India’s Initiative Towards Tighter Emission & Fuel Efficiency Norms

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(Research Institution of the Automotive Industry with the Ministry of Heavy Industries & Public Enterprises, Govt. of India)
ARAI - At A Glance

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 680+
- Facilities & Infrastructure: Rs.720 Crore
- Affiliates in China & Korea
- Accredited with
  - ISO 9001, 14001
  - OHSAS 18001
  - NABL (ISO/IEC 17025)

Laboratories:
- Academy
- Forging Industry Division
- Homologation and Technology Centre
- Regional Centre South Chennai

53 years of Building Automotive Excellence
Journey and Service Portfolio

**Journey**

- **1966 – 1980**
  - Tools
  - Facility Establishment
  - Experience
- **1970**
  - Testing House
- **1981 – 1990**
  - Testing Competency
  - Expertise
- **1991 – 2010**
  - Technology Development
  - Knowledge
- **2010 Onwards**
  - Testing + R&D House
  - Beyond 2010
  - Research

**Service Portfolio**

1. **Certification Testing / Homologation**
2. **R&D – National Interest, Industry and Internal R&D Projects**
3. **Assisting GOI – Standards Formulation & Regulations Harmonization**
4. **Consulting Services**
5. **Education & Training**

53 Years of Building Automotive Excellence (1966 – 2019)
Vehicle applications covered under CMVR

On road Application Automotive
- 2W
- 3W
- 4W-LDV
- 4W-HDV

Test on CD

Off road Application
- Tractor
- CEV
- Combine harvester
- Power Tiller

Test on Engine

Types of certification
- Type Approval
- Conformity of Production
- In-Use compliance (PUC)
- In-service Conformity

Documentation & Procedures
- AIS : AIS-137 Type Approval & Conformity of production test procedure
- Government notifications : Effective dates & limits, fuel Specification, COP requirement

Crawler Based Non-roadable machine Stage IV/ Stage V norms are under finalisation
Emission Norms and Fuel Quality improvement

Tightening of Emission Norms
- BSVI, OBD Stage-2, On Road emission compliance 2023
- BSVI, OBD Stage-1, ON Road emission 2020
- BSIV Nationwide-2017
- BSIII Nationwide, BSIV 11 Cities-2010
- BSII Nationwide, BSIII 11 cities 2005
- BSI (nationwide), BSII Metros 2000/2001
- 2nd set of norms Notified 1996
- Emission Norms for catalytic vehicles 1995
- 1st set of Norms notified 1991

Market
Fuel
Diesel
sulphur
Content
- 10 ppm entire country BSVI Nationwide-2020
- 50 ppm entire country BSIV Nationwide-2017
- 50 ppm 11 cities & 350 ppm Nationwide, (BSIV)-2010
- 350 ppm 11 cities & 500 ppm entire country (BSIII)-2005
- 500 ppm sulphur 11 cities -2004
- 2500 ppm sulphur entire country(BSI) -2000
- 2500 ppm in 4 metro cities -1998
- 2500 ppm sulphur in NCR- 1997
- 5000 ppm sulphur 4 metro cities- 1996
India Road Map for Fuel Efficiency Norms

- Fuel Efficiency Standards for Passenger cars & Labelling
- Fuel Efficiency standards for Heavy Duty vehicles
- Fuel Economy norms for 2/3 Wheelers
- Fuel Efficiency Standards for Tractors and subsequent labelling
- Electric vehicles (EV) and charging Infrastructure for EVs
Fuel efficiency norms for For M1 category (<3.5 tons GVW) are notified - Implementation from 1st April 2017 (Notification GSR 954 (E) dated 4th October 2016).

Vehicles to comply with the Average Fuel consumption Standard, notified under the Energy Conservation Act, 2001 vide notification of the Government of India in the Ministry of Power number 1072 (E), dated the 23rd April, 2015.

- Applicable procedure – AIS:137 and its Parts, as amended from time to time.
- Applicable to vehicle below 3.5 tons.
- Manufacturer to declare CO₂ values for all variants for CAFÉ.

Fuel Efficiency norms for heavy commercial diesel vehicles above 12.0 tons have been notified.

Fuel Efficiency norms for light and medium duty commercial diesel vehicles between 3.5 tons to 12.0 tons is under finalisation.

Simulation Test Procedures are under Evaluation for future regulatory purposes.
Fuel Efficiency Standards for Passenger Cars & Labelling

- **Phase-1 (2017-18)**
  - CAFE: 5.5 l/100 km (129.8 gmCO₂/km)
    @1037 kg

- **Phase 2 (2022-23)**
  - CAFE: 4.78 l/100 km (113.0 gmCO₂/km)
    @1145 kg
Average Fuel Consumption Standard

- Average Fuel Consumption Standard = Average Fuel Consumption standard in petrol equivalent liter per 100 kilometre.
  
  \[ \text{Average Fuel Consumption Standard} = a \times (W - b) + c \]

Where, \( a, b \) & \( c \) = constants

\[ W = \text{Weighted average of unladen mass in kg of all new said motor vehicle, manufactured or imported for sale by the manufacturer.} \]

<table>
<thead>
<tr>
<th>Constant</th>
<th>For fiscal year 2017-18 to 2021-22</th>
<th>For fiscal year 2022-23 onwards</th>
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<tbody>
<tr>
<td>( a )</td>
<td>0.0024</td>
<td>0.002</td>
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<td>( b )</td>
<td>1037</td>
<td>1145</td>
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<tr>
<td>( C )</td>
<td>5.4922</td>
<td>4.7694</td>
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<tr>
<td>Avg. F.C. Standard</td>
<td>( 0.0024 \times (W-1037)+5.4922 )</td>
<td>( 0.002 \times (W-1145)+4.7694 )</td>
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<td>Target CO2</td>
<td>130 g/km @1037 kg ULW</td>
<td>113 g/km @1145 kg ULW</td>
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Fuel consumption (km/l) is being determined at constant speeds of 40 km/h & 60 km/h with vehicle in fully laden condition.

CSFC Test is carried out for all combinations of Tyres, Drive train which produces higher fuel consumption as per worst case criteria.

HDFE Consolidated BSIV Data analysis was done as indicated below:
- FE data collection & analysis performed on 1000+ vehicle configurations of different manufacturers.
- Analysis carried out on results of fuel consumption measured as per category, GVW & axle configuration of vehicle.
- Deriving limiting equation at 80 percentile for fuel economy (l/100km) at 40 km/h & 60km/h speed.

Government of India has issued notification SO 2670 ( E ) for M3 & N3 categories of vehicle through Ministry of Power.

Monitoring performance of vehicles over Limiting equation.
**Proposed Fuel Efficiency Standards for Commercial Vehicles in India**

**Phase 1**
*(Track Testing)*

- Constant Speed Fuel Consumption (CSFC) at 40 kmph & 60 kmph (>12t HDV) & 50 kmph for buses

<table>
<thead>
<tr>
<th>Vehicle Category</th>
<th>Gross vehicle weight (tonnes)</th>
<th>Axle configuration</th>
<th>Equation</th>
<th>Fuel consumption (/100km)</th>
<th>Value at lower weight limit</th>
<th>Value at upper weight limit</th>
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Proposed Fuel Efficiency Standards for Commercial Vehicles in India

**Phase 2 (Simulation)**

- Drive Cycle based fuel consumption (Under discussions)

**VECTO Adaptation for India**

Model Input:
- Vehicle
  - $C_d \times A$
  - Mass,
- Tires
  - $r_{\text{tyre}}$, RRC
- Loss maps
  - $i_{\text{gear}}$, max. torque
- Full load curve
- Fuel map
- Correction factors
- Air Compressor
- HVAC
- Alternator
- Cooling fan
- Steering pump
- Auxiliary
- *generic data for trucks*
  - *specific for buses*
- HDH System
- Motor, battery

Simulation Tool Development for India Specific Application
Thank you !