Environmental and Safety Performance of Commercially Available Light-duty Tire Models in North America

Meeting Deck – June 11, 2018

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ecoTECHNOLOGY for Vehicles
Overview of Transport Canada / eTV Program

Background
- Tire Technology and Performance
- Developing Minimum Performance Standards

Project Methodology
- Testing Matrix

Test Results
- Studless winter tires (P195/65R15)
- All-season tires (P205/55R16)
- All-season tires (assorted sizes)

Conclusions
OVERVIEW OF TRANSPORT CANADA'S ECOTECHNOLOGY FOR VEHICLES PROGRAM

The ecoTECHNOLOGY for Vehicles II (eTV II) program

• supports Transport Canada (TC)’s strategic objective to develop a safe and environmentally responsible transportation system.
• supports a proactive and integrated approach to address environmental benefits and potential safety risks of advanced transportation technologies.

The initiative tests, evaluates and provides technical information on the environmental and safety performance of advanced light-duty vehicle (LDV) and heavy-duty vehicle (HDV) technologies, to:

• guide the proactive development of new or revised safety regulations, standards, codes and guidelines;
• support the development of non-regulatory industry codes and standards that anchor the market and industry efforts to integrate new vehicle technologies; and,
• help inform the development of future vehicle emissions regulations.
BACKGROUND – TIRE CONSUMER INFORMATION/LABELING PROGRAMS

• The European Union (EU) regulation 661/2009 sets mandatory maximum rolling resistance of 12 kg/t for all passenger car tires and EU regulation 1222/2009 requires defined mandatory consumer information be included on all tires produced after July 2012.

• The U.S. National Highway Traffic Safety Administration (NHTSA) issued a notice of proposed rule making (NPRM) in June 2009 to establish a rating system for rolling resistance, wet traction and tread wear.
BACKGROUND – TIRE TECHNOLOGY AND PERFORMANCE

Tire Design Factors
- Tread pattern (lugs, sipes, gaps)
- Dimensions (profile, void ratio, tread depth)
- Material composition (rubber compounds, filler)
- Tire construction (belt overlay)
- Higher rated pressure

Maintenance & Driving Factors
- Inflation pressure
- Driving surface / speed
- Vehicle load
- Surface (concrete, asphalt, other)
- Weather (Precipitation, Temperature)
To develop a Tire Consumer Information Program (TCIP) or a Minimum Performance Standard several questions and challenges must be addressed.

Environmental Performance

What is the typical environmental performance (energy efficiency) of commercially-available tires in Canada?

Safety Performance

What is typical safety performance (wet grip and snow grip) of commercially-available tires in Canada? And how is safety performance correlated with environmental performance?

Consumer Preferences

How do safety and environmental performance correlate with other consumer preferences (i.e. tread wear and purchase price)?
PROJECT METHODOLOGY

1. **TIRE STRATIFICATION**
2. **RANDOM SAMPLING**
3. **PURCHASING & SHIPPING**
4. **TESTING**
5. **ANALYSIS**

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<table>
<thead>
<tr>
<th>Winter Tires</th>
<th>All Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Studless</td>
<td>All-weather</td>
</tr>
<tr>
<td>Studable</td>
<td>H&amp;V Rated</td>
</tr>
<tr>
<td>Studded</td>
<td>A/T Off-Road</td>
</tr>
</tbody>
</table>

**Categories:**
- **Winter Tires:** Studless, Studable, Studded
- **All Season:** All-weather, H&V Rated, A/T Off-Road
## TESTING MATRIX

<table>
<thead>
<tr>
<th>Grp</th>
<th>Tire Type</th>
<th>Tire Size^</th>
<th>TP##^</th>
<th>SP##^</th>
<th>SP#</th>
<th>RR</th>
<th>DMA</th>
<th>WG</th>
<th>SG</th>
<th>IG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Studless winter</td>
<td>P195/65R15</td>
<td>27/7</td>
<td>16/7</td>
<td>23</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>All-season (M+S/H&amp;V)</td>
<td>P205/55R16</td>
<td>69/37</td>
<td>42/8</td>
<td>50</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>All-season (various)</td>
<td>various</td>
<td>N/A</td>
<td>57/1</td>
<td>58</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

^ The most popular size in that tire type (in terms of sales), provided by TRAC.

## Table Description

- **TP** – total population
- **SP** – sample population
- **RR** – variability of test procedure (same tire size/different tire sizes)
- Correlation between rolling resistance and wet grip inconclusive ($R^2 = 0.1888$).
- Seven (7) winter tire models failed to meet the stage 1 EU wet grip index minimum (1.0).
Figure 2. Snow Traction vs Rolling Resistance Coefficient (Winter Tire Sample - 23 Tires Tested - P195/65R15)

- Correlation between rolling resistance and snow traction inconclusive ($R^2=0.1777$).
- Two of the most energy efficient winter tires had good snow traction performance.
- Purchase price in both CAD & USD showed little relationship with RRC.
- Purchase price showed a relationship with WGI in both CAD & USD.
- 14 tire models rated as an “E” for energy efficiency, and binned towards the mid/lower end of the EU label
- 15 tire models rated as an “F” for wet grip, and binned towards the lower end of the EU label
- RRC showed a minimal relationship with WGI
- Certain all season tires failed to meet the EU Stage 1 RRC and WGI minimum standards
ALL-SEASON TIRE TESTING I - PURCHASE PRICE

- Purchase price showed no relationship with RRC in USD & CAD

Figure 8. Purchase Price vs Rolling Resistance Coefficient (All-Season Tire Sample - 29 USD, 20 CAD tires – P205/55R16)

CAD
AVG $: 146.44
MAX $: 179.99
MIN $: 101.99

US
AVG $: 110.33
MAX $: 165.25
MIN $: 68.15
ALL-SEASON TIRE TESTING I - PURCHASE PRICE

Figure 9. Wet Grip Index vs Purchase Price (All-Season Tire Sample - 29 USD, 20 CAD tires priced – P205/55R16)

- WGI showed a weak correlation with purchase price ($R^2 \sim 0.32$)
- 25 tire models rated as an “E” for rolling resistance, RRC values binned towards mid/lower end of EU label
- 33 tire models rates as an “E” for wet grip, WGI values binned towards the lower end of the EU label
- RRC showed a minimal relationship with WGI ($R^2 = 0.0044$)
- A subset of all-season tires failed to meet the EU Stage 1 RRC and WGI minimum standards
ALL-SEASON TIRE TESTING PART II – PURCHASE PRICE

Figure 13. Purchase Price vs Rolling Resistance Coefficient (All-Season Tire Sample - 30 USD, 27 CAD tires priced – Assorted Sizes)

- WGI showed a small correlation with purchase price ($R^2 \approx 0.23$)
ALL-SEASON TIRE TESTING PART II – PURCHASE PRICE

- WGI showed a small correlation with purchase price ($R^2 \sim 0.23$)
ALL-SEASON TIRE TESTING PART II – EU BINNING

Figure 15. European Union C1 Rolling Resistance Coefficient Bin Count (All-Season Tire Sample - 58 tires tested – Assorted Sizes)

Figure 16. European Union C1 Wet Grip Index Bin Count EC 1235/2011

- RRC values binned towards the mid/lower end of the EU label
- WGI values binned towards the lower end of the EU label
CONCLUSIONS

• For the sample of all-season tires, no correlation was observed between rolling resistance and wet grip ($0.004 \leq R^2 \leq 0.065$).

• For the sample of studless winter tires, a weak negative correlation was observed between rolling resistance and wet grip ($R^2 = 0.188$), and a weak positive correlation between rolling resistance and snow traction ($0.156 \leq R^2 \leq 0.177$).

• When categorized according to the tire labeling standards from EC 1222/2009 & amendment 1235/2011, sample populations trended towards the lower ends of the performance bins for both rolling resistance and wet grip.
THANK YOU & ACKNOWLEDGEMENTS

Thank you.

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