control emissions *Contd..*



Usage of Bio fuels such as ethanol and bio diesel.

Carbon dioxide (CO₂) released when ethanol is used in vehicles is offset by the CO₂ captured when crops used to make the ethanol are grown.

Ethanol



Promotion of alternate fuels: Final notification G.S.R. 412 (E) dated 19th May 2015 for flex fuel ethanol (E85) and ethanol (ED95) vehicles is already released.



In future, ITS enablement & End of Life (old vehicle scrapping policy) vehicle management to be enforced. Vehicular retirement policy: MoHI and MoRTH are working on this.