

4 November 2020

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## **Agreement**

### **Concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations\***

(Revision 3, including the amendments which entered into force on 14 September 2017)

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#### **Addendum 116 – UN Regulation No. 117**

#### **Revision 4 - Amendment 3**

Supplement 11 to the 02 series of amendments – Date of entry into force: 25 September 2020

#### **Uniform provisions concerning the approval of tyres with regard to rolling sound emissions and/or to adhesion on wet surfaces and/or to rolling resistance**

This document is meant purely as documentation tool. The authentic and legal binding text is: ECE/TRANS/WP.29/2020/6 (as amended by paragraph 85 of the report ECE/TRANS/WP.29/1151).



**UNITED NATIONS**

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\* Former titles of the Agreement:

Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958 (original version); Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, done at Geneva on 5 October 1995 (Revision 2).

*Paragraph 2.1.*, amend to read:

- "2.1.        "Type of tyre" means tyres which do not differ in such essential characteristics as:
- (a)    The manufacturer's name;
  - (b)    The tyre class (see paragraph 2.4. below);
  - (c)    The tyre structure;
  - (d)    The category of use: normal tyre, snow tyre and special use tyre;
  - (e)    Whether tyre for use in severe snow conditions or not;
  - (f)    For Classes C2 and C3 tyres, whether traction tyre or not;
  - (g)    The tread pattern (see paragraph 3.2.1. of this Regulation)."

*Paragraph 2.18.*, amend to read:

- "2.18.        "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) standards
- (a)    E1136 – 17 for the size P195/75R14 and referred to as "SRTT14",
  - (b)    F2872 – 16 for the size 225/75R16C and referred to as "SRTT16C",
  - (c)    F2871 – 16 for the size 245/70R19.5 and referred to as "SRTT19.5",
  - (d)    F2870 – 16 for the size 315/70R22.5 and referred to as "SRTT22.5",
  - (e)    F2493 – 18 for the size P225/60R16 and referred to as "SRTT16"."

*Paragraph 2.19.1.*, amend to read:

- "2.19.1.      "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 Standard Reference Test Tyre (SRTT)."

*Paragraph 2.20.1.*, amend to read:

- "2.20.1.      "Rolling resistance  $F_r$ " means the loss of energy (or energy consumed) per unit of distance travelled.<sup>3</sup>"

*Paragraph 2.20.3.*, amend to read:

- "2.20.3.      "New test tyre" means a tyre which has not been previously used in a rolling deflected test which elevates the tyre's temperature to higher than that generated in rolling resistance tests, and which has not previously been exposed to a temperature above 40 °C.<sup>5,6</sup>"

*Paragraph 2.20.5.*, amend to read:

- "2.20.5.      "Capped inflation" means the process of inflating the tyre to the required cold inflation pressure and allowing the inflation pressure to build up, as the tyre is warmed up while running."

*Paragraph 2.20.8.*, amend to read:

- "2.20.8.      " inertia" or "moment of inertia" means the ratio of the torque applied to a rotating body, such as a tyre assembly or machine drum, to the rotational acceleration of this body.<sup>8</sup>"

*Paragraphs 3.1.2. to 3.1.10.*, amend to read and renumber:

- "3.1.2.        Manufacturer's name and address;
- 3.1.3.        If applicable, name and address of manufacturer's representative;
- 3.1.4.        Tyre class (Class C1, C2 or C3) (see paragraph 2.6. of this Regulation);

- 3.1.5. Category of use (normal, snow, or special);
- 3.1.5.1. Whether tyre for use in severe snow conditions or not;
- 3.1.5.2. For Class C2 and C3 tyres, whether traction tyre or not;
- 3.1.6. Tyre structure;
- 3.1.7. Brand name(s)/trademark(s), trade description(s)/commercial name(s);
- 3.1.8. A list of tyre size designations covered by this application and specifying for each brand name/trademark and/or each trade description/commercial name the applicable tyre size designations and service descriptions, adding in case of Class C1 tyres whether "reinforced" (or "extra load") or not."

Paragraph 3.4., amend to read:

- "3.4. With regard to the application, testing may be confined to a representative tyre size of the type of tyre, at the discretion of the Type Approval Authority."

Paragraph 6.2., amend to read:

- "6.2. The wet grip performance will be based on a procedure that compares either peak brake force coefficient ("pbfc") or mean fully developed deceleration ("mfdd") against values achieved by a Standard Reference Test Tyre (SRTT). The relative performance shall be indicated by a wet grip index (G)."

Paragraph 6.4., amend to read:

- "6.4. In order to be classified as a "snow tyre for use in severe snow conditions" the tyre shall meet the performance requirements of paragraph 6.4.1. below. The tyre shall meet these requirements based on a test method of Annex 7 by which:
  - (a) The mean fully developed deceleration ("mfdd") in a braking test;
  - (b) Or alternatively an average traction force in a traction test;
  - (c) Or alternatively the average acceleration in an acceleration test
 of the candidate tyre is compared to that of a Standard Reference Test Tyre (SRTT).  
The relative performance shall be indicated by a snow grip index."

Paragraph 6.4.1.1., amend to read:

- "6.4.1.1. Class C1, C2 and C3 tyres  
The minimum snow grip index value, as calculated in the procedure described in Annex 7 and compared with the respective Standard Reference Test Tyre (SRTT) shall be as follows:

Class of tyre	Snow grip index (brake on snow method) <sup>(a)</sup>		Snow grip index (spin traction method) <sup>(b)</sup>	Snow grip index (acceleration method) <sup>(c)</sup>
	Ref. = SRTT14	Ref. = SRTT16C	Ref. = SRTT14	Ref.s = SRTT19.5, SRTT22.5
C1	1.07	No	1.10	No
C2	No	1.02	1.10	No
C3	No	No	No	1.25

(a) See paragraph 3. of Annex 7 to this Regulation  
(b) See paragraph 2. of Annex 7 to this Regulation  
(c) See paragraph 4. of Annex 7 to this Regulation"

Insert a new paragraph 12.9. to read:

"12.9. Until 3 months after the date of entry into force of Supplement 11 to the 02 series of amendments to this Regulation, Contracting Parties applying this Regulation can continue to grant type approvals according to the 02 series of amendments to this Regulation, without taking into account the provisions of Supplement 11."

*Annex 1*

*Item 3.*, amend to read:

"...

3. "Tyre class" of the type of tyre: ....."

*Items 3.1. and 3.2.*, renumber to 4.1. and 4.2.

Insert *new items 4. and 5.* to read:

"4. "Category of use" of the type of tyre: ....."

4.1. Snow tyre for use in severe snow conditions (Yes/No)<sup>2</sup>

4.2. Traction tyre (Yes/No)<sup>2</sup>

5. Tyre structure: ....."

*Items 4. to 14.2.*, renumber as 6. to 16.2., respectively.

*Items 8.1. to 8.4. (new)*, amend to read:

"8.1. Sound level of the representative tyre size, see paragraph 2.7. of this Regulation, as per item 7. of the test report in Appendix 1 to Annex 3: ..... dB(A) at reference speed of 70/80 km/h<sup>2</sup>

8.2. Wet adhesion level of the representative tyre size, see paragraph 2.7. of this Regulation, as per item 7. of the test report in the appendix to Annex 5: ..... (G) using the vehicle or trailer method<sup>2</sup>

8.3. Rolling resistance level of the representative tyre size, see paragraph 2.7. of this Regulation, as per item 7. of the test report in Appendix 1 to Annex 6.....

8.4. Snow grip level of the representative tyre size, see paragraph 2.7. of Regulation No. 117, as per item 7. of the test report in the appendix<sup>3</sup> to Annex 7:..... (Snow grip index) using the brake on snow method<sup>2</sup>, spin traction method<sup>2</sup> or acceleration method.<sup>2</sup>"

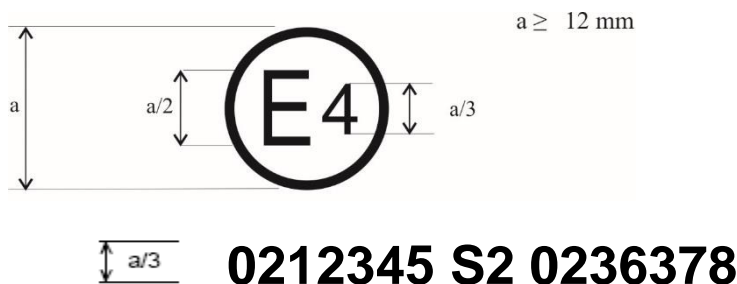
*Item 16.2. (new)*, amend to read:

"16.2. A list of tyre size designations: Specify for each brand name/trademark and/or each trade description/Commercial name the list of tyre size designations and service descriptions, adding in case of Class C1 tyres whether "reinforced" (or "extra load") or not."



*Annex 2*

*Appendix 2, example 2, figure*, amend to read:

"



Or

	<b>0212345 S2WR2</b>
	<b>0236378</b>

*Annex 3*

*Paragraph 1.1.*, amend to read:

"1.1. Acoustic measurements

The sound level meter or the equivalent measuring system, including the windscreen recommended by the manufacturer shall meet or exceed the requirements of Type 1 instruments in accordance with IEC 61672-1:2013."

*Paragraph 1.1.1.*, amend to read:

"1.1.1. Calibration

At the beginning and at the end of every measurement session, the entire measurement system shall be checked by means of a sound calibrator that fulfils the requirements for sound calibrators of at least precision Class 1 according to IEC 60942:2017. Without any further adjustment the difference between the readings of two consecutive checks shall be less than or equal to 0.5 dB(A). If this value is exceeded, the results of the measurements obtained after the previous satisfactory check shall be discarded."

*Paragraph 4.3.*, renumber as 4.2. and amend to read:

"4.2. Temperature correction

For Class C1 and Class C2 tyres, the rolling sound levels  $L_i(\vartheta_i)$  obtained at the test surface temperature  $\vartheta_i$  (where  $i$  denotes the number of the single measurement) shall be normalized to a test surface reference temperature  $\vartheta_{ref}$  by applying a temperature correction, according to the following formula:

$$L_i(\vartheta_{ref}) = L_i(\vartheta_i) + K(\vartheta_{ref} - \vartheta_i)$$

where:

$$\vartheta_{ref} = 20 \text{ }^\circ\text{C},$$

For Class C1 tyres, the coefficient  $K$  is:

- 0.03 dB(A)/ $^\circ\text{C}$  when  $\vartheta_i > \vartheta_{ref}$  and
- 0.06 dB(A)/ $^\circ\text{C}$  when  $\vartheta_i < \vartheta_{ref}$ .

For Class C2 tyres, the coefficient  $K$  is - 0.02 dB(A)/ $^\circ\text{C}$ .

Notwithstanding the above procedure, the temperature correction may be made only on the final reported tyre rolling sound level  $L_R$ , utilizing the arithmetic mean value of the measured temperatures, if the measured test surface temperature does not change more than 5  $^\circ\text{C}$  within all measurements necessary for the determination of the sound level of one set of tyres. In this case the regression analysis below shall be based on the uncorrected rolling sound levels  $L_i(\vartheta_i)$ .

There will be no temperature correction for Class C3 tyres."

*Paragraph 4.2. (former)*, renumber as 4.3. and amend to read:

"4.3. Regression analysis of rolling sound measurements

The tyre-road rolling sound level  $L_R(\vartheta_{ref})$  in dB(A) is determined by a regression analysis according to:

$$L_R(\vartheta_{ref}) = \bar{L} - a \cdot \bar{\tau}$$

where:

$\bar{L}$  is the mean value of the temperature-corrected rolling sound levels  $L_i(\vartheta_{\text{ref}})$ , measured in dB(A):

$$\bar{L} = \frac{1}{n} \sum_{i=1}^n L_i(\vartheta_{\text{ref}})$$

$n$  is the number of measurements ( $n \geq 16$ ),

$\bar{\tau}$  is the mean value of logarithms of speeds  $V_i$ :

$$\bar{\tau} = \frac{1}{n} \sum_{i=1}^n \tau_i \quad \text{with} \quad \tau_i = \log_{10} \left( \frac{V_i}{V_{\text{ref}}} \right)$$

$a$  is the slope of the regression line in dB(A):

$$a = \frac{\sum_{i=1}^n [(\tau_i - \bar{\tau})(L_i(\vartheta_{\text{ref}}) - \bar{L})]}{\sum_{i=1}^n (\tau_i - \bar{\tau})^2}$$

"

Paragraph 4.4., amend to read:

"4.4. In order to take account of any measuring instrument inaccuracies, the temperature corrected tyre rolling sound level  $L_R(\vartheta_{\text{ref}})$  in dB(A) shall be reduced by 1 dB(A) and then rounded down to the nearest lower whole value to obtain the final result."

Paragraph 4.5. shall be deleted.

Annex 3 - Appendix 1, amend to read:

"...

Part 1 – Report

...

2. Name and address of manufacturer: .....

...

4. Brand name and trade description: .....

...

6. Category of use: .....

6.1. Tyre for use in severe snow conditions (Yes/No)<sup>1</sup>

6.2. Traction tyre (Yes/No)<sup>1</sup>

7. Sound level according to paragraph 4.4. of Annex 3: ..... dB(A)  
at reference speed of 70/80 km/h<sup>1</sup>

...

Part 2 – Test data

...

4.3. Reference (test) inflation pressure<sup>2</sup>: ..... kPa

...

5. Valid test results: .....

Run No.	Test speed km/h	Direction of run	Sound level left <sup>a</sup> measured dB(A)	Sound level right <sup>a</sup> measured dB(A)	Air temp. °C	Test surface temp. °C	Sound level left <sup>a</sup> temp. corrected <sup>b</sup> dB(A)	Sound level right <sup>a</sup> temp. corrected <sup>b</sup> dB(A)	Comments
1									
2									
3									
4									
5									
6									
7									
8									

<sup>a</sup> Relative to the vehicle.

<sup>b</sup> Omit, if regression according to paragraph 4.3. of Annex 3 is made on the uncorrected rolling sound level values.

5.1. Regression line slope: .....

5.2. Sound level according to paragraph 4.3. of Annex 3:  
..... dB(A)"

*Annex 3 - Appendix 1*, add a new footnote 2:

"<sup>2</sup> for C2 and C3 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation"

*Annex 5, part A*

*Paragraphs 1.4 and 1.5.*, delete.

*Paragraph 2.4.*, amend to read:

"2.4. "Reference tyre(s) (R)" means a tyre or a tyre set of Standard Reference Test Tyres SRTT16."

*Paragraphs 2.12. and 2.13.* shall be deleted.

*Paragraph 3.2.2.*, amend to read:

"3.2.2. Standard Reference Test Tyre method

This method uses the Standard Reference Test Tyre SRTT14.

Perform at least six (6) valid measurements of the peak braking force coefficient with the SRTT14 using the trailer towed by a vehicle or a tyre test vehicle test procedure as specified in clause 4.2. (at 65 km/h and 180 kPa).

The average ( $\mu_{\text{peak,ave}}$ ) of the measured peak braking force coefficients shall be corrected for the effects of temperature as follows:

$$\mu_{\text{peak,corr}} = \mu_{\text{peak,ave}} + 0.0035 \cdot (t - 20)$$

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

The temperature corrected average peak braking force coefficient ( $\mu_{\text{peak,corr}}$ ) shall be  $0.7 \pm 0.1$ ."

*Paragraph 4.1.6.2., first sentence*, amend to read:

" The AD coefficient of variation  $CV_{AD}$  is calculated as follows:

$$CV_{AD} = 100\% \cdot \frac{\sigma_{AD}}{AD}$$

where

$\sigma_{AD} = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (AD_i - \overline{AD})^2}$  denotes the corrected sample standard deviation and

$\overline{AD}$  the arithmetic mean of the Average Decelerations ( $AD_i$ ) of  $N$  test runs."

Paragraph 4.1.7.3., amend to read:

"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 E1136 – 17 shall be applied."

Paragraph 4.2.8.2., first sentence, amend to read:

" The  $\mu_{\text{peak}}$  coefficient of variation  $CV_{\mu}$  is calculated as follows:

$$CV_{\mu} = 100\% \cdot \frac{\sigma_{\mu}}{\mu_{\text{peak}}}$$

where

$\sigma_{\mu} = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (\mu_{\text{peak},i} - \overline{\mu_{\text{peak}}})^2}$  denotes the corrected sample standard deviation and

$\overline{\mu_{\text{peak}}}$  the arithmetic mean of the peak braking force coefficients ( $\mu_{\text{peak},i}$ ) of  $N$  test runs."

Annex 5, part B

Paragraph 1.1.1., amend to read:

"1.1.1. Standard Reference Test Tyre (SRTT) method

This method uses the Standard Reference Test Tyre SRTT14.

Perform at least six (6) valid measurements of the peak braking force coefficients with the Standard Reference Test Tyre SRTT14 using the trailer or special purpose tyre evaluation vehicle test procedure as specified in clause 2.1. (at 65 km/h and 180 kPa).

The average ( $\mu_{\text{peak,ave}}$ ) of the measured peak braking force coefficients shall be corrected for the effects of temperature as follows:

$$\mu_{\text{peak,corr}} = \mu_{\text{peak,ave}} + 0.0035 \cdot (t - 20)$$

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

The temperature corrected average peak braking force coefficient ( $\mu_{\text{peak,corr}}$ ) shall be  $0.7 \pm 0.1$ .

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 meters distance of where the surface was characterized."

Paragraph 1.4., amend to read:

"1.4. In order to cover the range of the tyre sizes fitting the commercial vehicles, the Standard Reference Test Tyres (SRTT) shall be used to measure the relative wet index as shown in the following table:

For C3 tyres	
Narrow family	Wide family



$S_{\text{Nominal}} < 285 \text{ mm}$	$S_{\text{Nominal}} \geq 285 \text{ mm}$
SRTT19.5	SRTT22.5
<i>For C2 tyres</i> SRTT16C	
$S_{\text{Nominal}} = \text{Tyre nominal section width}$	

Paragraph 2.1.2.1., amend to read:

"2.1.2.1. ...

$P_r$  = Inflation pressure corresponding to the the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation...."

Paragraph 2.1.2.12., amend to read:

"2.1.2.12. ...

Analogue signals should be filtered to remove noise. ..."

Paragraph 2.1.2.13., amend to read:

"2.1.2.13. ...

For the reference tyre:

If the coefficient of variation of the peak braking coefficient  $CV_{\mu}$  of the reference tyre, which is calculated by the formula given in 4.2.8.2. of part (A) of this Annex, 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  $CV_{\mu}$  are calculated for all the candidate tyres according to the formula in 4.2.8.2. of part (A) of this Annex. If one coefficient of variation is greater than five per cent, discard the data for this candidate tyre and repeat the test. ..."

Paragraph 2.2.2.3., amend to read:

"2.2.2.3. ...

$P_r$  = Inflation pressure corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation.

...

$P_r$  = Inflation pressure corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation.

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

Paragraph 2.2.2.8.1., amend to read:

"2.2.2.8.1. ...

All conditions are in conformity with paragraphs 2.2.1. to 2.2.2.5. above."

Annex 5 – Appendix, Example 1, amend to read:

" ...

No.	1	2	3	4	5	6	7	8	9	10
Size										
Service description										
Reference (test) inflation pressure <sup>(1)</sup> (kPa)										
Tyre identification										
...										
Wet Grip Index										
Surface temp. (°C)										
...										

...  
<sup>(1)</sup> for C2 and C3 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation"

Annex 5 – Appendix, Example 2, amend to read:

" ...

No.	1	2	3	4	5
Brand name	Uniroyal	TYRE B	TYRE C	TYRE D	Uniroyal
Pattern/Trade description	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
Reference (test) inflation pressure <sup>(1)</sup> (kPa)					
Tyre identification	XXXXXXXXXX	YYYYYYYYYY	<del>ZZZZZZZZ</del>	NNNNNNNNNN	XXXXXXXXXX

...  
<sup>(1)</sup> for C2 and C3 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation"

Annex 6

Paragraph 2.2., amend to read:

"2.2. Measuring rim

The tyre shall be mounted on a steel or light alloy measuring rim, as follows:

- (a) For Class C1 tyres, the width of the rim shall be as defined in ISO 4000-1:2015,
- (b) For Class C2 and C3 tyres, the width of the rim shall be as defined in ISO 4209 1:2001.

In cases where the width is not defined in the above mentioned ISO Standards, the rim width as defined by one of the standards organizations as specified in Appendix 4 may be used."

Paragraph 2.4.3. shall be deleted.

Paragraph 3.1., amend to read:

"3.1. General

The test consists of a measurement of rolling resistance in which the tyre is inflated to the required cold inflation pressure and the inflation pressure allowed to build up, i.e., "capped inflation".

Paragraph 3.2, amend to read:

"3.2. Test speeds

The rolling resistance coefficient value shall be obtained at the appropriate drum speed specified in Table 1."

Table 1, amend to read:

"Table 1

**Test Speeds (in km/h)**

<i>Tyre Class</i>	<i>C1</i>	<i>C2 and C3</i>	<i>C3</i>	
Load index	All	LI ≤ 121	LI > 121	
Speed symbol	All	All	J (100 km/h) and lower	K (110 km/h) and higher
Test speed (km/h)	80	80	60	80

"

Table 2, amend to read:

"Table 2

**Test loads and inflation pressures**

<i>Tyre Class</i>	<i>C1</i>		<i>C2, C3</i>
	<i>Standard load</i>	<i>Reinforced or extra load</i>	
Load % of maximum load capacity as indicated by the load capacity index	80	80	85 (refer to single application)
Inflation pressure kPa	210	250	Test inflation pressure corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation.

Note: The inflation pressure shall be capped with the accuracy specified in paragraph 4. of Appendix 1 to this annex.

"

Paragraph 4.6.2., amend to read:

"4.6.2. Deceleration method

The deceleration method follows the procedure below:

- (a) Remove the tyre from the test surface while running at a speed greater than test speed;
- (b) Record the deceleration of the test drum  $\Delta\omega_{D0}/\Delta t$  and that of the unloaded tyre  $\Delta\omega_{T0}/\Delta t$  or record the deceleration of the test drum  $j_{D0}$  and

that of the unloaded tyre  $j_{T0}$  in exact or approximate form in accordance with paragraph 3.5. above.

The speed range for measurement includes the test speed and does not exceed 10 km/h above and 10 km/h below the test speed."

*Paragraph 5.1.5.*, amend to read:

"5.1.5. Deceleration method

Calculate the parasitic losses  $F_{pl}$ , in newton.

$$F_{pl} = \frac{I_D}{R} \left( \frac{\Delta\omega_{D0}}{\Delta t_0} \right) + \frac{I_T}{R_r} \left( \frac{\Delta\omega_{T0}}{\Delta t_0} \right)$$

where: ...

$\Delta\omega_{D0}$  is the test drum angular speed increment, drum without tyre, in radians per second,

$\Delta\omega_{T0}$  is the tyre angular speed increment, unloaded tyre, in radian per second. ..."

*Paragraph 5.2.1.*, amend to read:

"5.2.1. General

The rolling resistance  $F_r$ , expressed in newton, is calculated using the values obtained by testing the tyre to the conditions specified in this Regulation and by subtracting the appropriate parasitic losses  $F_{pl}$ , obtained according to paragraph 5.1. above."

*Paragraph 6.4.*, amend to read:

"6.4. Measurement result

Where  $n$  measurements are greater than 1, if required by paragraph 4.6. above, the measurement result shall be the average of the  $C_r$  values obtained for the  $n$  measurements, after the corrections described in paragraphs 6.2. and 6.3. above have been made. Following this method, final  $C_r$  results shall be expressed in N/kN and rounded to the first decimal place according to ISO 80000-1:2009, B.3, rule B."

*Annex 6 - Appendix 1*

*Paragraph 1.*, amend to read:

"1. Purpose

The limits specified in this appendix are necessary, but may not be sufficient, in order to achieve suitable levels of repeatable test results, which can also be correlated among various test laboratories."

"2.2. Run-out

In case vehicle rims are used, the run-out shall meet the following criteria:

(i) for C1 tyres, C2 tyres and for C3 tyres with  $LI \leq 121$ :

- (a) Maximum radial run-out: 0.5 mm,
- (b) Maximum lateral run-out: 0.5 mm;

(ii) for C3 tyres with  $LI \geq 122$ :

- (a) Maximum radial run-out: 2.0 mm,
- (b) Maximum lateral run-out: 2.0 mm."

Paragraph 3.1., amend to read:

"3.1. Load application

The direction of tyre loading application shall be kept normal to the test surface and shall pass through the wheel centre within:

- (a) 1 mrad for the force method;
- (b) 5 mrad for the torque, power and deceleration methods."

Paragraph 4.(a), amend to read:

"(a) Tyre loading:

- (i) For C1 tyres, C2 tyres and for C3 tyres with  $LI \leq 121$ :  $\pm 20$  N or  $\pm 0.5$  per cent, whichever is greater;
- (ii) For C3 tyres with  $LI \geq 122$ :  $\pm 45$  N or  $\pm 0.5$  per cent whichever is greater;"

Paragraph 5., amend to read:

"...

<i>Parameter</i>	<i>C1 tyres, C2 tyres and C3 tyres with LI ≤ 121</i>	<i>C3 tyres with LI ≥ 122</i>
Tyre load	$\pm 10$ N or $\pm 0.5$ % <sup>(a)</sup>	$\pm 30$ N or $\pm 0.5$ % <sup>(a)</sup>

..."

Paragraph 7., amend to read:

"7. Test surface roughness

The roughness, measured laterally, of the new smooth steel drum surface shall have a maximum centreline average height value of 6.3  $\mu\text{m}$ . This value should be reconfirmed in case visible damage should occur. ..."

Annex 6 - Appendix 2, amend to read:

## "Annex 6 - Appendix 2

(omitted)"

Annex 6 - Appendix 3, amend to read and add a footnote (1):

"...

Part I: Report

...

2. Name and address of manufacturer: .....

...

4. Brand name and trade description: .....

...

6. Category of use: .....

6.1. Tyre for use in severe snow conditions (Yes/No)<sup>2</sup>.....

Part 2: Test data

...

3.3. Reference (test) inflation pressure<sup>(1)</sup>: ..... kPa

<sup>(1)</sup> for C2 and C3 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation as indicated on the sidewall. "

Annex 7

Paragraph 3.4.1.1., amend to read:

"3.4.1.1. For each tyre and each braking test, the arithmetic mean  $\bar{a}$  and corrected sample standard deviation  $\sigma_a$  of the mfdd shall be computed and reported.

The coefficient of variation  $CV_a$  of a tyre braking test shall be computed as:

$$CV_a = 100\% \cdot \frac{\sigma_a}{\bar{a}}$$

with

$$\sigma_a = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (a_i - \bar{a})^2}$$

"

Paragraph 3.4.1.2., amend to read:

"3.4.1.2 Weighted averages  $wa_{SRTT}$  of two successive tests of the SRTT shall be computed taking into account the number of candidate tyres in between:

In the case of the order of testing R1 – T – R2, the weighted average of the SRTT to be used in the comparison of the performance of the candidate tyre shall be taken to be:

$$wa_{SRTT} = \frac{1}{2}(\overline{a_{R1}} + \overline{a_{R2}})$$

Where:

$\overline{a_{Rn}}$  is the arithmetic mean of the mfdd for the n-th test of the SRTT.

In the case of the order of testing R1 – T1 – T2 – R2, the weighted averages  $wa_{SRTT}$  of the SRTT to be used in the comparison of the performance of the candidate tyre shall be taken to be:

$$wa_{SRTT} = \frac{2}{3}\overline{a_{R1}} + \frac{1}{3}\overline{a_{R2}} \quad \text{for comparison with the candidate tyre T1 and}$$

$$wa_{SRTT} = \frac{1}{3}\overline{a_{R1}} + \frac{2}{3}\overline{a_{R2}} \quad \text{for comparison with the candidate tyre T2. "}$$

Paragraph 3.4.1.3., amend to read:

"3.4.1.3. The snow grip index (SG) of a candidate tyre Tn shall be computed as the quotient of the arithmetic mean  $\overline{a_{Tn}}$  of the mfdd of the tyre Tn and the applicable weighted average  $wa_{SRTT}$  of the SRTT:

$$SG(Tn) = \frac{\overline{a_{Tn}}}{wa_{SRTT}}$$

"

Paragraph 3.4.2., amend to read:

"3.4.2. Statistical validations

The sets of repeats of measured or computed mfdd for each tyre should be examined for normality, drift, eventual outliers.

The consistency of the arithmetic means  $\bar{a}$  and corrected sample standard deviations  $\sigma_a$  of successive braking tests of SRTT should be examined.

In addition and in order to take in account possible test evolution, the coefficient of validation  $CVal_a(SRTT)$  is calculated on the basis of the average values of any two consecutive groups of the minimum 6 runs of the Standard Reference Test Tyre according to

$$CVal_a(\text{SRTT}) = 100\% \times \left| \frac{\overline{a_{R2}} - \overline{a_{R1}}}{\overline{a_{R1}}} \right|$$

The coefficient of validation  $CVal_a(\text{SRTT})$  shall not differ by more than 5 per cent.

The coefficient of variation  $CV_a$ , as defined in paragraph 3.1.1. of this annex, of any braking test shall be less than 6 per cent.

If those conditions are not met, tests shall be performed again after re-grooming the test course."

*Paragraph 4.1.*, amend to read:

"4.1. (omitted)"

*Paragraph 4.2.*, amend to read:

"4.2. Methods for measuring snow grip index

Snow performance is based on a test method by which the average acceleration in an acceleration test, of a candidate tyre is compared to that of a standard reference tyre.

The relative performance shall be indicated by a snow grip index (SG).

When tested in accordance with the acceleration test in paragraph 4.7. below, the average acceleration of a candidate snow tyre shall be at least 1.25 compared to one of the two equivalent Standard Reference Test Tyres SRTT19.5 and SRTT22.5."

*Paragraph 4.7.*, amend to read:

"4.7. Acceleration on snow test procedure for snow grip index of Class C3"

*Paragraph 4.7.5.4.*, amend to read:

"4.7.5.4. For every candidate tyre and the standard reference tyre, the acceleration test runs shall be repeated a minimum of 6 times and the coefficients of variation  $CV_{AA}$  shall be lower than or equal to 6 per cent.  $CV_{AA}$  shall be calculated for minimum 6 valid runs according to

$$CV_{AA} = 100\% \cdot \frac{\sigma_{AA}}{\overline{AA}}$$

where

$\sigma_{AA} = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (AA_i - \overline{AA})^2}$  denotes the corrected sample standard deviation and

$\overline{AA}$  the arithmetic mean of the Average Accelerations ( $AA_i$ ) of  $N$  test runs."

*Paragraph 4.8.1.*, amend to read:

"4.8.1. Calculation of the average acceleration  $AA$

Each time the measurement is repeated, the average acceleration  $AA$  ( $\text{m} \cdot \text{s}^{-2}$ ) is calculated by

$$AA = \frac{S_f^2 - S_i^2}{2D}$$

Where  $D$  (m) is the distance covered between the initial speed  $S_i$  ( $\text{m} \cdot \text{s}^{-1}$ ) and the final speed  $S_f$  ( $\text{m} \cdot \text{s}^{-1}$ )."

Paragraphs 4.8.2. and 4.8.3., amend to read:

"4.8.2. Validation of results

For the candidate tyres:

The coefficient of variation  $CV_{AA}$  of the average acceleration is calculated according to the formula in 4.7.5.4. of this Annex for all the candidate tyres. If one coefficient of variation is greater than 6 per cent, discard the data for this candidate tyre and repeat the test.

For the reference tyre:

If the coefficient of variation  $CV_{AA}$  of the average acceleration calculated according to the formula in 4.7.5.4. of this Annex for each group of min 6 runs of the reference tyre is higher than 6 per cent, discard all data and repeat the test for all tyres (the candidate tyres and the reference tyre).

In addition and in order to take in account possible test evolution, the coefficient of validation  $CVal_{AA}(SRTT)$  is calculated on the basis of the average values of any two consecutive groups of minimum 6 runs of the reference tyre according to

$$CVal_{AA}(SRTT) = 100\% \times \left| \frac{\overline{AA_2} - \overline{AA_1}}{\overline{AA_1}} \right|$$

If the coefficient of validation is greater than 6 per cent, discard the data for all the candidate tyres and repeat the test.

4.8.3. Calculation of the weighted averages

Weighted averages  $wa_{SRTT}$  of the average accelerations of two successive tests of the SRTT are calculated according to Table 1:

Table 1

<i>If the number of sets of candidate tyres between two successive runs of the reference tyre is:</i>	<i>and the set of candidate tyres to be qualified is:</i>	<i>then <math>wa_{SRTT}</math> is calculated by applying the following:</i>
1   R – T1 – R	T1	$wa_{SRTT} = \frac{1}{2}(\overline{AA_{R1}} + \overline{AA_{R2}})$
2   R – T1 – T2 – R	T1 T2	$wa_{SRTT} = \frac{2}{3}\overline{AA_{R1}} + \frac{1}{3}\overline{AA_{R2}}$ $wa_{SRTT} = \frac{1}{3}\overline{AA_{R1}} + \frac{2}{3}\overline{AA_{R2}}$
3   R – T1 – T2 – T3 – R	T1 T2 T3	$wa_{SRTT} = \frac{3}{4}\overline{AA_{R1}} + \frac{1}{4}\overline{AA_{R2}}$ $wa_{SRTT} = \frac{1}{2}(\overline{AA_{R1}} + \overline{AA_{R2}})$ $wa_{SRTT} = \frac{1}{4}\overline{AA_{R1}} + \frac{3}{4}\overline{AA_{R2}}$

where  $\overline{AA_{Rn}}$  is the arithmetic mean of the average accelerations in the n-th test of the Standard Reference Test Tyre."

Paragraph 4.8.4., shall be deleted.

Paragraph 4.8.5., renumber as 4.8.4. and amend to read:



"4.8.4. Calculation of the relative snow grip index of the tyre

The snow grip index represents the relative performance of the candidate tyre compared to the reference tyre.

$$SG(T_n) = \frac{\overline{AA_{T_n}}}{wa_{SRTT}}$$

where  $\overline{AA_{T_n}}$  is the arithmetic mean of the average accelerations of the n-th candidate tyre"

Paragraph 4.8.6., renumber as 4.8.5.

Annex 7 - Appendix 2, amend to read:

"...

Part 1 - Report

...

2. Name and address of manufacturer: .....

...

4. Brand name and trade description: .....

...

7. Snow grip index relative to SRTT according to paragraph 6.4.1.1.

...

Part 2 - Test data

...

4. Test tyre details and data:

	<i>SRTT</i> (1st test)	<i>Candidate 1</i>	<i>Candidate 2</i>	<i>SRTT</i> (2nd test)
Brand name				
Trade description/ commercial name				
Tyre size designation				
Service description				
Test rim width code				
Reference (test) inflation pressure <sup>(1)</sup> (kPa)				
Tyre loads F/R (kg)				
Tyre loads F/R (% of load associated to LI <sup>(2)</sup> )				
Tyre pressure F/R (kPa)				

5. Test results: mean fully developed decelerations ( $m \cdot s^{-2}$ ) / traction coefficient<sup>(3)</sup>

<i>Run number</i>	<i>Specification</i>	<i>SRTT</i> (1st test)	<i>Candidate 1</i>	<i>Candidate 2</i>	<i>SRTT</i> (2nd test)
1					
2					
3					

Run number	Specification	SRTT <small>(1st test)</small>	Candidate 1	Candidate 2	SRTT <small>(2nd test)</small>
4					
5					
6					
Mean					
Standard deviation					
Coefficient of variation	$CV_a \leq 6\%$				
Coefficient of Validation	$CV_{val}(SRTT) \leq 5\%$	X	X	X	
SRTT weighted average		X			X
Snow grip index		1.00			X

"

Annex 7 - Appendix 2, add new footnotes (1) and (2) and renumber the former footnote (1) to (3):

- "<sup>(1)</sup> for C2 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation
- <sup>(2)</sup> for C2 tyres, refer to single load
- <sup>(3)</sup> Strike out what does not apply."

Annex 7 - Appendix 3, amend to read:

"...

Part 1 - Report

...

2. Name and address of manufacturer: .....

...

4. Brand name and trade description: .....

...

Part 2 - Test data

...

4. Test tyre details and data:

	SRTT <small>(1st test)</small>	Candidate 1	Candidate 2	Candidate 3	SRTT <small>(2nd test)</small>
Brand name					
Trade description/ commercial name					
Tyre size designation					
Service description					

Test rim width code					
Reference (test) inflation pressure <sup>(1)</sup> (kPa)					
Tyre loads F/R (kg)					
Tyre loads F/R (% of load associated to LI <sup>(2)</sup> )					
Tyre pressure F/R (kPa)					

5. Test results: average accelerations ( $m \cdot s^{-2}$ )

Run number	Specification	SRTT (1st test)	Candidate 1	Candidate 2	Candidate 3	SRTT (2nd test)
1						
2						
3						
4						
5						
6						
Mean						
Standard deviation						
Slip ratio (per cent)						
Coefficient of variation	$CV_{AA} \leq 6\%$					
Coefficient of Validation	$CVal_{AA}(SRTT) \leq 6\%$					
SRTT weighted average						
Snow grip index		1.00				

..."

Annex 7 - Appendix 3, add new footnotes (1) and (2):

"<sup>(1)</sup> corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation

"<sup>(2)</sup> refer to single load"