United Nations ECE/TRANS/WP.29/GRB/2011/11

Economic and Social Council

Distr.: General
2 September 2011

English only

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

Working Party on Noise

Fifty-fourth session
Geneva, 19–21 September 2011
Item 6 of the provisional agenda
Regulation No. 117 (Tyre rolling noise and wet grip adhesion)

Proposal for Supplement 1 to the 02 series of amendments to Regulation No. 117

Submitted by the expert from the Russian Federation *

The text reproduced below was prepared by the expert from the Russian Federation as agreed during the fifty-third session of the Working Party on Noise (GRB) (see ECE/TRANS/WP.29/GRE/51, para. 21). It is based on Informal documents GRB-53-07 and GRB 53-11. The modifications to the current text of the Regulation are marked in bold for new text or strikethrough for deleted text.

* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (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

Annex 6

Paragraph 3.5., amend to read:

"3.5. Duration and speed.

When the deceleration method is selected, the following requirements apply:

(a) **The deceleration j shall be determined in exact dω/dt or approximate Δω/Δt form, where ω is angular velocity, t – time**

(b) For duration Δt, the time increments shall not exceed 0.5 s;

(c) Any variation of the test drum speed shall not exceed 1 km/h within one time increment."

Paragraph 4.6.1., amend to read:

"4.6.1. Skim test reading

Skim test reading follows the procedure below:

(a) Reduce the load to maintain the tyre at the test speed without slippage. [3]

The load values should be as follows:

(i) Class C1 tyres: recommended value ~~of~~ **not to exceed** 100 N; ~~not to exceed 200 N~~;

(ii) Class C2 tyres: recommended value ~~of~~ **not to exceed** 150 N; ~~not to exceed 200 N for machines designed for Class C1 tyre measurement or 500 N for machine designed for Class C2 and C3 tyres~~;

(iii) Class C3 tyres: recommended value ~~of~~ **not to exceed 220 N** ~~400 N; not to exceed 500 N~~.

…."

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;

(b) Record the deceleration of the test drum $\mathbf{j_{D0}}$ and that of the unloaded tyre $\mathbf{j_{T0}}$ **in exact or approximate form in accordance with paragraph 3.5.**"

[3] With the exception of the force method, the measured value includes the bearing and aerodynamic losses of the wheel, the tyre, and the drum losses which also need to be considered.
It is known that the spindle and drum bearing frictions depend on the applied load. Consequently, it is different for the loaded system measurement and the skim test reading. However, for practical reasons, this difference can be disregarded.

Paragraph 5.1.5., amend to read:

"5.1.5. Deceleration method

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

$$F_{pl} = \frac{I_D}{R} j_{D0} + \frac{I_T}{R_r} j_{T0}$$

where:

ID is the test drum inertia in rotation, in kilogram meter squared;

R is the test drum surface radius, in meter;

~~ω_{D0} is the test drum angular speed, without tyre, in radians per second;~~

~~Δt_0 is the time increment chosen for the measurement of the parasitic losses without tyre, in second;~~

j_{D0} is the deceleration of the test drum, without tyre, in radians per second squared;

IT is the spindle, tyre and wheel inertia in rotation, in kilogram meter squared;

Rr is the tyre rolling radius, in metre;

~~ω_{T0} is the tyre angular speed, unloaded tyre, in radian per second.~~

j_{T0} is the deceleration of unloaded tyre, in radians per second squared."

Paragraph 5.2.5., amend to read:

"5.2.5. Deceleration method

The rolling resistance F_r, in newton, is calculated using the equation:

$$Fr = \frac{I_D}{R} j_V + \frac{RI_T}{R_r^2} j_V - F_{pl}$$

where:

Where:

ID is the test drum inertia in rotation, in kilogram metre squared,

R is the test drum surface radius, in meter,

F_{pl} represents the parasitic losses as calculated in paragraph 5.1.5.,

~~Δt_v is the time increment chosen for measurement, in second,~~

~~$\Delta\omega_v$ is the test drum angular speed increment, without tyre, in radian per second,~~

jV is the deceleration of the test drum, in radians per second squared,

I_T is the spindle, tyre and wheel inertia in rotation, in kilogram metre squared,

R_r is the tyre rolling radius, in metre,

F_r is the rolling resistance, in newton."

Annex 6, Appendix 1

Paragraph 4, amend to read:

"4. Control accuracy

…

(d) time: +/- ~~0.02 s~~ **0.5 ms**

…"

II. Justification

Annex 6, paragraphs 3.5., 5.1.5. and 5.2.5.:

The deceleration in similar methods of determining rolling resistance plays an important role. But the formula in Annex 6, paragraphs 5.1.5. and 5.2.5. of Regulation No. 117, refer only to the approximate form of deceleration $\Delta\omega/\Delta t$, where $\Delta\omega$ and Δt are increments of angular speed and time. These formulas have been carried over from old standards: ISO 8767 (1992) and ISO 9948 (1992) of the last century and thus do not allow usage of the exact form: $d\omega/dt$.

Therefore, it is proposed that Regulation No. 117 should allow a wider application of engineering knowledge especially in its simplest form.

Annex 6, paragraph 4.6.1.(a).:

Paragraph 4.6.1. in Regulation No. 117 and paragraph 7.6.2. in standard ISO 28580 both regulate increased norms of skim test load values without any information about the experimental confirmation of such actions. Skim test load increasing is aimed to artificially increase tyre losses and the consequent understating of rolling resistance coefficient. The detailed theoretical and experimental analyses and justification of the proposal were presented in Informal document GRB-53-11.

Annex 6, Appendix 1:

Annex 6, paragraph 3.5.(a) states that the duration Δt for the deceleration method shall not exceed 0.5 s. Consequently, an accuracy of time measurement in percentage taking into account the existing norm in item (d) equal 0.02 s:

$$\delta_t = \frac{0.02}{0.5} = 4\%,$$

is too much. For a test machine with R_D= 0.85 m the time increment Δt (period of one revolution) at a speed of 80 km/h equals 0.24 s. In this case:

$$\delta_t = \frac{0.02}{0.24} = 8.3\% \text{ (!)}$$

To maintain the angular velocity ω in limits ±0.2% (see ISO 18164 paragraph C.4.1) it is necessary to state the Δt limit equal ±0.5 ms. In this case:

$$\delta_t = \frac{0.0005}{0.24} \approx 0.2\%$$

(As soon as $\omega = \frac{U}{R} = \frac{2\pi R}{\Delta t R} = \frac{2\pi}{\Delta t}$,

then consequently: $\delta\omega = \delta_t$)