Proposed Coastdown Wind Speed Requirement Updates for WLTP

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Background

- The coastdown wind speed validation requirements that are in the current GTR need better definition:
  - The cross wind requirements, as currently written, do not specify whether it should be applied to an average or peak measurement. If the criteria is applied to peak measurements, it is too restrictive and may result in unnecessary test voids.
  - The procedure for calculating an average wind value is not specified in detail.
  - For on-board anemometry, the peak wind measurement is not specified with any filtering (only single point measurement), which may result in unnecessary test voids.
• 4.1.1.1.1. Permissible wind conditions when using stationary anemometry

Stationary anemometry shall be used only when wind speeds over a period of 5 seconds averages less than 5 m/s and peak wind speeds are less than 8 m/s for less than 2 seconds. In addition, the vector component of the wind speed across the test road shall be less than 2 m/s. Any wind correction shall be calculated as given in paragraph 4.5.3. of this annex. Wind correction may be waived when the lowest arithmetic average wind speed is 2 m/s or less.

• 4.1.1.1.2. Wind conditions using on-board anemometry

For testing with an on-board anemometer, a device shall be used as described in paragraph 4.3.2. of this annex. The overall arithmetic average of the wind speed during the test activity over the test road shall be less than 7 m/s with peak wind speeds of less than 10 m/s. In addition, the vector component of the wind speed across the road shall be less than 4 m/s.
Data Comparison

• To evaluate the wind speed evaluation criteria, three on-board anemometry coastdowns on the same test vehicle were evaluated.

• The three coastdown tests were run with a range of wind conditions (low, medium, high). The “high” wind test does not meet the internal Ford criteria used for North American (EPA) testing.

• Test vehicle is a 2.5L Sedan used for coastdown correlation.
Comparison of Three Coastdowns Under Various Wind Conditions

<table>
<thead>
<tr>
<th>Wind Condition</th>
<th>Average Wind Speed (m/s)</th>
<th>Peak Wind Speed (m/s)</th>
<th>Average Cross-Wind (m/s)</th>
<th>Peak Cross-wind (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>1.8</td>
<td>4.2</td>
<td>1.2</td>
<td>4.2</td>
</tr>
<tr>
<td>Medium</td>
<td>3.1</td>
<td>6.8</td>
<td>2.9</td>
<td>6.7</td>
</tr>
<tr>
<td>High</td>
<td>5.1</td>
<td>8.0</td>
<td>4.1</td>
<td>6.8</td>
</tr>
<tr>
<td>GTR Limit</td>
<td>7.0</td>
<td>10.0</td>
<td>4.0</td>
<td></td>
</tr>
</tbody>
</table>
Comparison of Coastdown Results for Different Wind Conditions

- **Low**
- **Medium**
- **High**

<table>
<thead>
<tr>
<th>Wind Condition</th>
<th>Force at 30 mph (lbs)</th>
<th>Force at 50 mph (lbs)</th>
<th>Force at 70 mph (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>52.8</td>
<td>89.0</td>
<td>139.0</td>
</tr>
<tr>
<td>Medium</td>
<td>52.9</td>
<td>89.2</td>
<td>139.7</td>
</tr>
<tr>
<td>High</td>
<td>53.6</td>
<td>91.1</td>
<td>143.6</td>
</tr>
</tbody>
</table>
Coastdown Comparison – All Run Pairs

Drag force (lb) vs. Velocity (mph) graph showing multiple run pairs.

Legend:
- all runs (L)
- pair 1l
- pair 2l
- pair 3l
- pair 4l
- pair 5l
- pair 6l
- pair 7l
- pair 8l
- all runs (M)
- pair 1m
- pair 2m
- pair 3m
- pair 4m
- pair 5m
- all runs (H)
- pair 1h
- pair 2h
- pair 3h
- pair 4h
- pair 5h
- MCP
Coastdown Comparison – All Run Pairs

- Low winds
- Medium winds
- High winds

HP@50 mph
Control Chart Comparison

**30 MPH**

**Conclusion**: Run pairs only start to exceed $2\sigma$ control limits for high wind test

**50 MPH**

**70 MPH**
Proposal

• Revise language to clarify that cross wind requirements are based on average (not peak) measurements.

• Revise language to specify that average wind values should be calculated for each run pair, which provides flexibility to discard run pairs that do not meet the average wind criteria (instead of invalidating an entire test).

• Revise language to clarify that peak wind measurements must not exceed the tolerance “for more than 5 consecutive seconds” (which would allow a brief excursion over the tolerance due to instrumentation issues – i.e. an alternative to filtering)
Proposed Language for On-Board Anemometry

4.1.1.1.2. Wind conditions using on-board anemometry

For testing with an on-board anemometer, a device shall be used as described in paragraph 4.3.2. of this annex. The overall arithmetic average of the wind speed during the test activity each valid run pair over the test road shall be less than 7 m/s, with peak wind speeds of less than not exceeding 10 m/s for more than 5 consecutive seconds. In addition, the average vector component of the wind speed across the road shall be less than 4 m/s during each valid run pair. Run pairs that do not meet the above criteria must be excluded from the coastdown analysis.
Proposed Language for Stationary Anemometry (Optional, for consistency)

• 4.1.1.1.1. Permissible wind conditions when using stationary anemometry

Stationary anemometry shall be used only when the average wind speeds during each valid run pair over the test road is over a period of 5 seconds averages less than 5 m/s, and with peak wind speeds are less than not exceeding 8 m/s for less than 2 for more than 5 consecutive seconds. In addition, the average vector component of the wind speed across the test road shall be less than 2 m/s during each valid run pair. Run pairs that do not meet the above criteria must be excluded from the coastdown analysis. Any wind correction shall be calculated as given in paragraph 4.5.3. of this annex. Wind correction may be waived when the lowest arithmetic average wind speed is 2 m/s or less.