Proposal to amend ECE/TRANS/WP29/GRRF/2011/12 - Proposal for Supplement 1 to the 01 series of amendments to Regulation No. 117 (Tyre rolling noise and wet grip adhesion)

This document from the expert of ETRTO is a proposal to amend the document ECE/TRANS/WP29/GRRF/2011/12 - Proposal for Supplement 1 to the 01 series of amendments to Regulation No. 117 (Tyre rolling noise and wet grip adhesion) from the European Commission. The original text is in black letters. Additions are underlined and deletions are strike through.

Additional justification are given in the section "ETRTO additional comments and justifications".

As specific definitions are now included in annex 5:

Delete paragraphs from 2.11 to 2.18 in document Regulation No. 117 – Rev.1, Incorporating all valid text up to:

Corrigendum 1 to the original version of the Regulation, subject of Depositary Notification

C.N.557.2005.TREATIES-16 dated 15 July 2005

Corrigendum 2 to the original version of the Regulation, subject of Depositary Notification

C.N.583.2006.TREATIES-1 dated 1 August 2006

01 series of amendments - Date of entry into force: 2 February 2007

Corrigendum 1 to the 01 series of amendments, subject of Depositary Notification

C.N.554.2007.TREATIES-1 dated 9 May 2007.

2.11. "Adhesion on wet surfaces" means the relative braking performance, on a wet surface, of a test vehicle equipped with the candidate tyre in comparison to that of the same test vehicle equipped with a reference tyre (SRTT).

2.12. "Standard reference test tyre (SRTT)" means a tyre that is produced, controlled and stored in accordance with the American Society for Testing and Materials (ASTM) standard E 1136 - 93 (re-approved 1998).

2.13. "Candidate tyre" means a tyre, representative of the type, that is submitted for approval in accordance with this Regulation.

2.14. "Control tyre" means a normal production tyre that is used to establish the wet grip performance of tyre sizes unable to be fitted to the same vehicle as the standard reference test tyre – see paragraph 2.2.2.16. of Annex 5 to this Regulation.

2.15. "Wet grip index ("G")" means the ratio between the performance of the candidate tyre and the performance of the standard reference test tyre.

2.16. "Peak brake force coefficient ("pbfc")" means the maximum value of the ratio of braking force to vertical load on the tyre prior to wheel lock up.

2.17. "Mean fully developed deceleration ("mfdd")" means the average deceleration calculated on the basis of the measured distance recorded when decelerating a vehicle between two specified speeds.

2.18. "Coupling (hitch) height" means the height when measured perpendicularly from the centre of the articulation point of the trailer towing coupling or hitch to the ground,

~~when the towing vehicle and trailer are coupled together. The vehicle and trailer must be standing on level pavement surface in its test mode complete with the appropriate tyre(s) to be used in the particular test.~~

In Annex 5 as proposed in document GRRF/2011/12, amend to read:

"Annex 5

Testing method for measuring the wet grip index (G) of C1 tyres.

1.	Mandatory standards
	The following documents listed apply.
1.1.	ASTM E 303-93 (Reapproved 2008), Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.
1.2.	ASTM E 501-08, Standard Specification for Standard Rib Tire for Pavement Skid-Resistance Tests.
1.3.	ASTM E 965-96 (Reapproved 2006), Standard Test Method for Measuring Pavement Macrotexture Depth Using a Volumetric Technique.
1.4.	ASTM E 1136-93 (Reapproved 2003), Standard Specification for a Radial Standard Reference Test Tire ~~("SRTT14").~~**P195/75R14.**
1.5.	ASTM F 2493-08, Standard Specification for a Radial Standard Reference Test Tire ~~("SRTT16").~~**P225/60R16.**
2.	Definitions
	For the purposes of testing wet grip of C1 tyres:
2.1.	*"test run"* means a single pass of a loaded tyre over a given test track surface.
2.2.	*"test tyre(s)"* means a candidate tyre, a reference tyre or a control tyre or tyre set that is used in a test run.
2.3.	*"candidate tyre(s) (T)"* means a tyre or a tyre set that is tested for the purpose of calculating its wet grip index.
2.4.	*"reference tyre(s) (R)"* means a tyre or a tyre set that has the characteristics indicated in **the** ASTM F 2493-08 and referred to as **the** Standard Reference Test Tyre ~~16 inches (SRTT16").~~.
2.5.	*"control tyre(s) (C)"* means an intermediate tyre or a set of intermediate tyres which is used when the candidate tyre and the reference tyre cannot be directly compared on the same vehicle.
2.6.	*"braking force of a tyre"* means the longitudinal force, expressed in newton, resulting from braking torque application.
2.7.	*"braking force coefficient of a tyre (BFC)"* means the ratio of the braking force to the vertical load.
2.8.	*"peak braking force coefficient of a tyre"* means the maximum value of a tyre braking force coefficient that occurs prior to wheel lockup as the braking torque is progressively increased.

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2.9.   *"lockup of a wheel"* means the condition of a wheel in which its rotational velocity about the wheel spin axis is zero and it is prevented from rotating in the presence of applied wheel torque.

2.10.   *"vertical load"* means the load in newton imposed on the tyre perpendicular to the road surface.

2.11.   *"tyre test vehicle"* means a dedicated special purpose vehicle which has instruments to measure the vertical and the longitudinal forces on one test tyre during braking.

2.12   "SRTT14" means the ASTM E 1136-93 (Reapproved 2003), Standard Specification for a Radial Standard Reference Test Tire P195/75R14.

2.13   "SRTT16" means the ASTM F 2493-08, Standard Specification for a Radial Standard Reference Test Tire P225/60R16.

3.   General test conditions

3.1.   Track characteristics

The test track shall have the following characteristics:

3.1.1.   The surface shall have a dense asphalt surface with a uniform gradient of not more than 2 per cent and shall not deviate more than 6 mm when tested with a 3 m straight edge.

3.1.2.   The surface shall have a pavement of uniform age, composition, and wear. The test surface shall be free of loose material and foreign deposits.

3.1.3.   The maximum chipping size shall be 10 mm (tolerances permitted from 8 mm to 13 mm).

3.1.4.   The texture depth as measured by a sand patch shall be 0.7 ± 0.3 mm. It shall be measured in accordance with ASTM E 965-96 (Reapproved 2006).

3.1.5.   The wetted frictional properties of the surface shall be measured with either method (a) or (b) in section 3.2.

3.2.   Methods to measure the wetted frictional properties of the surface

3.2.1.   British Pendulum Number (BPN) method **(a)**

The British Pendulum Number method shall be as defined in ASTM E 303-93 (Reapproved in 2008).

Pad rubber component formulation and physical properties shall be as specified in ASTM E 501-08.

The averaged British Pendulum Number (BPN) shall be between 42 and 60 BPN after temperature correction as follows.

BPN shall be corrected by the wetted road surface temperature. Unless temperature correction recommendations are indicated by the British pendulum manufacturer, the following formula is used:

BPN = BPN(measured value) + temperature correction

temperature correction = $-0.0018\, t^{2} + 0.34\, t - 6.1$

where *t* is the wetted road surface temperature in degrees Celsius.

Effects of slider pad wear: ~~The~~the pad shall be removed for maximum wear when the wear on the striking edge of the slider reaches 3.2 mm in the plane of the slider or 1.6 mm vertical to it in accordance with section 5.2.2 and Figure 3 of ASTM E 303-93 (Reapproved 2008).

For the purpose of checking track surface BPN consistency for the measurement of wet grip on an instrumented passenger car : the BPN values of the test track should not vary over the entire stopping distance so as to decrease the dispersion of test results. The wetted frictional properties of the

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surface shall be measured five times at each point of the BPN measurement every 10 meters and the coefficient of variation of the averaged BPN shall not exceed 10 per cent.

3.2.2.   ASTM E 1136 Standard Reference Test Tyre ("SRTT14") method **(b)**

By derogation with ~~point (4) of section~~**paragraph** 2~~*~~**.4**, this method uses the reference tyre that has the characteristics indicated in **the** ASTM E 1136-93 (Reapproved 2003) and referred to as SRTT14"[+].

The average peak braking force coefficient ($\mu_{peak,ave}$) of the SRTT14" shall be 0.7 ± 0.1 at 65 km/h.

The average peak braking force coefficient ($\mu_{peak,ave}$) of the SRTT14" shall be corrected ~~by~~**for** the wetted road surface temperature as follows:

peak braking force coefficient ($\mu_{peak,ave}$) = peak braking force coefficient (measured) + temperature correction

temperature correction = 0.0035 x (t - 20)

where t is the wetted road surface temperature in degrees Celsius.

3.3.   Atmospheric conditions

The wind conditions shall not interfere with wetting of the surface (wind-shields are allowed).

Both the wetted surface temperature and the ambient temperature shall be between 2°C and 20°C for snow tyres and 5°C and 35°C for normal tyres.

The wetted surface temperature shall not vary during the test by more than 10°C.

The ambient temperature must remain close to the wetted surface temperature; the difference between the ambient and the wetted surface temperatures must be less than 10°C.

4.   Testing methods for measuring wet grip

For the calculation of the wet grip index (G) of a candidate tyre, the wet grip braking performance of the candidate tyre is compared to the wet grip braking performance of the reference tyre on a vehicle travelling straight ahead on a wet, paved surface. It is measured with one of the following methods:

(a)   Vehicle method consisting of testing a set of tyres mounted on an instrumented passenger car;

(b)   Testing method using a trailer towed by a vehicle or a tyre test vehicle, equipped with the test tyre(s).

4.1.   Testing method **(a)** using an instrumented passenger car

4.1.1.   Principle

The testing method covers a procedure for measuring the deceleration performance of C1 tyres during braking, using an instrumented passenger car equipped with an Antilock Braking System (ABS), where 'instrumented passenger car' means a passenger car that is fitted with the measuring equipment listed in section 4.1.2.2 for the purpose of this testing method. Starting with a defined initial speed, the brakes are applied hard enough on four wheels at the same time to activate the ABS. The average deceleration is calculated between two pre-defined speeds.

~~*   *Note by the secretariat*: Cross reference not clear.~~
~~+   The size of the ASTM E 1136 SRTT is P195/75R14~~

4.1.2.   Equipment

4.1.2.1.   Vehicle

Permitted modifications on the passenger car are as follows:

(a)   those allowing the number of tyre sizes that can be mounted on the vehicle to be increased;

(b)   those permitting automatic activation of the braking device to be installed;

(c)   Any other modification of the braking system is prohibited.

4.1.2.2.   Measuring equipment

The vehicle shall be fitted with a sensor suitable for measuring speed on a wet surface and distance covered between two speeds.

To measure vehicle speed, a fifth wheel or non-contact speed-measuring system shall be used.

4.1.3.   Conditioning of the test track and wetting condition

theThe test track surface shall be watered at least half an hour prior to testing in order to equalize the surface temperature and water temperature. External watering should be supplied continuously throughout testing. For the whole testing area, the water depth shall be 1.0 ± 0.5 mm, measured from the peak of the pavement.

The test track should then be conditioned by conducting at least ten test runs with tyres not involved in the test programme at 90 km/h.

4.1.4.   Tyres and rims

4.1.4.1.   Tyre preparation and break-in

The test tyres shall be trimmed to remove all protuberances on the tread surface caused by mould air vents or flashes at mould junctions.

The test tyres shall be mounted on the test rim declared by the tyre manufacturer.

A proper bead seat should be achieved by the use of a suitable lubricant. Excessive use of lubricant should be avoided to prevent slipping of the tyre on the wheel rim.

The test tyres/rim assemblies shall be stored in a location for a minimum of two hours such that they all have the same ambient temperature prior to testing. They should be shielded from the sun to avoid excessive heating by solar radiation.

For tyre break-in, two braking runs shall be performed.

4.1.4.2.   Tyre load

The static load on each axle tyre shall lie between 60 per cent and 90 per cent of the tested tyre load capacity. Tyre loads on the same axle should not differ by more than 10 per cent.

4.1.4.3.   Tyre inflation pressure

On the front and rear axles, the inflation pressures shall be 220 kPa (for standard- and extra-load tyres). The tyre pressure should be checked just prior to testing at ambient temperature and adjusted if required.

4.1.5.   Procedure

4.1.5.1.   Test run

The following test procedure applies for each test run.

4.1.5.1.1.   The passenger car is driven in a straight line up to 85 ± 2 km/h.

4.1.5.1.2.   Once the passenger car has reached 85 ± 2 km/h, the brakes are always activated at the same place on the test track referred to as 'braking starting point', with a longitudinal tolerance of 5 m and a transverse tolerance of 0.5 m.

4.1.5.1.3.   The brakes are activated either automatically or manually.

4.1.5.1.3.1.   The automatic activation of the brakes is performed by means of a detection system made of two parts, one indexed to the test track and one on board the passenger car.

4.1.5.1.3.2.   The manual activation of the brakes depends on the type of transmission as follows. In both cases, a minimum of 600 N pedal efforts is required.

For manual transmission, the driver should release the clutch and depress the brake pedal sharply, holding it down as long as necessary to perform the measurement.

For automatic transmission, the driver should select neutral gear and then depress the brake pedal sharply, holding it down as long as necessary to perform the measurement.

4.1.5.1.4.   The average deceleration is calculated between 80 km/h and 20 km/h.

If any of the specifications listed above (including speed tolerance, longitudinal and transverse tolerance for the braking starting point, and braking time) are not met when a test run is made, the measurement is discarded and a new test run is made.

4.1.5.2.   Test cycle

A number of test runs are made in order to measure the wet grip index of a set of candidate tyres (T) according to the following procedure, whereby each test run shall be made in the same direction and up to three different set of candidate tyres may be measured within the same test cycle:

4.1.5.2.1.   First, the set of reference tyres are mounted on the instrumented passenger car.

4.1.5.2.2.   After at least three valid measurements have been made in accordance with section 4.1.5.1., the set of reference tyres is replaced by a set of candidate tyres.

4.1.5.2.3.   After six valid measurements of the candidate tyres are performed, two more set of candidate tyres may be measured.

4.1.5.2.4.   The test cycle is closed by three more valid measurements of the same set of reference tyres as at the beginning of the test cycle.

Examples:

(a)   The run order for a test cycle of three sets of candidate tyres (T1 to T3) plus a set of reference tyres (R) would be the following:

R-T1-T2-T3-R

(b)   The run order for a test cycle of five sets of candidate tyres (T1 to T5) plus a set of reference tyres (R) would be the following:

R-T1-T2-T3-R-T4-T5-R

4.1.6.   Processing of measurement results

4.1.6.1.   Calculation of the average deceleration (*AD*)

The average deceleration (*AD)* is calculated for each valid test run in m.s^{-2}/s^2 as follows:

$$AD = \left| \frac{S_f{}^2 - S_i{}^2}{2d} \right|$$

where:

S_f is the final speed in m/s; S_f = 20 km/h = 5.556 m/s

S_i is the initial speed in m/s; S_i = 80 km/h = 22.222 m/s

d is the distance covered between S_i and S_f **in metre**.

4.1.6.2.   Validation of results

The *AD* coefficient of variation is calculated as follows:

(Standard Deviation / Average) x 100.

For the reference tyres *(R)*: If the *AD* coefficient of variation of any two consecutive groups of three test runs of the reference tyre set is higher than 3 per cent, all data should be discarded and the test repeated for all test tyres (the candidate tyres and the reference tyres).

For the candidate tyres *(T)*: The *AD* coefficients of variation are calculated for each candidate tyre set. If one coefficient of variation is higher than 3 per cent, the data should be discarded and the test repeated for that candidate tyre set.

4.1.6.3.   Calculation of adjusted average deceleration (*Ra*)

The average deceleration (*AD*) of the reference tyre set used for the calculation of its braking force coefficient is adjusted according to the positioning of each candidate tyre set in a given test cycle.

This adjusted *AD* of the reference tyre (*Ra*) is calculated in m/s^2 in accordance with table 1 where R_1 is the average of the *AD* values in the first test of the reference tyre set (R) and R_2 is the average of the *AD* values in the second test of the same reference tyre set (R).

Table 1

Number of sets of candidate tyres within one test cycle	Set of candidate tyres	Ra
1 (R_1-T1-R_2)	T1	$Ra = 1/2\ (R_1 + R_2)$
2 (R_1-T1-T2-R_2)	T1	$Ra = 2/3\ R_1 + 1/3\ R_2$
	T2	$Ra = 1/3\ R_1 + 2/3\ R_2$
3 (R_1-T1-T2-T3-R_2)	T1	$Ra = 3/4\ R_1 + 1/4\ R_2$
	T2	$Ra = 1/2\ (R_1 + R_2)$
	T3	$Ra = 1/4\ R_1 + 3/4\ R_2$

4.1.6.4.   Calculation of the braking force coefficient (*BFC*)

The braking force coefficient (*BFC*) is calculated for a braking on the two axles according to Table 2 where *Ta* ($a = 1, 2$ or 3) is the average of the *AD* values for each candidate tyre *(T)* set that is part of a test cycle.

Table 2

Test Tyre	Braking force coefficient		
Reference tyre	*BFC(R)*=	Ra/g	
Candidate tyre	*BFC(T)*=	Ta/g	
g is the acceleration due to gravity, *g*= 9.81 m~~·s⁻²~~/s²			

4.1.6.5.   Calculation of the wet grip index of the candidate tyre

The wet grip index of the candidate tyre ($G(T)$) is calculated as follows:

$$G(T) = \left[\frac{BFC(T)}{BFC(R)} \times 125 + a \times (t - t_0) + b \times \left(\frac{BFC(R)}{BFC(R_0)} - 1{,}0 \right) \right] \times 10^{-2}$$

where:

t is the measured wet surface temperature in degree Celsius when the candidate tyre *(T)* is tested

t_0 is the wet surface reference temperature condition, t_0=20°C for normal tyres and t_0=10°C for snow tyres

$BFC(R_0)$ is the braking force coefficient for the reference tyre in the reference conditions, BFC(R_0) = 0.68

a= -0.4232 and b = -8.297 for normal tyres, a = 0.7721 and b = 31.18 for snow tyres *[a is expressed as (1/°C)]*

4.1.7.   Wet grip performance comparison between a candidate tyre and a reference tyre using a control tyre

4.1.7.1.   General

Where the candidate tyre size is significantly different from that of the reference tyre, a direct comparison on the same instrumented passenger car may not be possible. This testing method uses an intermediate tyre, hereinafter called the control tyre as defined in ~~point 5 of section 2~~**paragraph 2.5**.

4.1.7.2.   Principle of the approach

The principle is the use of a control tyre set and two different instrumented passenger cars for the test cycle of a candidate tyre set in comparison with a reference tyre set.

One instrumented passenger car is fitted with the reference tyre set followed by the control tyre set, the other with the control tyre set followed by the candidate tyre set.

The specifications listed in sections 4.1.2. to 4.1.4 apply.

The first test cycle is a comparison between the control tyre set and the reference tyre set.

The second test cycle is a comparison between the candidate tyre set and the control tyre set. It is done on the same test track and during the same day as the first test cycle. The wetted surface temperature shall be within ± 5 °C of the temperature of the first test cycle. The same control tyre set shall be used for the first and the second test cycles.

The wet grip index of the candidate tyre ($G(T)$) is calculated as follows:

$G(T) = G_1 \times G_2$

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where:

G_1 is the relative wet grip index of the control tyre *(C)* compared to the reference tyre *(R)* calculated as follows:

$$G_1 = \left[\frac{BFC(C)}{BFC(R)} \times 125 + a \times (t - t_0) + b \times \left(\frac{BFC(R)}{BFC(R_0)} - 1,0 \right) \right] \times 10^{-2}$$

G_2 is the relative wet grip index of the candidate tyre *(T)* compared to the control tyre *(C)* calculated as follows:

$$G_2 = \frac{BFC(T)}{BFC(C)}$$

4.1.7.3.   Storage and preservation

It is necessary that all the tyres of a control tyre set have been stored in the same conditions. As soon as the control tyre set has been tested in comparison with the reference tyre, the specific storage conditions defined in ASTM E 1136-93 (Reapproved 2003) shall be applied.

4.1.7.4.   Replacement of reference tyres and control tyres

When irregular wear or damage results from tests, or when wear influences the test results, the use of the tyre shall be discontinued.

4.2.   Testing method **(b)** using a trailer towed by a vehicle or a tyre test vehicle

4.2.1.   Principle

The measurements are conducted on test tyres mounted on a trailer towed by a vehicle (hereafter referred to as tow vehicle) or on a tyre test vehicle. The brake in the test position is applied firmly until sufficient braking torque is generated to produce the maximum braking force that will occur prior to wheel lockup at a test speed of 65 km/h.

4.2.2.   Equipment

4.2.2.1.   Tow vehicle and trailer or tyre test vehicle

The tow vehicle or the tyre test vehicle shall have the capability of maintaining the specified speed of 65 ± 2 km/h even under the maximum braking forces.

The trailer or the tyre test vehicle shall be equipped with one place where the tyre can be fitted for measurement purposes hereafter called 'test position' and the following accessories:

(a)   equipment to activate brakes in the test position;

(b)   a water tank to store sufficient water to supply the road surface wetting system, unless external watering is used;

(c)   recording equipment to record signals from transducers installed at the test position and to monitor water application rate if the self-watering option is used.

The maximum variation of toe-settings and camber angle for the test position shall be within ± 0.5° with maximum vertical load. Suspension arms and bushings shall have sufficient rigidity necessary to minimize free play and ensure compliance under application of maximum braking forces. The suspension system shall provide adequate load-carrying capacity and be of such a design as to isolate suspension resonance.

The test position shall be equipped with a typical or special automotive brake system which can apply sufficient braking torque to produce the maximum value of braking test wheel longitudinal force at the conditions specified.

The brake application system shall be able to control the time interval between initial brake application and peak longitudinal force as specified in section 4.2.7.1.

The trailer or the tyre test vehicle shall be designed to accommodate the range of candidate tyre sizes to be tested.

The trailer or the tyre test vehicle shall have provisions for adjustment of vertical load as specified in section 4.2.5.2.

4.2.2.2.   Measuring equipment

The test wheel position on the trailer or the tyre test vehicle shall be equipped with a rotational wheel velocity measuring system and with transducers to measure the braking force and vertical load at the test wheel.

General requirements for measurement system: The instrumentation system shall conform to the following overall requirements at ambient temperatures between 0 °C and 45 °C:

(a)   overall system accuracy, force: ± 1.5 per cent of the full scale of the vertical load or braking force;

(b)   overall system accuracy, speed: ± 1.5 per cent of speed or ± 1.0 km/h, whichever is greater.

Vehicle speed: To measure vehicle speed, a fifth wheel or non-contact precision speed-measuring system should be used.

Braking forces: The braking force-measuring transducers shall measure longitudinal force generated at the tyre–road interface as a result of brake application within a range from 0 per cent to at least 125 per cent of the applied vertical load. The transducer design and location shall minimize inertial effects and vibration-induced mechanical resonance.

Vertical load: The vertical load-measuring transducer shall measure the vertical load at the test position during brake application. The transducer shall have the same specifications as described previously.

Signal conditioning and recording system: All signal conditioning and recording equipment shall provide linear output with necessary gain and data reading resolution to meet the specified previous requirements. In addition, the following requirements apply:

(a)   The minimum frequency response shall be flat from 0 Hz to 50 Hz (100 Hz) within ± 1 per cent full scale;

(b)   The signal-to-noise ratio shall be at least 20/1;

(c)   The gain shall be sufficient to permit full-scale display for full-scale input signal level;

(d)   The input impedance shall be at least ten times larger than the output impedance of the signal source;

(e)   The equipment shall be insensitive to vibrations, acceleration, and changes in ambient temperature.

4.2.3.   Conditioning of the test track

The test track should be conditioned by conducting at least ten test runs with tyres not involved in the test program at 65 ± 2 km/h.

4.2.4.   Wetting conditions

The tow vehicle and trailer or the tyre test vehicle may be optionally equipped with a pavement-wetting system, less the storage tank, which, in the case of the trailer, is mounted on the tow vehicle. The water being applied to the pavement ahead of the test tyres shall be supplied by a nozzle suitably designed to ensure that the water layer encountered by the test tyre has a uniform cross section at the test speed with a minimum splash and overspray.

The nozzle configuration and position shall ensure that the water jets are directed towards the test tyre and pointed towards the pavement at an angle of 20° to 30°.

The water shall strike the pavement 250 mm to 450 mm ahead of the centre of tyre contact. The nozzle shall be located 25 mm above the pavement or at the minimum height required to clear obstacles which the tester is expected to encounter, but in no case more than 100 mm above the pavement.

The water layer shall be at least 25 mm wider than the test tyre tread and applied so the tyre is centrally located between the edges. Water delivery rate shall ensure a water depth of 1.0 ± 0.5 mm and shall be consistent throughout the test to within ± 10 per cent. The volume of water per unit of wetted width shall be directly proportional to the test speed. The quantity of water applied at 65 km/h shall be 18 l/s per meter of width of wetted surface in case of a water depth of 1.0 mm.

4.2.5.   Tyres and rims

4.2.5.1.   Tyre preparation and break-in

The test tyres shall be trimmed to remove all protuberances on the tread surface caused by mould air vents or flashes at mould junctions.

The test tyre shall be mounted on the test rim declared by the tyre manufacturer.

A proper bead seat should be achieved by the use of a suitable lubricant. Excessive use of lubricant should be avoided to prevent slipping of the tyre on the wheel rim.

The test tyres/rim assemblies shall be stored in a location for a minimum of two hours such that they all have the same ambient temperature prior to testing. They should be shielded from the sun to avoid excessive heating by solar radiation.

For tyre break-in, two braking runs shall be performed under the load, pressure and speed as specified in 4.2.5.2, 4.2.5.3 and 4.2.7.1 respectively.

4.2.5.2.   Tyre load

The test load on the test tyre is 75 ± 5 per cent of the tyre load capacity.

4.2.5.3.   Tyre inflation pressure

The test tyre cold inflation pressure shall be 180 kPa for standard-load tyres. For extra-load tyres, the cold inflation pressure shall be 220 kPa.

The tyre pressure should be checked just prior to testing at ambient temperature and adjusted if required.

4.2.6.   Preparation of the tow vehicle and trailer or the tyre test vehicle

4.2.6.1.   Trailer

For one axle trailers, the hitch height and transverse position shall be adjusted once the test tyre has been loaded to the specified test load in order to avoid any disturbance of the measuring results. The longitudinal distance from the centre line of the articulation point of the coupling to the transverse centre line of the axle of the trailer shall be at least ten times the "hitch height" or the "coupling (hitch) height".

4.2.6.2.   Instrumentation and equipment

Install the fifth wheel, when used, in accordance with the manufacturer's specifications and locate it as near as possible to the mid-track position of the tow trailer or the tyre test vehicle.

4.2.7.   Procedure

4.2.7.1.   Test run

The following procedure applies for each test run:

4.2.7.1.1.   The tow vehicle or the tyre test vehicle is driven onto the test track in a straight line at the specified test speed 65 ± 2 km/h.

4.2.7.1.2.   The recording system is launched.

4.2.7.1.3.   Water is delivered to the pavement ahead of the test tyre approximately 0.5 s prior to brake application (for internal watering system).

4.2.7.1.4.   The trailer brakes are activated within 2 metres of a measurement point of the wetted frictional properties of the surface and sand depth in accordance with points 4 and 5 of section 3.1. The rate of braking application shall be such that the time interval between initial application of force and peak longitudinal force is in the range 0.2 s to 0.5 s.

4.2.7.1.5.   The recording system is stopped.

4.2.7.2.   Test cycle

A number of test runs are made in order to measure the wet grip index of the candidate tyre (T) according to the following procedure, whereby each test run shall be made at**from** the same spot on the test track and in the same direction. Up to three candidate tyres may be measured within the same test cycle, provided that the tests are completed within one day.

4.2.7.2.1.   First, the reference tyre is tested.

4.2.7.2.2.   After at least six valid measurements are performed in accordance with section 4.2.7.1, the reference tyre is replaced by the candidate tyre.

4.2.7.2.3.   After six valid measurements of the candidate tyre are performed, two more candidate tyres may be measured.

4.2.7.2.4.   The test cycle is closed by six more valid measurements of the same reference tyre as at the beginning of the test cycle.

Examples:

(a) The run order for a test cycle of three candidate tyres (T1 to T3) plus the reference tyre (R) would be the following:

R-T1-T2-T3-R

(b) The run order for a test cycle of five candidate tyres (T1 to T5) plus the reference tyre R would be the following:

R-T1-T2-T3-R-T4-T5-R

4.2.8. Processing of measurement results

4.2.8.1. Calculation of the peak braking force coefficient

The tyre peak braking force coefficient (μ_{peak}) is the highest value of $\mu(t)$ before lockup occurs calculated as follows for each test run. Analogue signals should be filtered to remove noise. Digitally recorded signals must be filtered using a moving average technique.

$$\mu(t) = \left| \frac{fh(t)}{fv(t)} \right|$$

where:

$\mu(t)$ is the dynamic tyre braking force coefficient in real time;

$fh(t)$ is the dynamic braking force in real time, in N;

$fv(t)$ is the dynamic vertical load in real time, in N.

4.2.8.2. Validation of results

The μ_{peak} coefficient of variation is calculated as follows:

(Standard Deviation / Average) x 100

For the reference tyre *(R)*: If the coefficient of variation of the peak braking force coefficient (μ_{peak}) of the reference tyre is higher than 5 per cent, all data should be discarded and the test repeated for all test tyres (the candidate tyre(s) and the reference tyre).

For the candidate tyre(s) *(T)*: The coefficient of variation of the peak braking force coefficient (μ_{peak}) is calculated for each candidate tyre. If one coefficient of variation is higher than 5 per cent, the data should be discarded and the test repeated for this candidate tyre.

4.2.8.3. Calculation of the adjusted average peak braking force coefficient

The average peak braking force coefficient of the reference tyre used for the calculation of its braking force coefficient is adjusted according to the positioning of each candidate tyre in a given test cycle.

This adjusted average peak braking force coefficient of the reference tyre *(Ra)* is calculated in accordance with table 3 where R_1 is the average peak tyre braking coefficient in the first test of the reference tyre (R) and R_2 is the average peak tyre braking coefficient in the second test of the same reference tyre (R).

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Table 3

Number of candidate tyre(s) within one test cycle	candidate tyre	Ra
1 (R$_1$-T1-R$_2$)	T1	Ra = 1/2 (R$_1$ + R$_2$)
2 (R$_1$-T1-T2-R$_2$)	T1	Ra = 2/3 R$_1$ + 1/3 R$_2$
	T2	Ra = 1/3 R$_1$ + 2/3 R$_2$
3 (R$_1$-T1-T2-T3-R$_2$)	T1	Ra = 3/4 R$_1$ + 1/4 R$_2$
	T2	Ra = 1/2 (R$_1$ +R$_2$)
	T3	Ra = 1/4 R$_1$ + 3/4 R$_2$

4.2.8.4   Calculation of the average peak braking coefficient ($\mu_{peak,ave}$)

The average value of the peak braking coefficients ($\mu_{peak,ave}$) is calculated according to table 4 whereby Ta (a= 1, 2 or 3) is the average of the peak braking force coefficients measured for one candidate tyre within one test cycle.

Comment [A2]: Paragraph 4.2.8.4 to be added

Table 4

Test tyre	$\mu_{peak,ave}$
Reference tyre	$\mu_{peak,ave}(R)=Ra$ as per Table 3
Candidate tyre	$\mu_{peak,ave}(T) = Ta$

4.2.8.5.   Calculation of the wet grip index of the candidate tyre

The wet grip index of the candidate tyre $(G(T))$ is calculated as follows:

$$G(T) = \left[\frac{\mu_{peak,ave}(T)}{\mu_{peak,ave}(R)} \times 125 + a \times (t - t_0) + b \times \left(\frac{\mu_{peak,ave}(R)}{\mu_{peak,ave}(R_0)} - 1,0 \right) \right] \times 10^{-2}$$

Comment [A3]: "Point" to be used in place of comma for decimal separation

where:

t is the measured wet surface temperature in degree Celsius when the candidate tyre (T) is tested

t_0 is the wet surface reference temperature condition

t_0=20°C for normal tyres t_0=10°C for snow tyres

$\mu_{peak,ave}(R_0) = 0.85$ is the peak braking force coefficient for the reference tyre in the reference conditions

a= -0.4232 and b = -8.297 for normal tyres, a = 0.7721 and b = 31.18 for snow tyres" *[a is expressed as (1/°C)]*

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"Appendix   Test reports examples of wet grip index.

Example 1: Test report of wet grip index using trailer method

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Test report number:	Test date:
Type of road surface:	Texture depth (mm):
μ peak (SRTT14" ESRTT14E 1136):	or BPN:
Speed (km/h):	Water depth (mm):

No.		1	2	3	4	5	6	7	8	9	10
Size											
Service description											
Tyre identification											
Rim											
Pattern											
Load (N)											
Pressure (kPa)											
μpeak	1										
	2										
	3										
	4										
	5										
	6										
	7										
	8										
Average											
Standard deviation σ											
(σ/average)≤5 per cent											
Ra, Adjusted											
Wet grip index											
Surface temp. (°C)											
Ambient temp. (°C)											
Remarks											

Example 2: Test report of wet grip index using passenger car method

Driver:		Test date:			

Track: Passenger Car: Initial speed (km/h):
    Texture depth (mm):   Brand: Final speed (km/h):
    BPN: Model:
    Water depth (mm):   Type

No.	1	2	3	4	5
Brand	Uniroyal	TYRE B	TYRE C	TYRE D	Uniroyal
Pattern	ASTM F 2493 SRTT16"	PATTERN B	PATTERN C	PATTERN D	ASTM F 2493 SRTT16"
Size	P225/60R16	SIZE B	SIZE C	SIZE D	P225/60R16
Service description	97S	LI/SS	LI/SS	LI/SS	97S
Tyre identification	XXXXXXXX	YYYYYYYYY	*ZZZZZZZZZ*	NNNNNNNNN	XXXXXXXX
Rim					
Front axle pressure (kPa)					
Rear axle pressure (kPa)					
Front axle load (~~Nkg~~)					
Rear axle load (kg)					
Wet surface temp (°C)					
Ambient temp (°C)					

	Braking distance (m)	Average deceleration (m/s^2)	Braking distance (m)	Average deceleration (m/s^2)	Braking distance (m)	Average deceleration (m/s^2)	Braking distance (m)	Average deceleration (m/s^2)	Braking distance (m)	Average deceleration (m/s^2)
Measurement 1										
2										
3										
4										
5										
6										
7										
8										
9										
10										

Average *AD* (m/s^2)

Standard deviation (m/s^2)

Validation of results
Coeff. of variation (per cent) < 3 per cent
Adjusted average *AD* of ref. tyre: R_a (m/s^2)
BFC(R) reference tyre (SRTT16~~"))~~
BFC(T) candidate tyre

Wet grip index (%)

"

Additional comments and justifications by ETRTO experts

Item #	Clause No./ Subclause No./ Annex (e.g. 3.1)	Paragraph/ Figure/Tabl e/Note (e.g. Table 1)	Type of com-ment[1]	Comment (justification for change)	Proposed change
1	§ 1 Mandatory standards	§ 1. (4)	Ed	Non SI units should no longer be used in the EU. To be in line with ETRTO Standard nomenclature. SRTT rim code 14 Size to be added	From "(SRTT14") " To "P195/75R14 (SRTT14) "
2		§ 1. (5)	Ed	Non SI units should no longer be used in the EU. To be in line with ETRTO Standard nomenclature. SRTT rim code 16 Size to be added	From "(SRTT16") " To "P225/60R16 (SRTT16) "
3	§ 2 Definitions	§ 2. (4)	Ed	Non SI units should no longer be used in the EU. To be in line with ETRTO Standard nomenclature.	From " 16 inches (SRTT16") " To " rim code 16 (SRTT16) "
4	§ 4 Testing method using an instrumented passenger car - Conditioning of the test track and wetting condition	§ 4.1.3 First sentence	Ed		From " he " To " The "
5	§ 4 Testing method using an instrumented passenger car - Processing of measurement results - Calculation of the average deceleration (AD)	§ 4.1.6.1 Page 9 First sentence	Ed		From " $m.s^{-2}$ " To " m/s^2 "
6		§ 4.1.6.1 Last sentence	Ed		From " $m.s^{-1}$ " To " m/s "
7		§ 4.1.6.1 Last sentence	Ed		From " $m.s^{-1}$ " To " m/s "

Item #	Clause No./ Subclause No./ Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note (e.g. Table 1)	Type of com-ment[1]	Comment (justification for change)	Proposed change
8		§ 4.1.6.1 Page 10 First sentence	Ed		From " m.s^{-1} " To " m/s "
9		§ 4.1.6.1 First sentence	Ed		From " m.s^{-1} " To " m/s "
10	§ 4	§ 4.1.6.3 Second sentence	Ed		From " m.s^{-2} " To " m/s^2 "
11	§ 4	§ 4.1.6.4 Table 2 Last row	Ed		From " m.s^{-2} " To " m/s^2 "
12	§ 4.2 Testing method using a trailer towed by a vehicle or a tyre test vehicle Test cycle	§ 4.2.7.2 First sentence	Ed	To be in line with current Reg.117.01 Annex 5	From " at the same spot " To " from the same spot "
13	After Table 3	§ 3.2.8.4	Ed	Misprinting of the paragraph number	From § 3.2.8.4 To § 4.2.8.4
14	Annex A Test reports examples of wet grip index. Example 1: Test report of wet grip index using trailer method.	Annex A Example 1	Ed	Non SI units should no longer be used in the EU. To be in line with ETRTO Standard nomenclature.	From " µ peak (SRTT14" E 1136): " To " µ peak (SRTT14 E 1136): "

Item #	Clause No./ Subclause No./ Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note (e.g. Table 1)	Type of com-ment[1]	Comment (justification for change)	Proposed change
15	Annex A Test reports examples of wet grip index. Example 1: Test report of wet grip index using trailer method.	Annex A Example 1	Ed	Only one value between BPN and SRTT14 peak mu measurement is needed to characterize the track surface.	To add the word "or" before BPN.
16	Annex A Test reports examples of wet grip index. Example 2: Test report of wet grip index using passenger car method	Annex A Example 2 Table Pattern No. 1 and 5	Ed	Non SI units should no longer be used in the EU. To be in line with ETRTO Standard nomenclature.	From " SRTT16" " To "SRTT16 "
17		Annex A Example 2 Table Front axle load	Te	While in the trailer method the tyre is loaded by a vertical load (Newton), in the vehicle method the tyre is loaded by the weight (kg); for instance the vehicle must be weighed	From " (N) " To " (kg) "
18	Annex A Test reports examples	Annex A Example 2 Table	Te	To be consistent with § 4.1.4.2 Tyre load - "each axle"	Insert below the "Front axle load (kg)" a new line "Rear axle load (kg)"
19	§ 4.1.6.5	End of the paragraph	Ed	Dimension not included	To insert at the end of the paragraph the following sentence [a expressed as (1/°C)]

Item #	Clause No./ Subclause No./ Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note (e.g. Table 1)	Type of com-ment[1]	Comment (justification for change)	Proposed change
20	§ 4.2.8.5	End of the paragraph	Ed	Dimension not included	To insert at the end of the paragraph the following sentence [a expressed as (1/°C)]
21	Whole document		ed	For consistency reason, the "point" in place of the "comma" must be used for decimal number separation	To replace in the whole document the "comma" used for decimal number separation with the "point" (e.g. 123.45 in place of 123,45)
22	Reg.117.01 Definitions			As specific definitions are now included in annex 5: Delete paragraphs from 2.11 to 2.18 in document Regulation No. 117 – Rev.1, Incorporating all valid text up to: Corrigendum 1 to the original version of the Regulation, subject of Depositary Notification C.N.557.2005.TREATIES-16 dated 15 July 2005 Corrigendum 2 to the original version of the Regulation, subject of Depositary Notification C.N.583.2006.TREATIES-1 dated 1 August 2006 01 series of amendments - Date of entry into force: 2 February 2007 Corrigendum 1 to the 01 series of amendments, subject of Depositary Notification C.N.554.2007.TREATIES-1 dated 9 May 2007.	Delete paragraphs from 2.11 to 2.18

1   Type of comment: ge = **general**   te = **technical**   ed = **editorial**