UNECE Regulation No 117

Testing method for measuring the wet grip index of C1 tyres
Proposed amendments

Ref ECE/TRANS/WP29GRRF/2011/12
Informal document GRRF-69-23

GRRF 71st session
Tyre Industry requests to amend R.117.02 by adopting the same test method for wet grip (C1 tyre category) as the one used for labeling purpose.

Background
When EC decided to introduce an EU regulation for tyre wet grip labelling, the tyre industry checked if the existing test method designed for Type Approval was suitable for that purpose. The assessment made by tyre industry highlighted a too wide dispersion of the test results to comply with the requirements of labeling scheme (bandwidth of 15%).

Design of Experiment
• One Round Robin Test performed in three sessions at different temperature to cover the full range.
• Participation: 8 companies.
• Testing surfaces: 9
• Tyre sizes: 9 (5 Normal and 4 Snow tyres)
• Test method: vehicle and trailer.

More than 300 tests over more than 10 testing surfaces have been performed by the industry to verify the new testing conditions.
## UNECE R117 vs. R1222/2009 Grading - Wet Grip Test Procedures

### Round Robin Tests - Normal Tyres (Year 2008)

<table>
<thead>
<tr>
<th>Tyre Size</th>
<th>205/55 R 16</th>
<th>225/45 R 17</th>
<th>205/55 R 16</th>
<th>195/65 R 15</th>
<th>225/45 R 17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand Name</td>
<td>BRIDGESTONE</td>
<td>CONTINENTAL</td>
<td>MICHELIN</td>
<td>VREDESTEIN</td>
<td>COOPER</td>
</tr>
</tbody>
</table>

### Round Robin Tests - Snow Tyres (Year 2008)

<table>
<thead>
<tr>
<th>Tyre Size</th>
<th>P195/75 R 14</th>
<th>P225/60 R 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM</td>
<td>E 1136</td>
<td>F 2493 – 08</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th>Tyre Size</th>
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<th>205/55 R 16</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand Name</td>
<td>CONTINENTAL</td>
<td>MICHELIN</td>
<td>GOODYEAR</td>
<td>BRIDGESTONE</td>
</tr>
</tbody>
</table>

The selection of the test tyre sizes was according to the most representative tyres in their respective product segments.
Concept of the new test method

1. Use SRTT16 (Index of SRTT16 = 125)
2. Temperature adjustment and Surface Friction adjustment
3. Reference test conditions.

Explanations of the above three points are given in the following slides.
1. Use SRTT16 (Index of SRTT16 = 125)

- 2008 ETRTO Round Robin Test

![Graph showing wet grip index before adjustment, temp adjustment, and surface friction adjustment.](image)

\[ \text{Wet Grip Index (T)} = \frac{\text{BFC(T)}}{\text{BFC(R)}} \times 125 + a \times (t-t_0) + b \times \left( \frac{\text{BFC(R)}}{\text{BFC(R0)}} - 1.0 \right) \]

18 Test conditions (7 sites, Temperature from 5 to 32 °C, Vehicle & Trailer)
1. Use SRTT16 (Index of SRTT16 = 125)

Uniroyal Tiger Paw
195/75 R 14
SRRT E1136

Uniroyal Tiger Paw
225/60 R 16
ASTM F2493’08
2. Temperature adjustment and Surface friction adjustment

- The test results variability of current wet grip test method in R117.02 is mainly due to the high diversity of the sensitivity behavior of the tyres to Track grip and Temperature parameters.

- These different sensitivities can be explained by the choice of proper tyre design criteria addressed to different conditions of use. That is the reason why, different treatments for snow and normal tyres are applied.

- For both normal and snow tyre the concept of temperature and friction ADJUSTMENT is introduced, (a and b coefficient) being representative of average variation of snow and summer categories.
Temperature behavior of normal and snow tyres are different. Average slope of round robin tyres for both groups leading to adjustment factors a (see chart 6): -0.4232 (normal) and 0.7721 (snow)

For this reason the “a” factor is different for Normal and Snow tyres
Surface friction behavior of normal and snow tyres are different. Average slope of round robin tyres for both groups leading to adjustment factors b (see chart 6): -8.297 (normal) and +31.18 (snow).

For this reason the “b” factor is different for Normal and Snow tyres.
3. Reference test conditions

• Temperature normalization

  20 °C for Normal tyres as middle of the range 5-35 °C.
  10 °C for Snow tyres as middle of the range 2-20 °C.

  Note: reference temperature of 20 °C for snow tyre is not appropriate for service conditions and therefore the test temperature range had to be changed from 5-35 °C to 2-20 °C.

• Surface normalization

  0.70 which is the middle of the μ range 0.60-0.80 (SRTT 14 μ) corresponding to BPN=51 which is the middle of the BPN range 42-60.
Test Results from the Round Robin Test 2008-2009

R117 test method application

Normal type 1

Avg / Std
143 / 7.1%

Normal type 2

Avg / Std
138 / 8.6%

Normal type 3

Avg / Std
124 / 5.5%

New test method application

Avg / Std
142 / 4.3%

New test method allows to reduce significantly Standard Deviation

-2.8% 40%

-1.9% 22%

-2.7% 50%
New test method allows to reduce significantly Standard Deviation

Test Results from the Round Robin Test 2008-2009

R117 test method application

New test method application

Tested on 9 different tracks
Temperature range from cold to hot

Normal tyre1
Std 7.1%

Std 8.6%

Normal tyre2

Normal tyre3

Current R117

Test method for Wet grip grading

-2.8%
40%

-1.9%
22%

-2.7%
50%

New test method allows to reduce significantly Standard Deviation
## Test Results from the Round Robin Test 2008-2009

### R117 test method application

<table>
<thead>
<tr>
<th>Track 1</th>
<th>Track 2</th>
<th>Track 3</th>
<th>Track 4</th>
<th>Track 5</th>
<th>Track 6</th>
<th>Track 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg / Std</td>
<td>135 / 11.9%</td>
<td>134 / 11.9%</td>
<td>133 / 13.1%</td>
<td>132 / 7.3%</td>
<td>131 / 4.9%</td>
<td>130 / 3.3%</td>
</tr>
</tbody>
</table>

### New test method application

<table>
<thead>
<tr>
<th>Track 1</th>
<th>Track 2</th>
<th>Track 3</th>
<th>Track 4</th>
<th>Track 5</th>
<th>Track 6</th>
<th>Track 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg / Std</td>
<td>134 / 6.8%</td>
<td>133 / 6.8%</td>
<td>132 / 8.6%</td>
<td>131 / 4.5%</td>
<td>130 / 3.4%</td>
<td>129 / 2.4%</td>
</tr>
</tbody>
</table>

- **Snow tyre 1**
  - Avg / Std: 132 / 11.9%
  - New test method allows to reduce significantly Standard Deviation: -5.1%

- **Snow tyre 2**
  - Avg / Std: 135 / 13.1%
  - New test method allows to reduce significantly Standard Deviation: -4.5%

- **Snow tyre 3**
  - Avg / Std: 124 / 7.3%
  - New test method allows to reduce significantly Standard Deviation: -2.4%
Test Results from the Round Robin Test 2008-2009

R117 test method application

- Snow tyre 1: Std 11.9%
- Snow tyre 2: Std 13.1%
- Snow tyre 3: Std 7.3%

New test method application

- Tested on 9 different tracks
- Temperature range from cold to hot
- Current R117

Test method for Wet grip grading

- New test method allows to reduce significantly Standard Deviation
- Std 6.8%
- Std 8.6%
- Std 4.9%
- Std 3.3%

New test method application

- -5.1% (43%)
- -4.5% (34%)
- -2.4% (33%)

New test method allows to reduce significantly Standard Deviation
<table>
<thead>
<tr>
<th>Improvement Action</th>
<th>Current Reg117</th>
<th>Test Method for WetGrip Grading</th>
<th>Test Method for WetGrip Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality Target</td>
<td>Item not covered</td>
<td>Weighted standard deviation&lt;=5%</td>
<td>Weighted standard deviation&lt;=5%</td>
</tr>
<tr>
<td>Reference Tire</td>
<td>SRTT14</td>
<td>ASTM 16=125%</td>
<td>ASTM 16=125%</td>
</tr>
<tr>
<td>Differentiate Normal/Snow grading scheme</td>
<td>not mentioned</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Differentiate Normal/Snow testing conditions</td>
<td>not mentioned</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Wet surface Temperature Range</td>
<td>5-35 °C</td>
<td>5-35 °C</td>
<td>2-20 °C</td>
</tr>
<tr>
<td>Ambient Temperature Range</td>
<td>not mentioned</td>
<td>5-35 °C close to water temp (10° C max. difference)</td>
<td>2-20° C close to water temp (10° C max. difference)</td>
</tr>
<tr>
<td>BPN Range</td>
<td>40-60</td>
<td>as Reg117 for skid trailer mu (0.6-0.8) corresponding BPN range 42-60</td>
<td>as Reg117 for skid trailer mu (0.6-0.8) BPN range 42-60</td>
</tr>
<tr>
<td>Correction Factor introduction for Wet Grip Index (Friction and Temperature)</td>
<td>not mentioned</td>
<td>Yes Both different between normal &amp; snow tyres</td>
<td>Yes Both different between normal &amp; snow tyres</td>
</tr>
<tr>
<td>Reference conditions</td>
<td>not mentioned</td>
<td>for vehicle (20°C, 0.68 mfdd) for trailer (20°C, 0.85 pbfc)</td>
<td>for vehicle (10°C, 0.68 mfdd) for trailer (10°C, 0.85 pbfc)</td>
</tr>
<tr>
<td>Pros (by column)</td>
<td>reliable for homologation</td>
<td>the method is valid for both normal &amp; snow tyres</td>
<td>the method is valid for both normal &amp; snow tyres</td>
</tr>
</tbody>
</table>

*BPN* = British pendulum Number  
*mfdd* = mean fully developed deceleration  
*pbfc* = peack braking force coefficient
Advantages of a single wet grip test method (C1 tyre category):

• Reduces the test results dispersion.

• Introduces an SRTT Rim code 16 that fits better on the current vehicle mountings (size much closer to current tyre sizes). This reduces the need to use an intermediate control tyre.

• Cost saving: CoP test results can be used for market surveillance in the frame of tyre labelling.

• Cost reduction for Tyre Industry due to adoption of a single test method.
Annex
Basic concept of R117 and new Test method

80km/h → 20km/h     Deceleration G
Water film  0.5-1.5mm
Modified truck (on the center of floor, we can add additional tyre axle which the test tyre will be attached.)

65 km/h Peak Braking Force Coefficient
Water film 0.5-1.5mm
Tow vehicle and trailer

Only this tyre is under brake

Test position

Tow vehicle

Test tyre

trailer

Test position

65 km/h Peak Braking Force Coefficient
Water film 0.5-1.5mm

Provided by Continental
BPN measurement

Rubber piece
End