The impact of Tyre Regulations on Heavy Duty Vehicle Fuel Efficiency

Divya Kumar Tyagi

General Manager-Norms & Regulations, India

Delhi, April-2015
• Classification of regulations for tyres
• What is Rolling Resistance and How does it affect Fuel Economy
• Benchmark and Benefit: Status of Tyre RR regulations in other countries
  • Implications for India
• Benchmark: Heavy Duty Vehicle Regulations in Other Countries and Link to Tyre RR
• Conclusion and Recommendations
Expectations from tyres

Function and Safety

Performance
What regulators are doing worldwide?

Examples

<table>
<thead>
<tr>
<th>Function and Safety</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>R30/R54/R64/R75</td>
<td>R117: Rolling Resistance, Wet Grip, Noise</td>
</tr>
<tr>
<td>FMVSS 49 CFR Part 571</td>
<td>TFE CIP: Rolling Resistance, Wet Grip, Wear</td>
</tr>
<tr>
<td>GB 9743/GB9744</td>
<td>GB/T29042-2012: Rolling Resistance</td>
</tr>
</tbody>
</table>
What regulators are doing in India?

**Function and Safety**
- R30/R54/R64/R75
- FMVSS 49 CFR Part 571
- GB 9743/GB9744
- IS15633/IS15636/IS15627

**Performance**
- R117: Rolling Resistance, Wet Grip, Noise
- TFE CIP: Rolling Resistance, Wet Grip, Wear
- GB/T29042-2012

**NO REGULATIONS**
What are performance parameters and Are these important in Indian context?

Importance for India

• Fuel Saving of 865 million liters per year
• Green house gas (GHG) reduction (2.3 million tons of CO2 every year)
Tyre Contribution to Fuel Consumption

- Aerodynamic drag: 40%
- Mechanical losses: 25%
- Rolling resistance: 35%

Source: USA Dept of Energy
For every 1000kg of GVW, rolling resistance drag is 6.5kg
For e.g. 16 ton truck, rolling resistance drag is 6.5*16 = 105kg
Tyre Rolling Resistance

Rolling Resistance is caused by the energy consumed in heating the tyre. Thus, the hotter a tyre the higher the Rolling Resistance. These are infrared images of two different truck tyres rolling under identical conditions.
For every 10% change in tyre rolling resistance, one can achieve between 3 and 4% fuel savings for heavy duty vehicles.

Truck tyres in the India market can vary in rolling resistance by over 30%, so the potential is large.

Note: India heavy truck tyre market is 70% bias tyres, which have inherently higher RR than radials.
Tyre RR Regulations

- Tyre RR can be regulated in two ways:
  - *Max cap on tyre RR*: such regulation has been announced in European Union, China, Russia, Korea, Brazil, Saudi Arabia
  - *Grading of tyre RR*: such regulation has been announced in European Union, United States, Korea, Brazil, Saudi Arabia
- BIS is in discussion to create a *maximum cap on tyre RR* for India, starting with passenger car tyres but nothing certain for Truck Tyres
- What could be the theoretical effect of capping Heavy Truck Tyre RR for India?
Environment

- 7 tires per truck
- Truck run 30,000 km/year
- Current fuel efficiency → 40 l/100km
- Total trucks → 3 million
- 2.67 kg of CO2 per Liter of diesel
- Contribution of tires → 1/3 of fuel (conservative).

Papers
EPA RR Fuel truck Bachman-Erb-Johnson.pdf

- Weighted Average RR based on graphs
  - WO = 8.06 kg/t
  - W = 7.48 kg/t
- Difference in average RR = 7.2%
- Impact on fuel economy = 2.4%
- Total fuel consumed (billion liters)
  - WO = 36.0
  - W = 35.1

- Savings ➔ 864 million liters per year
- Savings ➔ 2.3 million tons of CO2 per year
Vehicle Regulations: Heavy Duty Vehicles

- Challenge: In many Countries, HDV are not packaged in “models” in the same manner as passenger cars: How to look at vehicle fuel economy?
- One Benchmark Solution: Both USA and Europe use computer modeling
- Manufacturers must measure engines but must model the entire truck assembly
- *Tyre Rolling Resistance is key to success for such regulations*
<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Parameter Controlled</th>
<th>When? (Model Year)</th>
<th>Name of Computer Model</th>
<th>How Tyre RR Integrated into Model?</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>gCO2/t<em>mile, gal/1,000t</em>mile</td>
<td>Phase 1 MY 2014-2017, Phase 2 MY 2018-?</td>
<td>GEM</td>
<td>Exact RR for each tyre provided by tyre manufacturer or measured by OEM</td>
</tr>
<tr>
<td>Europe</td>
<td>gCO2/t<em>km, gCO2/m3</em>km, gCO2/pass*km</td>
<td>&gt; MY 2019</td>
<td>VECTO</td>
<td>RR Grade median or actual RR value (likely)</td>
</tr>
<tr>
<td>China</td>
<td>Liter/100km</td>
<td>MY 2015</td>
<td></td>
<td>Actual RR or a Default RR value</td>
</tr>
<tr>
<td>Japan</td>
<td>km/l</td>
<td>MY 2015</td>
<td></td>
<td>Default RR value</td>
</tr>
</tbody>
</table>
Conclusions and Recommendations

- Countries around the world now regulate truck tyre rolling resistance
  - This is a real opportunity for India to set a maximum cap on tyre RR to improve fuel economy of the legacy truck fleet
- If CO$_2$ / Fuel Economy regulations are implemented for HDV in India, it would be wise to include actual RR in the calculations to promote wise selection of tyres
Thank you for your attention.