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Tyres – Regulation No. 117

Proposal for amendments to Regulation No. 117

Submitted by the experts from the from the European Commission, France and European Tyre and Rim Technical Organisation*

The text reproduced below was prepared jointly by the experts from the European Commission (EC), France and European Tyre and Rim Technical Organisation (ETRTO) in order to introduce wet grip provisions and testing procedures for tyres of categories C2 and C3. The document is based on informal documents GRRF-73-08, GRRF-73-18 and GRRF-73-21. The modifications to the existing text of the Regulation are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and ECE/TRANS/2010/8, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

Paragraph 1.1., amend to read:

"1.1. This Regulation applies to new pneumatic tyres of Classes C1, C2 and C3 with regard to their sound emissions, rolling resistance and ~~to new pneumatic tyres of class C1 with regard~~ to adhesion performance on wet surfaces (wet adhesion). It does not, however, apply to:"

Paragraph 1.1.8., amend to read:

"1.1.8. Professional off-road tyres ~~for the requirements on rolling resistance and rolling sound~~."

Paragraph 6.2.1., amend to read:

"6.2.1. … given in Annex 5 **(A)** to this Regulation…"

Insert new paragraphs 6.2.2. to 6.2.3., to read:

"**6.2.2. For Class C2 tyres, tested in accordance with either procedure given in Annex 5 (B) to this Regulation, the tyre shall meet the following requirements:**

Category of use		***Wet grip index (G)***	
		Other	***Traction tyres***
Normal tyre		**≥ 0.95**	**≥ 0.85**
Snow tyre		**≥ 0.95**	**≥ 0.85**
	Snow tyre for use in severe snow conditions	**≥ 0.85**	**≥ 0.85**
Special use tyre		**≥ 0.85**	**≥ 0.85**

6.2.3. For Class C3 tyres, tested in accordance with either procedure given in Annex 5 (B) to this Regulation, the tyre shall meet the following requirements:

Category of use		**Wet grip index (G)**	
		Other	**Traction tyres**
Normal tyre		**≥ 0.65**	**≥ 0.65**
Snow tyre		**≥ 0.65**	**≥ 0.65**
	Snow tyre for use in severe snow conditions	**≥ 0.65**	**≥ 0.65**
Special use tyre		**≥ 0.65**	**≥ 0.65**

"

Insert new paragraphs 12.8. to 12.10., to read:

"**12.8. As from 1 November 2016, Contracting Parties applying this Regulation shall refuse to grant approval for a type of C2 or C3 tyre if the tyre type**

to be approved does not meet the requirements of this Regulation as amended by the [supplement XX to the 02] series of amendments, including the requirements for wet grip performance set out in paragraphs 6.2.2 and 6.2.3.

12.9. **As from 1 November 2018, Contracting Parties applying this Regulation may refuse to allow the sale or entry into service of a type of C2 tyre which does not meet the requirements of this Regulation as amended by the [supplement XX to the 02] series of amendments, including the requirements for wet grip performance set out in paragraph 6.2.2.**

12.10. **As from 1 November 2020, Contracting Parties applying this Regulation may refuse to allow the sale or entry into service of a type of C3 tyre which does not meet the requirements of this Regulation as amended by of the supplement XX to the series 02 of amendments, including the requirements for wet grip performance set out in paragraph 6.2.3.**"

Annex 5, add a subtitle:

"Annex 5

Test procedures for measuring wet grip

(A) - C1 category tyres

..."

Insert new part (B), to read:

" **(B) – C2 and C3 category tyres**

1. **General Test Conditions**

1.1. **Track characteristics**

The surface shall be a dense asphalt surface with a uniform gradient of not more than two per cent and shall not deviate more than 6 mm when tested with a 3 m straightedge.

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

The maximum chipping size shall be from 8 mm to 13 mm.

The sand depth measured as specified in EN13036-1:2001 and ASTM E 965-96 (reapproved 2006) shall be (0.7±0.3) mm.

The surface friction value for the wetted track shall be established by one or other of the following methods:

1.1.1. **Standard reference test tyre (SRTT) method**

The average peak braking coefficient (μ peak average) of the ASTM E1136 -93 (reapproved 2003) reference tyre (Test method using a trailer or a tyre test vehicle as specified in clause 2.1) shall be 0.7 +/- 0.1 (at 65

km/h and 180 kPa). The measured values shall be corrected for the effects of temperature as follows:

pbfc = pbfc (measured) + 0.0035 · (t - 20)

where "t" is the wetted track surface temperature in degrees Celsius.

The test shall be conducted using the lanes and length of the track to be used for the wet grip test.

For the trailer method, testing is run in such a way that braking occurs within 10 metres distance of where the surface was characterized.

1.1.2. British pendulum number (BPN) method

The averaged British Pendulum Number (BPN) British Pendulum Tester method as specified in ASTM E 303-93 (reapproved 2008) using the Pad as specified in ASTM E 501-08 shall be (50±10) BPN after temperature correction.

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

BPN = BPN (measured value) – (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 pad should 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.

Check the test track testing surface BPN consistency for the measurement of wet grip on a standard vehicle.

In the lanes of the track to be used during the wet grip tests, the BPN shall be measured at intervals of 10 m along the length of the lanes. The BPN shall be measured 5 times at each point and the coefficient of variation of the BPN averages shall not exceed 10 per cent.

1.1.3. The Type Approval Authority shall satisfy itself of the characteristics of the track on the basis of evidence produced in test reports.

1.2. The surface may be wetted from the track-side or by a wetting system incorporated into the test vehicle or the trailer.

If a track-side system is used, the test surface shall be wetted for at least half an hour prior to testing in order to equalize the surface temperature and water temperature. It is recommended that track-side wetting be continuously applied throughout testing.

The water depth shall be between 0.5 and 2.0 mm.

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

The ambient and the wetted surface temperature shall be between 5 °C and 35 °C and shall not vary during the test by more than 10 °C.

1.4. In order to cover the range of the tyre sizes fitting the Commercial Vehicles, three Standard Reference Testing Tyre (SRTT) sizes shall be used to measure the relative wet index:

- SRTT 315/70R22.5 LI=154/150, ASTM F2870
- SRTT 245/70R19.5 LI=136/134, ASTM F2871
- SRTT 225/75 R 16 C LI=116/114, ASTM F2872

The three Standard Reference Testing Tyre sizes shall be used to measure the relative wet index as shown in the following table:

FOR C3 TYRES	
NARROW FAMILY $S_{Nominal} < 285$ mm	**WIDE FAMILY** $S_{Nominal} \geq 285$ mm
SRTT 245/70R19.5 LI=136/134	**SRTT 315/70R22.5** LI=154/150
FOR C2 TYRES **SRTT 225/75 R 16 C** LI=116/114	
$S_{Nominal}$ = Tyre Nominal Section width	

2. Test Procedure

The comparative wet grip performance shall be established using either:

(a) A trailer or special purpose tyre evaluation vehicle; or

(b) A standard production vehicle (M_2, M_3, N_1, N_2 or N_3, category) as defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.) contained in ECE/TRANS/WP.29/78/Rev.2.

2.1. Trailer or special purpose tyre evaluation vehicle procedure

2.1.1. The measurements are conducted on (a) tyre(s) mounted on a trailer towed by a vehicle or a tyre test vehicle.

The brake on the test position is applied firmly until sufficient braking torque results to produce maximum braking force that will occur prior to wheel lockup at a test speed of 50 km/h. The trailer, together with the towing vehicle, or the tyre evaluation vehicle shall comply with the following requirements:

2.1.1.1. Be capable of exceeding the upper limit for the test speed of 50 km/h and of maintaining the test speed requirement of (50±2) km/h even at the maximum level of application of braking forces;

2.1.1.2. Be equipped with an axle providing one test position having an hydraulic brake and actuation system that can be operated at the test position from the towing vehicle if applicable. The braking system shall be capable of providing sufficient braking torque to achieve the peak brake force coefficient over the range of tyre sizes and tyre loads to be tested;

2.1.1.3. Be capable of maintaining longitudinal alignment (toe) and camber of the test wheel and tyre assembly throughout the test within ±0.5° of the static figures achieved at the test tyre loaded condition;

2.1.1.4. In the case a track wetting system is incorporated:

The system shall be able to deliver the water such that the tyre, and track surface in front of the tyre, are wetted before the start of braking and throughout the duration of the test. The apparatus 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 shall be directed toward the test tyre and pointed toward the pavement at an angle of 15 to 30°.The water shall strike the pavement 0.25 to 0.5m ahead of the center of tyre contact. The nozzle shall be located 100 mm above the pavement or the minimum height required to clear obstacles which the tester is expected to encounter, but in no case more than 200 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. The volume of water per unit of wetted width shall be directly proportional to the test speed. The quantity of water applied at 50 km/h shall be 14 l/s per meter of the width of the wetted surface. The nominal values of rate of water application shall be maintained within ±10per cent.

2.1.2. Test procedure

2.1.2.1. Fit the test tyres on rims specified as per ISO 4209-1 (or as specified by the appropriate tyre and rim standards organizations) using conventional fitting methods. Ensure proper bead seating by the use of a suitable lubricant. Excessive use of lubricant should be avoided to prevent slipping of the tyre on the wheel rim.

Check the test tyres for the specified inflation pressure at ambient temperature (cold), just prior to testing. For the purpose of this standard the testing tyre cold inflation pressure P_t shall be calculated as follows:

$$P_t = P_r \times \left(\frac{Q_t}{Q_r} \right)^{1,25}$$

Where:

P_r = Inflation pressure marked on the sidewall. If P_r is not marked on the sidewall refer to the specified pressure in applicable tyre standards manuals corresponding to maximum load capacity for single applications

Q_t = The static test load of the tyre

Q_r = The maximum mass associated with the load capacity index of the tyre

2.1.2.2. For tyre break-in, two braking runs are performed. The tyre shall be conditioned for a minimum of two hours adjacent to the test track such that it is stabilized at the ambient temperature of the test track area. The tyre(s) shall not be exposed to direct sunshine during conditioning.

2.1.2.3. **The load conditions for testing shall be 75±5per cent of the value corresponding to the load index.**

2.1.2.4. **Shortly before testing, the track shall be conditioned by carrying out at least ten braking test runs at 50 km/h on the part of the track to be used for the performance test programme but using a tyre not involved in that programme;**

2.1.2.5. **Immediately prior to testing, the tyre inflation pressure shall be checked and reset, if necessary, to the values given in paragraph 2.1.2.1.**

2.1.2.6. **The test speed shall be at 50 ± 2 km/h and shall be maintained between these limits throughout the test run.**

2.1.2.7. **The direction of the test shall be the same for each set of tests and shall be the same for the test tyre as that used for the SRTT with which its performance is to be compared.**

2.1.2.8. **Deliver water to the pavement ahead of the test tyre approximately 0.5 s prior to brake application (for internal watering system). The brakes of the test wheel assembly shall be applied such that peak braking force is achieved within 0.2 s and 1.0 s of brake application.**

2.1.2.9. **For new tyres, the first two braking runs are discarded for tyre break-in.**

2.1.2.10. **For the evaluation of the performance of any tyre compared with that of the SRTT, the braking test should be run at the same area on the test pad.**

2.1.2.11. **The order of testing shall be:**

R1 - T - R2

Where:

R1 = the initial test of the SRTT,

R2 = the repeat test of the SRTT and

T = the test of the candidate tyre to be evaluated.

A maximum of three candidate tyres may be tested before repeating the SRTT test, for example:

R1 - T1 - T2 - T3 - R2

2.1.2.12. **Calculate the peak braking force coefficient, μ_{peak}, for each test using the following equation:**

$$\mu(t) = \left| \frac{f_h(t)}{f_v(t)} \right| \qquad \textbf{(1)}$$

where:

μ(t) = dynamic tyre braking force coefficient in real time,

fh(t) = dynamic braking force in real time, N,

fv(t) = dynamic vertical load in real time, N

Using equation (1) for dynamic tyre braking force coefficient, calculate the peak tyre braking force coefficient, μ_{peak}, by determining the highest value of μ(t) before lockup occurs. Analogic signals should be filtered to remove noise. Digitally recorded signals may be filtered using a moving average technique.

Calculate the average values of peak-braking coefficient ($\mu_{peak,\ ave}$) by averaging four or more valid repeated runs for each set of test and reference tyres for each test condition provided that the tests are completed within the same day.

2.1.2.13. Validation of results:

For the reference tyre:

If the coefficient of variation of the peak braking coefficient, which is calculated by "standard deviation/average x 100" of the reference tyre is higher than five per cent, discard all data and repeat the test for this reference tyre.

For the candidate tyres:

The coefficients of variation (standard deviation/average x 100) are calculated for all the candidate tyres. If one coefficient of variation is greater than five per cent, discard the data for this candidate tyre and repeat the test.

If R1 is the average of the peak braking coefficient in the first test of the reference tyre, R2 is the average of the peak braking coefficient in the second test of the reference tyre, the following operations are performed, according to the following table:

If the number of sets of candidate tyres between two successive runs of the reference tyre is :	*and the set of candidate tyres to be qualified is :*	*then "Ra" is calculated by applying the following :*
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	$Ra = 1/4\ R_1 + 3/4\ R_2$

2.1.2.14. The wet grip index (G) shall be calculated as:

$$\text{Wet Grip Index (G)} = \mu_{peak,ave}\ (T)/\mu_{peak,\ ave}\ (R)$$

It represents the relative Wet Grip Index for braking performance of the candidate tyre (T) compared to the reference tyre (R).

2.2. Standard vehicle procedure

2.2.1. The vehicle shall be a standard production vehicle (M_2, M_3, N_1, N_2 or N_3 category). The standard equipment is a two axle standard model commercial vehicle equipped with 4 disc brakes and an "ABS". In case tyre fitting is not possible i.e. Multi-purpose Tyres (MPT) or Free

Rolling Tyres (FRT) a vehicle model with drum brakes and ABS is allowed.

2.2.1.1. The vehicle shall not be modified except:

- **Those allowing an increase in the number of tyre sizes that can be mounted on the vehicle;**
- **those permitting the installation of an automatic activation of the braking device;**

Any other modification of the braking system is prohibited.

2.2.1.2. 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.

The following tolerances shall be respected:

- **for the speed measurements : ± 1 per cent or ± 0.5 km/h whichever is greater;**
- **for the distance measurements: ± 1 x 10-1 m.**

A display of the measured speed or the difference between the measured speed and the reference speed for the test can be used inside the vehicle so that the driver can adjust the speed of the vehicle.

A data acquisition system can be also used for storing the measurements.

2.2.2. Test procedure

Starting with a defined initial speed, the brakes are applied hard enough on the two axles at the same time to activate the ABS system.

2.2.2.1. The Average Deceleration (AD) is calculated between two defined speeds, with an initial speed of 60 km/h and a final speed of 20 km/h.

2.2.2.2. Vehicle equipment

The rear axle may be indifferently fitted with 2 or 4 tyres

For the reference tyre testing, both axles are fitted with reference tyres. (A total of 4 or 6 reference tyres depending on the choice above mentioned).

For the candidate tyre testing, 3 fitting configurations are possible:

(a) Configuration "Conf.1": Candidate tyres on Front and Rear axles: it is the standard configuration that should be used every time it is possible.

(b) Configuration "Conf.2": Candidate tyres on front axle and Reference tyre or Control tyre on rear axle: allowed in such cases where fitting the candidate tyre on the rear position is not possible.

(c) Configuration "Conf.3": Candidate tyres on rear axle and Reference tyre or Control tyre on front axle: permitted in such cases where fitting the candidate tyre on the front position is not possible.

2.2.2.3. Tyre inflation pressure

(a) For a vertical load higher or equal to 75 per cent of the load capacity of the tyre, the test inflation pressure "P_t" shall be calculated as follows:

$$P_t = P_r \cdot (Q_t/Q_r)^{1.25}$$

P_r = Inflation pressure marked on the sidewall. If P_r is not marked on the sidewall refer to the specified pressure in applicable tyre standards manuals corresponding to maximum load capacity for single applications

Q_t = the static test load of the tyre

Q_r = the maximum mass associated with the load capacity index of the tyre

(b) For a vertical load lower than 75 per cent of the load capacity of the tire, the test inflation pressure P_t shall be calculated as follows:

$$P_t = P_r \cdot (0.75)^{1.25} = (0.7) \cdot P_r$$

P_r = Inflation pressure marked on the sidewall.

If Pr is not marked on the sidewall refer to the specified pressure in applicable tyre standard manuals corresponding to maximum load capacity for single applications.

Check the tyre pressure just prior to testing at ambient temperature.

2.2.2.4. Tyre load

The static load on each axle tyre must lie between 60 per cent and 100 per cent of the candidate tyre load capacity. This value shall not exceed 100 per cent of the load capacity of the reference tyre.

Tyre load on the same axle should not differ by more than 10 per cent.

The use of fitting as per configurations Conf.2 and Conf.3 shall fulfil the following additional requirements:

Configuration 2: Front axle load > Rear axle load

The rear axle may be indifferently fitted with 2 or 4 tyres

Configuration 3: Rear axle load > Front axle load x 1.8

2.2.2.5. Tyre preparation and break-in

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

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

2.2.2.5.2. Place the fitted test tyres in a location for a minimum of two hours such that they all have the same ambient temperature prior to testing, and shield them from the sun to avoid excessive heating by solar radiation. For tyre break-in, perform two braking runs.

2.2.2.5.3. Condition the pavement by conducting at least ten test runs with tyres not involved in the test programme at an initial speed higher or equal to

65 km/h (which is higher than the initial test speed to guarantee that a sufficient length of track is conditioned).

2.2.2.6. Procedure

2.2.2.6.1. First, mount the set of reference tyres on the vehicle.

The vehicle accelerates in the starting zone up to 65 ± 2 km/h.

Activation of the brakes on the track is made always at the same place with a tolerance of 5 metres in longitudinal and 0.5 metres in transverse.

2.2.2.6.2. According to the type of transmission, two cases are possible:

(a) Manual transmission
As soon as the driver is in the measuring zone and having reached 65 ± 2 km/h, the clutch is released and the brake pedal depressed sharply, holding it down as long as necessary to perform the measurement.

(b) Automatic transmission
As soon as the driver is in the measuring zone and having reached 65 ± 2 km/h, select neutral gear and then the brake pedal is depressed sharply, holding it down as long as necessary to perform the measurement.

Automatic activation of the brakes can be performed by means of a detection system made of two parts, one indexed to the track and one embarked on the vehicle. In that case braking is made more rigorously at the same portion of the track.

If any of the above-mentioned conditions are not met when a measurement is made (speed tolerance, braking time, etc.), the measurement is discarded and a new measurement is made.

2.2.2.6.3. Test running order

Examples:

The run order for a test of 3 sets of candidate tyres (T1 to T3) plus a reference tyre R would be:

R - T1 - T2 - T3 - R

The run order for a test of 5 sets of tyres (T1 to T5) plus a reference tyre R would be:

R - T1 - T2 - T3 - R -T4 - T5 – R

2.2.2.6.4. The direction of the test shall be the same for each set of tests and shall be the same for the candidate test tyre as that used for the SRTT with which its performance is to be compared.

2.2.2.6.5. For each test and for new tires, the first two braking measurements are discarded.

2.2.2.6.6. After at least 3 valid measurements have been made in the same direction, the reference tyres are replaced by a set of the candidate tyres (one of the 3 configurations presented in paragraph 2.2.2.2.) and at least 6 valid measurements shall be performed.

2.2.2.6.7. A maximum of three sets of candidate tyres can be tested before the reference tyre is re-tested.

2.2.2.7. Processing of measurement results

2.2.2.7.1. Calculation of the Average Deceleration (AD)

Each time the measurement is repeated, the average deceleration AD ($m \cdot s^{-2}$) is calculated by:

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

Where d (m) is the distance covered between the initial speed Si ($m \cdot s^{-1}$) and the final speed Sf ($m \cdot s^{-1}$).

2.2.2.7.2. Validation of results

For the reference tyre:
If the coefficient of variation of the Average Deceleration "AD" of any two consecutive groups of 3 runs of the reference tyre is higher than 3 per cent, discard all data and repeat the test for all tyres (the candidate tyres and the reference tyre). The coefficient of variation is calculated by the following relation:

$$\frac{\text{standard deviation}}{\text{average}} \times 100$$

For the candidate tyres:
The coefficients of variation are calculated for all the candidate tyres.

$$\frac{\text{standard deviation}}{\text{average}} \times 100$$

If one coefficient of variation is greater than 3per cent, discard the data for this candidate tyre and repeat the test.

2.2.2.7.3. Calculation of the "average AD"

If R1 is the average of the AD values in the first test of the reference tyre and R2 is the average of the AD values in the second test of the reference tyre, the following operations are performed, according to Table 1.

Ra is the adjusted average AD of the reference tyre.

Table 1

Number of sets of candidate tyres between two successive runs of the reference tyre	*Set of candidate tyres to be qualified*	*Ra*
1 R1-T1-R2	**T1**	**a = 1/2 (R1 + R2)**
2 R1-T1-T2-R2	**T1**	**a = 2/3 R1 + 1/3 R2**
	T2	**a = 1/3 R1 + 2/3 R2**
3 R1-T1-T2-T3-R2	**T1**	**a = 3/4 R1 + 1/4 R2**
	T2	**a = 1/2 (R1 + R2)**
	T3	**a = 1/4 R1 + 3/4 R2**

2.2.2.7.4. Calculation of braking force coefficient, BFC

BFC(R) and BFC(T) are calculated according to Table 2:

Table 2

Tyre type	*Braking force coefficient is*
Reference tyre	$BFC(R) = \frac{Ra}{g}$
Candidate tyre	***BFC(T)= Ta/g***
g is the acceleration due to gravity (rounded to 9,81 m·s^{-2}).	

Ta (a = 1, 2, etc.) is the average of the AD values for a test of a candidate tyre.

2.2.2.7.5. Calculation of the relative wet grip performance index of the tyre

The Wet grip index represents the relative performance of the candidate tyre compared to the reference tyre. The way to obtain it depends on the test configuration as defined in paragraph 2.2.2.2. The wet grip index of the tyre is calculated as reported into Table 3:

Table 3

Configuration C1: *candidate tyres on both axles*	*Wet Grip Index* = $\frac{BFC(T)}{BFC(R)}$
Configuration C2: *candidate tyres on front axle and reference tyres on rear axle*	*Wet Grip Index* = $\frac{BFC(T)\left[a+b+h\cdot BFC(R)\right]-a\cdot BFC(R)}{BFC(R)\left[b+h\cdot BFC(T)\right]}$
Configuration C3: *reference tyres on front axle and candidate tyres on rear axle*	*Wet Grip index* = $\frac{BFC(T)\left[-a-b+h\cdot BFC(R)\right]+b\cdot BFC(R)}{BFC(R)\left[-a+h\cdot BFC(T)\right]}$

Where:

"G": centre of gravity of the loaded vehicle

"m": mass (in kilograms) of the loaded vehicle

"a": horizontal distance between front axle and centre of gravity of the loaded vehicle (m)

"b": horizontal distance between rear axle and centre of gravity of the loaded vehicle

"h": vertical distance between ground level and centre of gravity of the loaded vehicle (m).

N.B. When "h" is not precisely known, these worst case values shall apply: 1,2 for configuration C2, and 1,5 for configuration C3

"γ" loaded vehicle acceleration (m·s-^{2})

"g" acceleration due to the gravity (m·s-^{2})

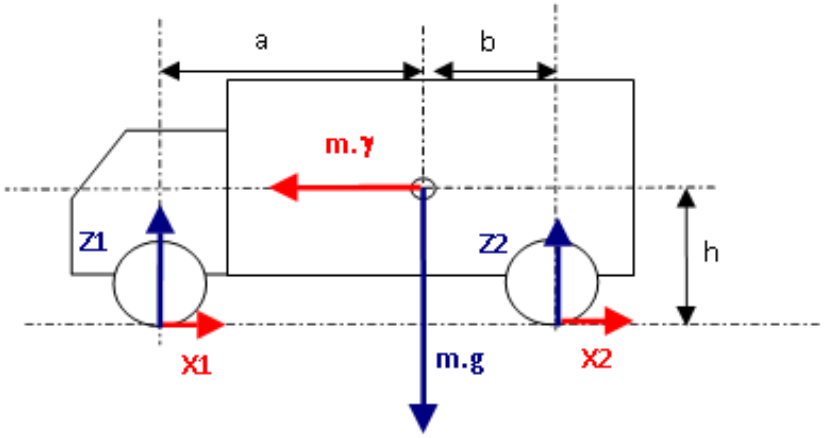
"X1" longitudinal (X-direction) reaction of the front tyre on the road

"X2" longitudinal (X-direction) reaction of the rear tyre on the road

"Z1" normal (Z-direction) reaction of the front tyre on the road

"Z2" normal (Z-direction) reaction of the rear tyre on the road

Figure 1
Nomenclature explanation related to grip index of the tyre



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

When the candidate tyre size is significantly different from the reference tyre, a direct comparison on the same vehicle may be not possible. This approach uses an intermediate tyre, hereinafter called the control tyre.

2.2.2.8.1. **The principle lies upon the use of a control tyre and 2 different vehicles for assessing a candidate tyre in comparison with a reference tyre.**

One vehicle can fit the reference tyre and the control tyre, the other the control tyre and the candidate tyre. All conditions are in conformity with sub-clauses 2.2.1.2. to 2.2.2.5..

2.2.2.8.2. **The first assessment is a comparison between the control tyre and the reference tyre. The result (Wet Grip Index 1) is the relative efficiency of the control tyre compared to the reference tyre.**

2.2.2.8.3. **The second assessment is a comparison between the candidate tyre and the control tyre. The result (Wet Grip Index 2) is the relative efficiency of the candidate tyre compared to the control tyre.**

The second assessment is done on the same track as the first one and within one week maximum. The wetted surface temperature must be in the range of ± 5°C of the temperature of the first assessment. The control tyre set (4 or 6 tyres) is physically the same set as the set used for the first assessment.

2.2.2.8.4. **The Wet Grip Index of the candidate tyre compared to the reference tyre is deduced by multiplying the relative efficiencies calculated above:**

(Wet Grip Index 1 x Wet Grip Index 2)

Note:
When the test expert decides to use an SRTT tyre as a control tyre (i.e. in the test procedure two SRTTs are compared directly instead of an SRTT with a control

tyre) the result of the comparison between the SRTTs is called the "local shift factor".

It is permitted to use a previous SRTTs comparison.

The comparison results must be checked periodically.

2.2.2.8.5. Selection of a set of tyres as a control tyre set

A "control tyre" set is a group of identical tyres made in the same factory during a one week period.

2.2.2.8.6. Reference and Control tyres

Before the first assessment (control tyre / reference tyre), normal storage conditions can be used. It is necessary that all the tyres of a control tyre set have been stored in the same conditions.

2.2.2.8.7. Storage of control tyres

As soon as the control tyre set has been assessed in comparison with the reference tyre, specific storage conditions shall be applied for Control tyres replacement.

2.2.2.8.8. Replacement of reference 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."

Annex 5, Appendix 1, Part 1, item 4.4., amend to read:

"Adhesion coefficient on wet surfaces relative to SRTT ~~according to paragraphs 2.1.2.15. or 2.2.2.15~~"

Annex 5, Appendix 1,Part 2, item 4.4., amend to read:

"4.4. Test data: .....

Tyre	*SRTT*	*Candidate*	*Control*
…			
Water depth (mm) (**C1:** from 0.5 to 1.5 mm) **(C2 and C3: from 0.5 to 2.0 mm)**			
…			

"

II. Justification

1. Due to new efforts of CO_2 reduction linked to heavy goods vehicles and buses, for instance within the European Union (EU), it may be expected that tyre manufacturers will begin improving the rolling resistance of C2 and C3 tyres as we have seen for C1 tyres. It is also commonly known that a reduction of the rolling resistance may also lead to a reduction of the tyre's wet grip properties.

2. As can also be read in the recitals (17) and (19) of the General Safety Regulation (EC) 661/2009 in force in the EU, and referring directly to Regulation No. 117, it is deemed appropriate to set out requirements concerning wet grip requirements ensuring that tyre safety levels are maintained, however no suitable testing protocol was available until recently, when International Standard Organization (ISO) provided the testing procedure outlined in this draft amendment.

3. It should be agreed that the current level of wet grip safety provided by C2 and C3 tyres can be deemed as sufficient and the current average performance levels should be taken as a baseline for the minimum type-approval values.

4. As C2 and C3 tyres will eventually need to be classified in terms of wet grip performance, mainly due to tyre labelling schemes introduced world-wide, the wet grip performance test will need to be performed for such tyres in due time and an application date for new types of tyres could therefore be set at 1 November 2016 without leading to unacceptable increased burden for the tyre industry.

5. Non complying tyres should eventually be phased out on 1 November 2018 for category C2 and 1 November 2020 for category C3.