

Informal Document No. 22
(53rd GRRF, 3-6 February 2003)
Agenda Items 6.3 and 6.4.

Original: RUSSIAN / ENGLISH

Introduction of Additions to the Regulations Nos. 30 and 54
Regarding Manufacturer's Information on Rolling Resistance Coefficient

Transmitted by the Russian Federation

This document has been prepared in addition to the Informal Document No. 7 distributed by the Russian Federation at 128th WP.29, 12-15 November 2002.

In addition to the previously presented information by the Russian Federation in regards to the subject, the tables Nos. 1 and 2 comparing standards of ISO, SAE and Russia in regards to bench measuring of rolling resistance coefficient are brought to the attention of the GRRF experts. The comparison indicates that by this time achieving of comparable results when different standards are used, in particular with respect to base test at 80 km/h for car and truck tires, has become possible. This is provided by test conditions and similar formulae of transforming to the same drum diameter and ambient temperature. It can be predicted that compatibility of the test results could be additionally increased, if tire temperature could be measured by, for example, non-contact means of infrared emission registration. Besides that, the presented comparison indicates possibility of relatively fast rapprochement of positions in regards to matrixes of test parameters in such form as "load – pressure".

In regards to the above-mentioned, the following additions to the Regulations Nos. 30 and 54 are introduced:

Regulations No. 30:

Insert new paragraph 4.1.15 to read:

"4.1.15. rolling resistance coefficient at speed 80 km/h and load 80% of maximal load determined in accordance with ISO 8767. Manufacturer may, if he wishes so, introduce additional data for speeds 50, 90, and 120 km/h determined by similar way. If different method of determination was used, its equivalence shall be proved".

Regulations No. 54:

Insert new paragraph 4.1.14 to read:

- "4.1.14. rolling resistance coefficient at load 85% of maximal load determined in accordance with ISO 9948.
- 4.1.14.1. for tires with load index 122 and higher and speed categories from K to M at speed 80 km/h, and for tires of speed categories from F to J at speed 60 km/h;
- 4.1.14.2. for tires with load index 121 and lower at speed 80 km/h, and, if required, 120 km/h;
- 4.1.14.3. Manufacturer may, if he wishes so, introduce additional data for alternative combinations of load and tire pressure as specified in the mentioned test method. If different method of determination was used, its equivalence shall be proved".

Table 1. Passenger car tyres – Methods of measuring rolling resistance.
Comparison of test conditions

Standard	Test method	Drum diameter [mm]	Test speed, km/h	Load, % of Max	Inflation pressure, kPa (base±)	Warm-up		Temperature sensor removing [cm]
						speed, km/h	time, minute	
ISO-8767	Force, Torque, Power, Deceleration	1500-3000	80	80	- 30	80.	30	ISO-8767
			50, 90, 120	90 50	-30, +70 -30, +70			
SAE-J1269, SAE-J1270	Force, Torque, Power	1708 (most standard)	80	90 50	-50, +70 -30, +70	80	30	SAE-J1269, SAE-J1270
SAE J2452	Force	1219-1707	80	70	00	80	30	SAE J2452
			from 115 to 15	90 60 30	-40, +60 -40 +10			
ГОСТ-4754 (Russian Federation)	Force	1592, 1707, 2000	80	80	+10 ÷ +40	80	60	ГОСТ-4754 (Russian Federation)
OCT- 37.001.522 (Russian Federation)	Deceleration	1592, 1707, 2000	from max to zero	80	-30	80	to stable temp.	OCT- 37.001.522 (Russian Federation)

Table 2. Truck and bus tyres – Methods of measuring rolling resistance.
Comparison of test conditions

Standard	Test method	Drum diameter [m]	Test speed, km/h	Load, % of Max	Inflation pressure, % of max	Warm-up		Temperature sensor removing [cm]
						speed, km/h	time, minute	
ISO-9948	Force, Torque, Power, Deceleration	1.700-3.000	80 60 ¹⁾	85	100	80.	90 30 ¹⁾	ISO-9948
				100	100,95			
				75	70			
				50	120			
				25	70			
SAE-J1269, SAE-J1270	Force, Torque, Power	1708 (most standard)	80	100 75 50 25	100,95 70 120 70	80	90 30	SAE-J1269, SAE-J1270
ГОСТ-5513 (Russian Federation)	Force	1.592, 1.707, 2.000	80 60 ¹⁾	85	100	80 60 ¹⁾	60	ГОСТ-5513 (Russian Federation)
OCT- 37.001.522 (Russian Federation)	Deceleration	1.592, 1.707, 2.000	from max to zero	85	100	80 60 ¹⁾	to stable temp.	OCT- 37.001.522 (Russian Federation)

Notation: ¹⁾ For tires of speed categories from F to J

Justification:

For further activity for creation of the uniform regulatory document basing on experience of the parties on application of the above-mentioned standards, the Russian Federation would like to base this document on the standards ISO 8767 and 9948 since they contain the most extended combination of alternative test methods. If the GRRF experts could come up to the decision of excluding from the list the power test method of as less accurate, the Russian Federation would agree with such decision.

In regards to the rest three test methods (force, torque, deceleration), it is considered appropriate to cite preambles of standards SAE J1270 and J2452, which have been confirmed by practice of our tests:

"The main disadvantage of **force** method is that the spindle force measured can contain a severe error caused by load misalignment and load-spindle force interaction ("crosstalk"). Elimination or compensation of these effects is necessary. A minor disadvantage is that the loaded radius of the tire must be measured in order to convert spindle force to rolling resistance."

"The main disadvantage of the **torque** method is that parasitic losses contained in the measurement include rotational test wheel losses as well as tire spindle losses. Hence, the parasitic losses are larger than those of the force method and can be of the same order of magnitude as the rolling resistance itself. In addition, speed-hunting oscillation in the drive motor can introduce errors."

The preamble to the standard ISO 8767 can be added to the above-said with no doubts:

"In measuring tire rolling resistance, it is necessary to measure small forces in the presence of much larger force. It is, therefore, essential that equipment and instrumentation of appropriate accuracy be used."

Considering above-mentioned, the attention should be paid to reserves of improvement of deceleration method. The major disadvantages of it, in the variant presented by the standards ISO 8767 and 9948, is necessity of determination of deceleration as a relation between small decrease of speed and small value of time $\Delta V/\Delta t$, which is a source of significant portion of errors, and unsatisfactory accuracy of measurement of inertia moment of a drum.

For improvement of the Russian standards for methods of measuring of rolling resistance, the goal was to develop the deceleration method, which could have provided for:

1. scanning of all rolling resistance coefficients within the speed range from 90 km/h or 120 km/h (maximum) to 0;
2. exclusion of necessity of measuring of speed indirectly;
3. possible measuring of rolling resistance on most drums, which are available for the most domestic manufacturers, and which were not originally intended for such purpose;
4. convenient and accurate measuring of inertia moments of the drum, test bench electric motor, and a wheel with a test tire

Such method and related equipment were developed, tested, and in 1999 were fixed by the Russian national standard of the automotive industry OST 37.001.522, presented in the tables 1 and 2.

If GRRF approves such a way of further activities, the Russian Federation would see a consolidated document in the form of ISO 8767 and 9948 with exclusion of power method and modified deceleration method and agreed by all participants a uniform matrix "load – tire pressure".

In conclusion, we should note that recently GRRF already paid attention to the subject of tire rolling resistance. The Russian proposals in regards to the subject are not somewhat original:

1. it is well known that the tire rolling resistance coefficient relates to the fuel consumption. The latter parameter is the major criterion of evaluation of performance of a vehicle and entire automotive fleet with respect to ecological and economical evaluation of performance;

2. tire rolling resistance is new or unknown parameter for none of tire manufacturers. It can be definitely said that every tire and vehicle manufacturer always uses such a parameter in practice and have clear opinion in regards to its evaluation (value of rolling resistance coefficient);

3. there is no problem in methodology of evaluation of tire rolling resistance; the experience reflected by ISO and national standards indicates that there should be significant difficulties in development of agreed uniform method;

4. we consider that limitation of value of tire rolling resistance coefficient and even activities for such purpose will cause increase of attention from tire manufacturers and consumers to the concern of tire rolling resistance and a search for further improvement of such a criterion;

5. it is known that reserves for reduction of tire rolling resistance coefficient exist. The rolling resistance coefficient may differ by 25-35% on tires presented on the market;

The extended proposals of the Russian Federation may be presented to the GRRF for preliminary consideration not later than in April – May of this year, so it could be possible to conclude discussion on the next GRRF session.