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Economic Commission for Europe**Inland Transport Committee****World Forum for Harmonization of Vehicle Regulations****Working Party on Pollution and Energy****Seventy-second session**

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Item 3(a) of the provisional agenda

Light vehicles – Regulations Nos. 68 (Measurement of the maximum speed, including electric vehicles), 83 (Emissions of M₁ and N₁ vehicles), 101 (CO₂ emissions/fuel consumption) and 103 (Replacement pollution control devices)**Proposal for a new Supplement to the 07 series of amendments to Regulation No. 83 (Emissions of M₁ and N₁ vehicles)****Submitted by the expert from the European Commission***

The text reproduced below was prepared by the expert from the European Commission. The proposal aims at correcting the calculation of the resistance to progress force. The modifications to the current text of Regulation No. 83 are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2014–2018 (ECE/TRANS/240, para. 105 and ECE/TRANS/2014/26, 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 4a – Appendix 7,

Paragraphs 5.1.1.1. to 5.1.1.2.7., amend to read:

"5.1.1.1. — Test equipment and error

Time shall be measured to an error lower than ± 0.1 s.

Speed shall be measured to an error lower than ± 2 per cent.

5.1.1.2. — Test procedure

5.1.1.2.1. — Accelerate the vehicle to a speed 10 km/h greater than the chosen test speed V .

5.1.1.2.2. — Place the gearbox in "neutral" position.

5.1.1.2.3. — Measure the time taken (t_1) for the vehicle to decelerate from speed

$$V_2 = V + \Delta V \text{ km/h to } V_1 = V - \Delta V \text{ km/h}$$

5.1.1.2.4. — Perform the same test in the opposite direction: t_2 .

5.1.1.2.5. — Take the average T of the two times t_1 and t_2 .

5.1.1.2.6. — Repeat these tests several times such that the statistical accuracy (p) of the average

$$T = \frac{1}{n} \sum_{i=1}^n T_i \text{ is not more than 2 per cent } (p \leq \pm 2 \text{ per cent})$$

The statistical accuracy (p) is defined by:

$$p = \left(\frac{t \cdot s}{\sqrt{n}} \right) \cdot \frac{100}{T}$$

Where:

t = coefficient given by the following table,

n = number of tests,

s = standard deviation, $s = \sqrt{\frac{\sum_{i=1}^n (T_i - T)^2}{n - 1}}$

n	4	5	6	7	8	9	10	11	12	13	14	15
t	3.2	2.8	2.6	2.5	2.4	2.3	2.3	2.2	2.2	2.2	2.2	2.2
$\frac{t}{\sqrt{n}}$	1.6	1.25	1.06	0.94	0.85	0.77	0.73	0.66	0.64	0.61	0.59	0.57

5.1.1.2.7. — Calculate the power by the formula:

$$P = \frac{M \cdot V \cdot \Delta V}{500 \cdot T}$$

Where:

P is expressed in kW,

V = speed of the test in m/s,

ΔV = speed deviation from speed V , in m/s as specified in paragraph 5.1.1.2.3. of this appendix,

M = reference mass in kg,

T = time in seconds (s).

5.1.1.1. Test equipment and error

Time shall be measured to an error lower than ± 0.1 s.

Speed shall be measured to an error lower than ± 2 per cent.

During the test, elapsed time and vehicle speed shall be measured and recorded at a minimum frequency of 1 Hz.

5.1.1.2. Test procedure

5.1.1.2.1. Accelerate the vehicle to a speed 10 km/h higher than the chosen test speed v .

5.1.1.2.2. Place the gearbox in "neutral" position.

5.1.1.2.3. For each reference speed point v_j , measure the time taken (ΔT_{aj}) for the vehicle to decelerate from speed

$$v_2 = v_j + \Delta v \text{ km/h to } v_1 = v_j - \Delta v \text{ km/h}$$

where:

Δv is equal to 5 km/h

v_j is each of the reference speed (km/h) points as indicated in the following table:

20	30	40	50	60	70	80	90	100	110	120
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5.1.1.2.4. Perform the same test in the opposite direction: ΔT_{bj}

5.1.1.2.5. These measurements shall be carried out in opposite directions until, for each reference speed v_j , a minimum of three consecutive pairs of measurements have been obtained which satisfy the statistical accuracy p_j , in per cent, as defined below.

$$p_j = \frac{t \times s_j}{\sqrt{n}} \times \frac{100}{\Delta T_j} \leq 3 \text{ per cent}$$

where:

p_j is the statistical accuracy of the measurements performed at reference speed v_j ;

n is the number of pairs of measurements;

ΔT_j is the mean coast down time at reference speed v_j in seconds, given by the equation:

$$\Delta T_j = \frac{1}{n} \sum_{i=1}^n \Delta T_{ji}$$

where ΔT_{ji} is the harmonic mean coast down time of the i^{th} pair of measurements at velocity v_j , seconds (s), given by the equation:

$$\Delta T_{ji} = \frac{2}{\left(\frac{1}{\Delta T_{aji}}\right) + \left(\frac{1}{\Delta T_{bji}}\right)}$$

where ΔT_{aji} and ΔT_{bji} are the coast down times of the i^{th} measurement at reference speed v_j , in seconds (s), in opposite directions a and b, respectively;

s_j is the standard deviation, in seconds (s), defined by:

$$s_j = \sqrt{\frac{1}{n-1} \sum_{i=1}^n (\Delta T_{ji} - \Delta T_j)^2}$$

t is a coefficient given in the following table:

Coefficient t as function of n

n	t	t/\sqrt{n}	n	t	t/\sqrt{n}
3	4.3	2.48	10	2.2	0.73
4	3.2	1.60	11	2.2	0.66
5	2.8	1.25	12	2.2	0.64
6	2.6	1.06	13	2.2	0.61
7	2.5	0.94	14	2.2	0.59
8	2.4	0.85	15	2.2	0.57
9	2.3	0.77			

5.1.1.2.6. If during a measurement in one direction any external factor or driver action occurs which influences the road load test, that measurement and the corresponding measurement in the opposite direction shall be rejected.

5.1.1.2.7. The total resistances, F_{aj} and F_{bj} , at reference speed v_j in directions a and b, are determined by the equations:

$$F_{aj} = \frac{1}{3.6} \times M \times \frac{2 \times \Delta v}{\Delta T_{aj}}$$

and

$$F_{bj} = \frac{1}{3.6} \times M \times \frac{2 \times \Delta v}{\Delta T_{bj}}$$

where:

F_{aj} is the total resistance at reference speed, j, in direction a, N;

F_{bj} is the total resistance at reference speed, j, in direction b, N;

M is the reference mass in kg;

Δv is the delta speed around v_j , taken according to 5.1.1.2.3.

ΔT_{aj} and ΔT_{bj} are the mean coast down times in directions a and b, respectively, corresponding to reference speed v_j , in seconds (s), given by the following equations:

$$\Delta T_{aj} = \frac{1}{n} \sum_{i=1}^n \Delta T_{aji}$$

$$\text{and } \Delta T_{bj} = \frac{1}{n} \sum_{i=1}^n \Delta T_{bji}$$

5.1.1.2.8. The following equation shall be used to compute the average total resistance:

$$F_j = \frac{(F_{aj} + F_{bj})}{2}$$

5.1.1.2.9. For each reference speed v_j calculate the power (P_j), kW, by the formula:

$$P_j = (F_j \times v_j)/1000$$

where:

F_j is the average resistance at reference speed, j, N;

v_j is the reference speed, j, m/s, defined in 5.1.1.2.3.

5.1.1.2.10. The complete power curve (P), kW, as a function of speed, km/h, shall be calculated with a least squares regression analysis."

Paragraph 5.1.1.2.8. (former), renumber as paragraph 5.1.1.2.11.

Paragraphs 5.1.2.2.5. to 5.1.2.2.7., amend to read:

"5.1.2.2.5. Carry out the operations specified in paragraph 5.1.1.2. of this appendix (with the exception of paragraphs 5.1.1.2.4. and ~~5.1.1.2.5.~~ of this appendix), replacing M by I in the formula set out in paragraph 5.1.1.2.7. of this appendix.

5.1.2.2.6. Adjust the brake to reproduce the corrected power (paragraph 5.1.1.2.~~118.~~ of this appendix) and to take into account the difference between the vehicle mass (M) on the track and the equivalent inertia test mass (I) to be used. This may be done by calculating the mean corrected road coast down time from V_2 to V_1 and reproducing the same time on the dynamometer by the following relationship:

$$T_{\text{corrected}} = \frac{T_{\text{measured}}}{K} \cdot \frac{I}{M}$$

K = value specified in paragraph 5.1.1.2.~~118.~~ above.

5.1.2.2.7. The power P_a to be absorbed by the dynamometer shall be determined in order to enable the same power (paragraph 5.1.1.2.~~118.~~ of this appendix) to be reproduced for the same vehicle on different days."

Paragraph 5.2.1.2.7., amend to read:

"5.2.1.2.7. The average torque C_T determined on the track shall be corrected to the reference ambient conditions as follows:

$$C_{T\text{corrected}} = K \cdot C_{T\text{measured}}$$

Where K has the value specified in paragraph 5.1.1.2.~~118.~~ of this appendix."

II. Justification

As Regulation No. 83 allows a limited slope of the test track (≤ 1.5 per cent) which is used to measure the vehicle coast down resistance to progress force, the calculation of this force on the basis of the average times (uphill and downhill of the test track) is wrong. The correct calculation shall be made by averaging the uphill and downhill resistance forces.
