United Nations ECE/TRANS/WP.29/GRBP/2020/5

Economic and Social Council

Distr.: General
14 November 2019

Original: English

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

Working Party on Noise and Tyres

Seventy-first session
Geneva, 28-31 January 2020
Item 5 (c) of the provisional agenda
Tyres: UN Regulation No. 109 (Retreaded tyres for commercial vehicles and their trailers)

Proposal for an amendment to UN Regulation No. 109

Submitted by the experts from the Bureau International Permanent des Associations de Vendeurs et Rechapeurs de Pneumatiques (BIPAVER)*

The text reproduced below has been prepared by the experts from BIPAVER in order to align the provisions for retreaded tyres marked with the three-peak-mountain snow-flake (3PMSF) symbol with the amendment proposals to UN Regulation No. 117 (ECE/TRANS/WP.29/GRBP/2019/19) and to complement ECE/TRANS/WP.29/GRBP/2019/17. The modifications to the existing text of the UN Regulation are marked in bold for new or strikethrough for deleted characters. For better readability paragraphs including physical/mathematical terms or formulas are deleted and replaced completely.

* In accordance with the programme of work of the Inland Transport Committee for 2020 as outlined in proposed programme budget for 2020 (A/74/6 (part V sect. 20) para 20.37), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

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I. Proposal

Paragraph 2.47., amend to read:

"2.47. "Standard ~~r~~**R**eference ~~t~~**T**est ~~t~~**T**yre (SRTT)" means a tyre that is produced, controlled and stored in accordance with the American Society for Testing and Materials (ASTM) standards:

(a) ~~E1136-93 (2003)~~ **E1136 – 17** for the size P195/75R14 **and referred to as "SRTT14"**;

(b) ~~F2872 (2011)~~ **F2872 – 16** for the size 225/75 R 16 C **and referred to as "SRTT16C"**;

(c) ~~F2871 (2011)~~**F2871 - 16** for the size 245/70R19.5 **and referred to as "SRTT19.5"**;

(d) ~~F2870 (2011)~~ **F2870 – 16** for the size 315/70R22.5 **and referred to as "SRTT22.5."**

Paragraph 4.3., amend to read:

"4.3. At the request of the Type Approval Authority, the ~~applicant~~ **Retreader** shall submit samples of tyres for test or copies of test reports from the technical services, communicated as given in paragraph 12. of this Regulation."

Paragraph 7.2., amend to read:

"7.2. In order to be classified as a "snow tyre for use in severe snow conditions", the retreaded tyre to comply with this Regulation shall meet the performance requirements of paragraph 7.2.1. The retreaded tyre size shall meet these requirements based on a test method of Annex 10 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 a candidate tyre is compared to that of a ~~s~~**S**tandard ~~r~~**R**eference ~~t~~**T**est **Tyre (SRTT).**

The relative performance shall be indicated by a snow grip index."

Paragraph 7.2.1., amend to read:

"7.2.1. For Class C2 and C3 tyres, the minimum snow **grip** index value, as calculated in the procedure described in Annex 10 and compared with the **respective Standard Reference Test Tyre (**SRTT**)** shall be as follows:

~~*Class of tyre*~~	~~*Snow grip index (spin traction method)* [(b)]~~	~~*Snow grip index (brake on snow method)* [(c)]~~	~~*Snow grip index (acceleration method)* [(c)]~~
	~~*Ref. = SRTT 14*~~	~~*Ref. = SRTT 16C*~~	~~*Ref. = SRTT 19.5*~~ ~~*Ref. = SRTT 22.5*~~
~~C2~~	~~1.10~~	~~1.02~~	~~No~~
~~C3~~	~~No~~	~~No~~	~~1.25~~

Class of tyre	*Snow grip index (brake on snow method)* [(a)]	*Snow grip index (spin traction method)* [(b)]	*Snow grip index (acceleration method)* [(c)]
	Ref. = SRTT16C	***Ref. = SRTT14***	***Ref. = SRTT19.5, SRTT22.5***
C2	1.02	1.10	No
C3	No	No	1.25

Annex 10,

Paragraph 3.4.1.1., amend to read:

"~~3.4.1.1. For each tyre and each braking test, the mean and standard deviation of the mfdd shall be computed and reported. The coefficient of variation CV of a tyre braking test shall be computed as:~~

$$\text{~~CV (tyre)} = \frac{\text{~~Std. dev (tyre)}}{\text{~~Mean (tyre)}}$$

3.4.1.1. For each tyre and each braking test, the arithmetic mean $\bar{a}$ and corrected sample standard deviation σ_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) 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) = (R1 + R2)/2~~

~~Where:~~
~~R1 is the mean fully developed deceleration for the first test of the SRTT and R2 is the mean mfdd for the second test of the SRTT.~~

~~In the case of the order of testing R1 – T1 – T2 – R2, the weighted average (wa) of the SRTT to be used in the comparison of the performance of the candidate tyre shall be taken to be:~~

~~wa (SRTT) = 2/3 R1 + 1/3 R2 for comparison with the candidate tyre T1; and:~~

~~wa (SRTT) = 1/3 R1 + 2/3 R2 for comparison with the candidate tyre T2.~~

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:

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

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:

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

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

Paragraph 3.4.1.3., amend to read:

"~~3.4.1.3. The snow grip index (SG) in per cent of a candidate tyre shall be computed as:~~

~~Snow Grip Index (candidate) = Mean (candidate) / wa (SRTT)~~

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

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

"

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 means and standard deviations of successive braking tests of SRTT should be examined.~~

~~The means of two successive SRTT braking tests shall not differ by more than 5 per cent.~~

~~The coefficient of variation of any braking test shall be less than 6 per cent.~~

~~If those conditions are not met, tests shall be performed again after regrooming the test course."~~

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 σ_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

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

The coefficient of validation $CVal_a$ (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. ~~According to the definition of C3 tyres reported into paragraph 2.52. of this Regulation, the additional classification for the purpose of this test method only applies:~~

~~(a) C3 Narrow (C3N), when the C3 tyre nominal section width is lower than 285 mm;~~

~~(b) C3 Wide (C3W), when the C3 tyre nominal section width is greater or equal to 285 mm.~~ **(omitted)"**

Paragraph 4.2., amend to read:

"4.2. Methods for measuring Snow Grip index (SG)

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.

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 ~~SRTTs ASTM F 2870~~ **Standard Reference Test Tyres SRTT19.5** and ~~ASTM F 2871~~ **SRTT22.5**."

Paragraph 4.7., amend to read:

"4.7. Acceleration on snow test procedure for snow grip index of ~~Classes C3N and C3W~~**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 (standard deviation/average*100) calculated for minimum 6 valid runs on the distance and the time should be lower than or equal to 6 per cent.~~

"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

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

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 4.8.2., amend to read:

"~~4.8.2. Validation of results~~

~~For the candidate tyres:~~

~~The coefficient of variation of the average acceleration is calculated for all the candidate tyres. If one coefficient of variation is greater than six per cent, discard the data for this candidate tyre and repeat the test.~~

$$\text{coefficien t of variation} = \frac{\text{stdev}}{\text{average}} \times 100$$

~~For the reference tyre:~~

~~If the coefficient of variation of the average acceleration "AA" 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 is calculated on the basis of the average values of any two consecutive groups of min 6 runs of the reference tyre. If the coefficient of validation is greater than 6 per cent, discard the data for all the candidate tyres and repeat the test.~~

$$\text{coefficient of validation} = \left|\frac{\text{Average2} - \text{Average1}}{\text{Average1}}\right| \times 100$$

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

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

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

Paragraph 4.8.3., amend to read:

"~~4.8.3. Calculation of the "average AA"~~

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

~~Table 1~~

~~*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 – T1 – R~~	~~T1~~	~~Ra = 1/2 (R1 + R2)~~
~~2 | R – T1 – T2 – R~~	~~T1~~ ~~T2~~	~~Ra = 2/3 R1 + 1/3 R2~~ ~~Ra = 1/3 R1 + 2/3 R2~~
~~3 | R – T1 – T2 – T3 – R~~	~~T1~~ ~~T2~~ ~~T3~~	~~Ra = 3/4 R1 + 1/4 R2~~ ~~Ra = 1/2 (R1 + R2)~~ ~~Ra = 1/4 R1 + 3/4 R2~~

~~"Ta" (a = 1, 2, …) is the average of the AA values for a test of a candidate tyre.~~

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

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"wa_{SRTT} is calculated by applying the following:***
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., delete:

"~~4.8.4. "AFC" Calculation (Acceleration Force Coefficient)~~

~~Also called AFC Acceleration Force Coefficient~~

~~Calculation on of AFC(Ta) and AFC(Ra) as defined in Table 2 :~~

~~Table 2~~

	~~*The acceleration force coefficient "AFC" is:*~~
~~Reference tyre~~	~~$AFC(R) = \frac{Ra}{g}$~~
~~Candidate tyre~~	~~$AFC(T) = \frac{Ta}{g}$~~

~~Ra and Ta are in m/s²~~
~~"g"= gravity acceleration (rounded to 9.81 m/s²)~~

"

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

"4.8.~~5~~**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.

~~$\text{Snow Grip Index} = \frac{AFC(T)}{AFC(R)}$~~

$$\boldsymbol{SG(\mathrm{Tn}) = \frac{\overline{AA_{\mathrm{Tn}}}}{wa_{\mathrm{SRTT}}}}$$

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

Paragraph 4.8.6., renumber to 4.8.5.

Annex 10,

Appendix 2, amend to read:

"Part 1 – Report

……..

2. Name and address of the ~~applicant~~ **Retreader**:

…….

4. ~~Manufacturer and b~~**B**rand name ~~or~~ **and** trade description:

…….

7. Snow **grip** index relative to SRTT according to paragraph 7.2.1.

……

Part 2 – Test data

…….

4. Test tyre details **and data:**

~~4.1. Tyre size designation and service description: .....~~

~~4.2. Tyre brand and trade description: .....~~

~~4.3. Test tyre data:~~

	SRTT (1st test)	*Candidate **1***	*Candidate **2***	*SRTT (2nd test)*
Brand name				
Trade Description/ commercial name				
Tyre ~~dimensions~~ **size designation**				
Service description				
Test rim width code				
Reference (test) inflation pressure(1) (kPa)				
Tyre loads F/R (kg)				
Tyre Loads ~~index~~ F/R (~~per cent~~ **% of load associated to LI(2)**)				
Tyre pressure F/R(kPa)				

5. Test results: mean fully developed decelerations (~~m/s²~~ **m · s^{-2}**) coefficient(~~1~~3).

Run number	*Specification*	*SRTT (1st test)*	*Candidate **1***	*Candidate **2***	*SRTT (2nd test)*
1					
2					
3					
4					
5					
6					
Mean					
~~Std~~ **Standard** deviation					
~~CV(%)~~ **Coefficient of variation**	~~< 6%~~ $CV_a \leq 6$ **%**				
Coefficient of Validation ~~SRTT~~	~~SRTT < 5%~~ $CVal_a$**(SRTT)** ≤ 5 **%**				
SRTT **weighted** average					
Snow **grip** index		1.00			

Add *footnotes (1) and (2)* and renumber the existing *footnote (1)* to (3):

"(1) **for C2 tyres, corresponding to the indication of the inflation pressure marked on the sidewall as required by paragraph 4.1. of this Regulation**

(2) **for C2 tyres, refer to single load**

~~1~~(3) Strike out what does not apply."

Appendix 3, amend to read:

"Part 1 – Report

……..

2. Name and address of the ~~applicant~~ **Retreader**:

…….

4. ~~Manufacturer and b~~**B**rand name ~~or~~ **and** trade description:

…….

7. Snow **grip** index relative to SRTT according to paragraph 7.2.1.

……

Part 2 – Test data

…….

4. Test tyre details **and data:**

~~4.1. Tyre size designation and service description: .....~~

~~4.2. Tyre brand and trade description: .....~~

~~4.3. Test tyre data:~~

	SRTT (1st test)	*Candidate **1***	*Candidate **2***	*Candidate **3***	*SRTT (2nd test)*
Brand name					
Trade Description/ commercial name					
Tyre ~~dimensions~~ **size designation**					
Service description					
Test rim width code					
Reference (test) inflation pressure(1) (kPa)					
Tyre loads F/R (kg)					
Tyre Loads ~~index~~ F/R (~~per cent~~ **% of load associated to LI(2)**)					
Tyre pressure F/R(kPa)					

5. Test results: mean fully developed decelerations (~~m/s²~~ **m · s^{-2}**) coefficient.

Run number	*Specification*	*SRTT (1st test)*	*Candidate **1***	*Candidate **2***	*Candidate **3***	*SRTT (2nd test)*
1						
2						
3						
4						
5						
6						

Mean						
~~Std.~~ **Standard** deviation						
~~CV(%)~~ **Coefficient of variation**	~~< 6%~~ ***CV*$_a$ ≤ 6 %**					
Coefficient of Validation ~~SRTT~~	~~SRTT < 5%~~ ***CVal*$_a$(SRTT) ≤ 6 %**					
SRTT **weighted** average						
Snow **grip** index		1.00				

Add footnotes (1) and (2) to read:

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

(2) refer to single load."

II. Justification

This amendment to UN Regulation No. 109 aims to ensure that the test procedures for retreaded tyres in respect to the 3PMSF testing is aligned with the amendment proposal to UN Regulation No. 117, as contained in ECE/TRANS/WP.29/GRBP/2019/19.