Transmitted by the expert
from the Russian Federation

Informal Document No. **GRB-53-11**
53rd GRB, 15-17 February 2011,
Agenda Item 6(a)

Proposal for draft amendments to Regulation No. 117 (Tyre rolling noise, wet grip adhesion and rolling resistance)

The text reproduced below was prepared by the experts from the Russian Federation. This proposal concerns existing methods of tyre rolling resistance determining.

I. Proposal

Annex 6., Test procedure for measuring rolling resistance
Paragraph 4.6.1 item (a), *change to the approved international norms of skim test load, to read:*

"(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~~."

II. Justification

The paragraph 4.6.1 as well as paragraph 7.6.2 in ISO 28580 regulates two times increased norms of skim test load values without any information about experimental confirmation of such action correctness. Skim test load increasing is aimed to artificial rise of tyre parasitic losses and consequent understating of rolling resistance (RR) coefficient. In supposition that Cr during skim test is the same as at RR test the next examples show the effect.

Example 1: PC tyre 205/55 R16; Lm=4830 N, Fr=50 N, Cr=0,0103. If maintaining force equal 200 N, then additional RR force Fra=200*0,0103=2 N or minus 4% from Fr. If maintaining force is 150 N, then additional force is minus 3% from Fr.

Example 2: CV tyre (LI<121) 225/65 R16; Lm=9340 N, Fr=84 N, Cr=0,009. If maintaining force equal 500 N, then additional RR force Fra=500*0,009=4,5 N or minus 5% from Fr.

Example 3: CV tyre (LI>121) 215/75 R17,5; Lm=14180 N, Fr=99 N, Cr=0,007. If maintaining force equal 500 N, then additional RR force Fra=3,5 N or minus 3,5% from Fr.

In a due time six experts from ISO/TC31/WG6 did not pay attention to the importance of this signal because the supposition of calculations perhaps was not correct on their mind. Although the sufficient time has been passed, but there is no data about real Cr at skim tests confirmed by experiment till now. The Russian Federation experts jointly with specialists of VMI Group (Holland) and Marangoni (Italy) carried out special experiments on this item. Parasitic resistance F_{pl} of test machine with tyre 225/70R15C at light contact (load 20 daN) was measured by time-distance deceleration method. Then parasitic losses F_{pD} of test machine with removed tyre were determined (Figure 1 and Table). The difference (F_{pl} -F_{pD}) gave total wheel-tyre skim reading losses. After that, parasitic losses of removed tyre by standard test were obtained. The difference between results obtained by both methods gave tyre RR force in skim reading regime (Figure 2) and then corresponding RR coefficient (Figure 3). The results are also presented in Table and show that at skim reading Cr sk (U=80 km/h) twice as many Cr when tyre is under full test load. A detected effect may be explained by sufficient rise of specific weight of hysteresis of the tread relatively that of the tyre rubber-cord-casing. Consequently measurement RR error in form of understating may be sufficiently more than shown in examples above.

Paragraph 7.7.2 of ISO 18164 does not regulate skim load magnitude. Analogous paragraphs of previous ISO 8767 and ISO 9948 state this magnitude on the level of 50 N for all type of vehicles. SAE

J1269 and J2452 regulate skim test load on the levels of 100,150 and 220 N for PC, CV and TB tyres correspondently. Twice increased skim test load norms introduced into Regulation No.117 are not validated and may be considered as aimed on tyre rolling resistance understating, being in conflict with the paragraph 2.17.10 ("energy loss within the tyre itself is virtually zero").

Table. Parasitic losses investigation of tyre 225/70 R15C by time-distance deceleration method accompanied with skim test.

U	F_{pl}	F_{pD}	F_{pl} -F_{pD}	F_{pT}	Fr sk	Cr sk	Cr
km/h	daN	daN	daN	daN	daN	N/kN	N/kN
0	7.8833	7.5833	0.3000	0.0741	0.2259	11.2967	7.7525
10	7.9166	7.6119	0.3047	0.0769	0.2278	11.3893	7.7626
20	8.0164	7.6976	0.3189	0.0856	0.2333	11.6669	7.7931
30	8.1828	7.8403	0.3425	0.0999	0.2426	12.1295	7.8438
40	8.4158	8.0402	0.3756	0.1200	0.2555	12.7773	7.9147
50	8.7153	8.2972	0.4181	0.1459	0.2722	13.6101	8.0060
60	9.0813	8.6113	0.4700	0.1775	0.2926	14.6280	8.1176
70	9.5140	8.9826	0.5314	0.2148	0.3166	15.8310	8.2494
80	10.0131	9.4109	0.6022	0.2579	0.3444	17.2190	8.4015
90	10.5789	9.8963	0.6825	0.3067	0.3758	18.7921	8.5739

Notation:

F_{pl} – total machine PL during skim test;
F_{pD} – machine PL with removed tyre;
F_{pl} -F_{pD} – total tyre PL during skim test;
F_{pT} – total removed tyre PL ;

Fr sk – tyre RR force during skim test as F_{pl} -F_{pD} - F_{pT};
Cr sk – tyre RR coefficient during skim test;
Cr – tyre RR coefficient as Fr/ L_m (L_m=934 daN).

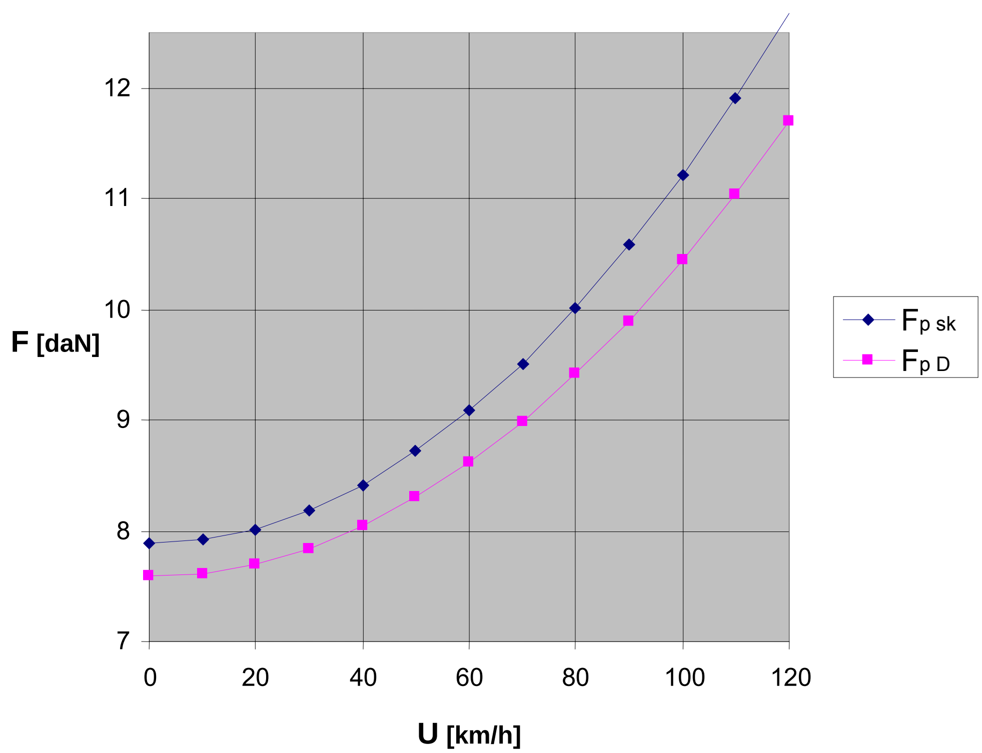

Figure 1. Tyre 225/70 R15C skim reading resistance($F_{p\,sk}$) in comparison with drum parasitic losses (F_{pD}) when tyre removed.

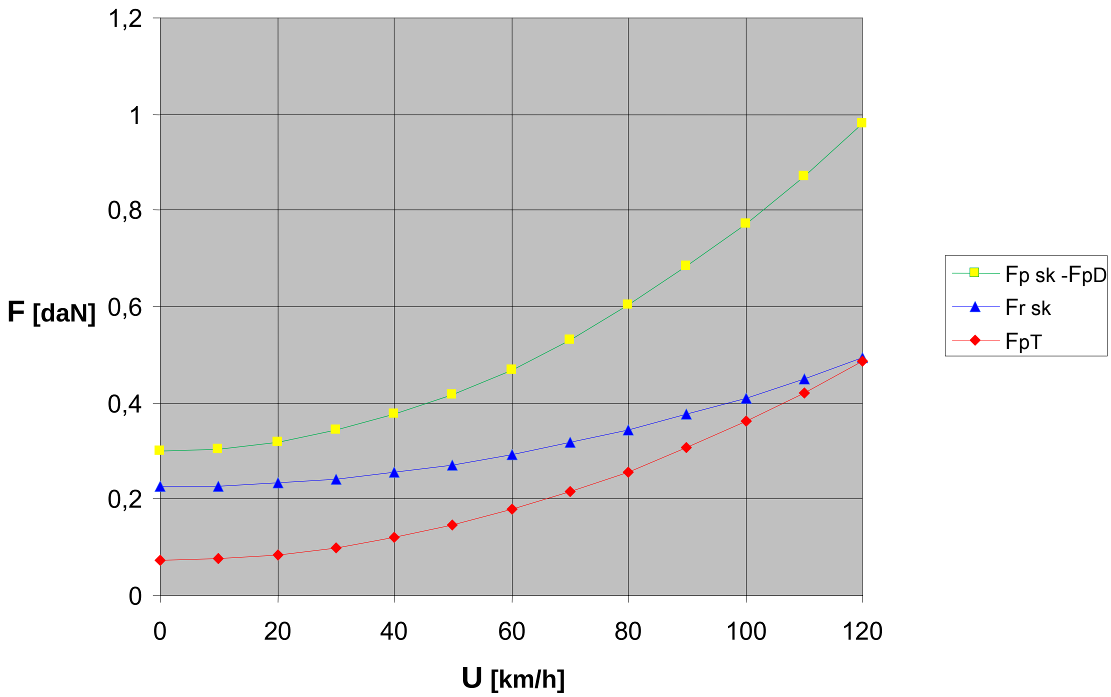

Figure 2. Tyre-wheel-hub parasitic losses of tyre 225/70 R15C removed (F_{pT}) in comparison with skimmed ($F_{p\,sk}$-F_{pD}) obtained by deceleration method and their difference ($F_{p\,sk}$-F_{pD}-F_{pT}) i.e. rolling resistance.

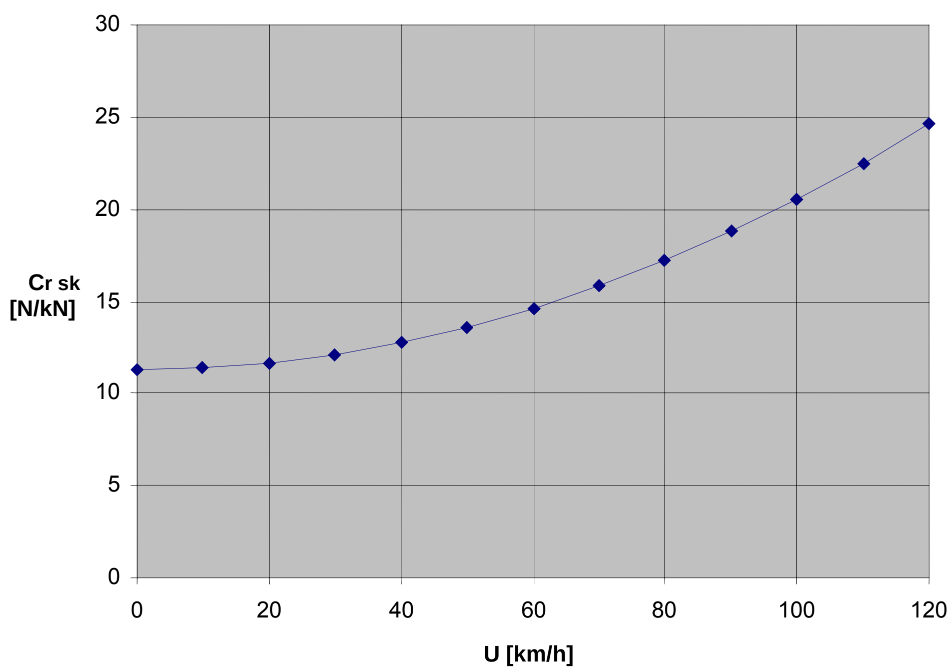

Figure 3. Tyre 225/70 R15C skim reading RR coefficient due to speed.

III. Proposal

Annex 6., Test procedure for measuring rolling resistance
Appendix 1, paragraph 4, item (d), *replace time measurement accuracy norm, to read:*

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

IV. Justification

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

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

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

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

To maintain angular velocity ω in limits ±0.2% (see ISO 18164 paragraph C.4.1) it is needed to state 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: $\delta\omega = \delta_t$)