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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-eighth session**

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Item 5 of the provisional agenda

UN Regulations Nos. 24 (Visible pollutants, measurement of power of C.I. engines (Diesel smoke)), 85 (Measurement of the net power), 115 (LPG and CNG retrofit systems), 133 (Recyclability of motor vehicles) and 143 (Heavy Duty Dual-Fuel Engine Retrofit Systems (HDDF-ERS))**Proposal for a new Supplement to UN Regulation No. 115 (LPG and CNG retrofit systems)****Submitted by the expert from Italy***

The text reproduced below was prepared by the expert from Italy and is based on informal document GRPE-71-03 (see report ECE/TRANS/WP.29/GRPE/71, paras. 36-37). The proposal is aimed at aligning UN Regulation No.115 to the new WLTC test cycle, defined in the UN GTR No.15. The modifications to the current text of UN Regulation No. 115 are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2018–2019 (ECE/TRANS/274, para. 123 and ECE/TRANS/2018/21 and Add.1, Cluster 3), 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.

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I. Proposal

Add new paragraphs 2.6. and 2.7. to read:

- "2.8. "NEDC" means the test cycle to verify the exhaust emissions after a cold start described in UN Regulation No. 83 up to 07 series of amendments.
- 2.9. "WLTC" means the Worldwide harmonized Light vehicles Test Cycle to verify the exhaust emissions after a cold start, as described in UN GTR No. 15."

Paragraph 6.1.2.1., amend to read:

- "6.1.2.1. One LPG retrofit system sample, as described in paragraph 2.2. of this Regulation, installed into the parent vehicle(s), as described in paragraph 2.5. of this Regulation, shall be submitted to the test procedures described in UN Regulations No. 83 and No. 101, **in UN GTR No. 15** or UN Regulation No. 49, where applicable, in the limits of the requirements of paragraphs 6.1.2.4. and 6.1.2.5. below. The vehicles and/or the engines are also submitted to a maximum power comparison test, as described in Regulation No. 85 for engines, or defined in paragraph 6.1.3. below for vehicles"

Paragraph 6.1.2.4.1.1., amend to read:

- "6.1.2.4.1.1. Measurements of tailpipe emissions shall be performed after a cold start with each fuel:
- (a) Reference petrol,
 - (b) Reference LPG A,
 - (c) Reference LPG B.

The emissions of CO, HC, and NO_x are calculated according to UN Regulation No. 83⁵ **or to UN GTR No. 15, as applicable.**"

Paragraphs 6.1.2.4.1.2.2., 6.1.2.4.1.3. and 6.1.2.4.1.4., amend to read:

- "6.1.2.4.1.2.2. Using of the table values **only for NEDC cycle**:

....

- 6.1.2.4.1.3. Exhaust emissions test in petrol mode

The test cycle (NEDC or WLTC) shall be chosen according to the initial type approval of the vehicle. The parent vehicle(s), equipped with the retrofit system, shall comply with the limit values according to the type approval of the original vehicle(s) including the deterioration factors applied during the type approval of the original vehicle(s).

- 6.1.2.4.1.4. **Specific requirements for NEDC test cycle.**

Subject to the requirements of paragraph 6.1.2.4.1.4.2. below, the tests shall be undertaken three times using reference petrol."

Former paragraph 6.1.2.4.1.4. renumber as 6.1.2.4.1.4.1.

Former paragraph 6.1.2.4.1.5. renumber as 6.1.2.4.1.4.2. and amend to read:

- "6.1.2.4.1.4.2. The number of emission tests prescribed in paragraph 6.1.2.4.1.4. may..."

Insert new paragraphs 6.1.2.4.1.5. and 6.1.2.4.1.5.1. to read:

- "6.1.2.4.1.5. **Specific provision for WLTC test cycle.**

Subject to the requirements of paragraph 6.1.2.4.1.5.1 below, the tests shall be undertaken two times using reference petrol.

6.1.2.4.1.5.1. The number of emission tests prescribed in paragraph 6.1.2.4.1.5 may be reduced to one test if the result obtained for each pollutant subject to limitation is less than or equal to 0.9 the emission limit (i.e. $V1 \leq 0.90 G$);

Where:

V1 value of the emission of one pollutant obtained from the first test of the Type I performed;

G limit value of the emissions of one pollutant (CO/HC/NO_x) according to the type approval of the vehicle(s) divided by the deterioration factors."

Paragraph 6.1.2.4.1.6., amend to read:

"6.1.2.4.1.6. Exhaust emissions test in LPG mode

The test cycle (NEDC or WLTC) shall be chosen according to the initial type approval of the vehicle. The parent vehicle, equipped with the retrofit system, shall comply with the limit values according to the type approval of the original vehicle(s) including the deterioration factors applied during the type approval of the original vehicle(s).

If the parent vehicle complies with UN Regulation No. 83, 05 series of amendments, or with Directive 98/69/EC, or with UN Regulation No. 49, 04 series of amendments, or with Directive 1999/96/EC, the vehicle shall not use petrol for more than a maximum of 90 seconds during each test.

For vehicles complying with **up to 07** series of amendments to UN Regulations No. 83, **or with the 05 or following series of amendments to UN Regulation No.49**, this period shall not exceed 60 seconds.

For vehicles approved with the WLTC cycle, this period shall be predetermined and shall not be changed by the driver."

Paragraph 6.1.2.4.1.6.2., amend to read:

"6.1.2.4.1.6.2. Use of petrol

If the parent vehicle complies with UN Regulation No. 83, 05 series of amendments, or with Directive 98/69/EC, or with UN Regulation No. 49, 04 series of amendments, or with Directive 1999/96/EC, the vehicle shall not use petrol for more than a maximum of 90 seconds during each test.

For vehicles complying with **up to 07** series of amendments to UN Regulations No. 83, **or with the 05 or following series of amendments to UN Regulation No.49**, this period shall not exceed 60 seconds.

For vehicles approved with the WLTC cycle, this period shall be predetermined and shall not be changed by the driver."

Paragraph 6.1.2.4.1.7., amend to read:

"6.1.2.4.1.7. **Specific provision for NEDC test cycle**

Subject to the requirements of paragraph 6.1.2.4.1.7.2 below, the tests shall be undertaken three times with each reference LPG.

6.1.2.4.1.7.1. Notwithstanding the requirements of paragraph 6.1.2.4.1.7. above, for each pollutant or combination of pollutants, one of the three test results may exceed, by not more than 10 per cent, the limit prescribed, provided that the arithmetical mean of the three results is below the prescribed limit. In this case the prescribed limits may be exceeded for more than one pollutant in the same test or in different tests."

Former paragraph 6.1.2.4.1.8. renumber as 6.1.2.4.1.7.2. and amend to read:

"6.1.2.4.1.7.2. The number of emission tests prescribed in paragraph 6.1.2.4.1.7. above..."

Insert new paragraphs 6.1.2.4.1.8. and 6.1.2.4.1.8.1., to read:

"6.1.2.4.1.8. Specific provision for WLTC test cycle

Subject to the requirements of paragraph 6.1.2.4.1.8.1 below, the tests shall be undertaken two times with each reference LPG.

6.1.2.4.1.8.1. The number of emission tests prescribed in paragraph 6.1.2.4.1.8. above on each LPG reference fuel may be reduced to one test if the result obtained for each pollutant or for the combined emission of two pollutants subject to limitation is less than or equal to 0.9 the emission limit (i.e. $M_1 \leq 0.90 G$);

Where:

M₁ value of the emission of one pollutant obtained from the first test of the Type I performed;

G limit value of the emissions of one pollutant (CO/HC/NO_x) or the sum of two pollutants (HC + NO_x) according to the type approval of the vehicle(s) divided by the deterioration factors."

Paragraph 6.1.2.4.3.1., amend to read:

"6.1.2.4.3.1. The emissions of CO₂ are calculated according to UN Regulation No. 101 **or to UN GTR No. 15 as applicable**, for each parent vehicle, if applicable.

The mean of CO₂ emissions shall be calculated as follows:

...."

Paragraph 6.2.2.1., amend to read:

"6.2.2.1. One CNG retrofit system sample, as described in paragraph 2.2. of this Regulation, installed into the parent vehicle(s), as described in paragraph 2.5. of this Regulation, shall be submitted to the test procedures described in UN Regulations No. 83 and No. 101, **in UN GTR No. 15** or UN Regulation No. 49, where applicable, in the limits of the requirements of paragraphs 6.2.2.4. and 6.2.2.5. below. The vehicles and/or the engines are also submitted to a maximum power comparison test, as described in UN Regulation No. 85 for engines, or defined in paragraph 6.2.3. below for vehicles."

Paragraph 6.2.2.4.1.1., amend to read:

"6.2.2.4.1.1. Measurements of tailpipe emissions shall be performed after a cold start with each fuel:

- (a) Reference petrol;
- (b) Reference G20 fuel;
- (c) Reference G25 fuel.

The emissions of CO, HC, and NO_x are calculated according to UN Regulation No. 83⁵ or to UN GTR No. 15, as applicable."

Paragraphs 6.2.2.4.1.2.2., 6.2.2.4.1.3. and 6.2.2.4.1.4., amend to read:

"6.2.2.4.1.2.2. Using of the table values **only for NEDC cycle**:

...."

"6.2.2.4.1.3. Exhaust emissions test in petrol mode

The test cycle (NEDC or WLTC) shall be chosen according to the initial type approval of the vehicle. The parent vehicle(s), equipped with the retrofit system, shall comply with the limit values according to the type approval of the original vehicle(s) including the deterioration factors applied during the type approval of the original vehicle(s).

6.2.2.4.1.4. **Specific requirements for NEDC test cycle.**

Subject to the requirements of paragraph 6.2.2.4.1.4.2 below, the tests shall be undertaken three times using reference petrol."

Former paragraph 6.2.2.4.1.4. renumber as 6.2.2.4.1.4.1.

Former paragraph 6.2.2.4.1.5. renumber as 6.2.2.4.1.4.2. and amend to read:

"6.2.2.4.1.4.2. The number of emission tests prescribed in paragraph 6.2.2.4.1.4. may..."

Insert new paragraphs 6.2.2.4.1.5. and 6.2.2.4.1.5.1. to read:

"6.2.2.4.1.5. **Specific provision for WLTC test cycle.**

Subject to the requirements of paragraph 6.2.2.4.1.5.1 below, the tests shall be undertaken two times using reference petrol.

6.2.2.4.1.5.1. **The number of emission tests prescribed in paragraph 6.2.2.4.1.5 may be reduced to one test if the result obtained for each pollutant subject to limitation is less than or equal to 0.9 the emission limit (i.e. $V1 \leq 0.90 G$);**

Where:

V1 value of the emission of one pollutant obtained from the first test of the Type I performed;

G limit value of the emissions of one pollutant (CO/HC/NO_x) according to the type approval of the vehicle(s) divided by the deterioration factors."

Paragraph 6.2.2.4.1.6., amend to read:

"6.2.2.4.1.6. Exhaust emissions test in CNG mode

The test cycle (NEDC or WLTC) shall be chosen according to the initial type approval of the vehicle. The parent vehicle, equipped with the retrofit system, shall comply with the limit values according to the type approval of the original vehicle(s) including the deterioration factors applied during the type approval of the original vehicle(s).

If the parent vehicle complies with UN Regulation No. 83, 05 series of amendments, or with Directive 98/69/EC, or with UN Regulation No. 49, 04 series of amendments, or with Directive 1999/96/EC, the vehicle shall not use petrol for more than a maximum of 90 seconds during each test.

For vehicles complying with **up to 07** series of amendments to UN Regulations No. 83, **or with the 05 or following series of amendments to UN Regulation No.49**, this period shall not exceed 60 seconds.

For vehicles approved with the WLTC cycle, this period shall be predetermined and shall not be changed by the driver."

Paragraph 6.2.2.4.1.6.2., amend to read:

"6.2.2.4.1.6.2. Use of petrol

If the parent vehicle complies with Regulation No. 83, 05 series of amendments, or with Directive 98/69/EC, or with Regulation No. 49, 04 series of amendments, or with Directive 1999/96/EC, the vehicle shall not use petrol for more than a maximum of 90 seconds during each test.

For vehicles complying with **up to 07** series of amendments to UN Regulations No. 83, **or with the 05 or following series of amendments to UN Regulation No.49**, this period shall not exceed 60 seconds.

For vehicles approved with the WLTC cycle, this period shall be predetermined and shall not be changed by the driver."

Paragraph 6.2.2.4.1.7., amend to read:

"6.2.2.4.1.7. **Specific provision for NEDC test cycle**

Subject to the requirements of paragraph 6.2.2.4.1.7.2 below, the tests shall be undertaken three times with each reference CNG.

6.2.2.4.1.7.1. Notwithstanding the requirements of paragraph 6.1.2.4.1.7. above, for each pollutant or combination of pollutants, one of the three test results may exceed, by not more than 10 per cent, the limit prescribed, provided that the arithmetical mean of the three results is below the prescribed limit. In this case the prescribed limits may be exceeded for more than one pollutant in the same test or in different tests."

Former paragraph 6.2.2.4.1.8. renumber as 6.2.2.4.1.7.2. and amend to read:

"6.2.2.4.1.7.2. The number of emission tests prescribed in paragraph 6.2.2.4.1.7. above..."

Insert new paragraphs 6.2.2.4.1.8. and 6.2.2.4.1.8.1., to read:

"6.2.2.4.1.8. **Specific provision for WLTC test cycle**

Subject to the requirements of paragraph 6.2.2.4.1.8.1 below, the tests shall be undertaken two times with each reference CNG.

6.2.2.4.1.8.1. The number of emission tests prescribed in paragraph 6.1.2.4.1.8. above on each CNG reference fuel may be reduced to one test if the result obtained for each pollutant or for the combined emission of two pollutants subject to limitation is less than or equal to 0.9 the emission limit (i.e. $M_1 \leq 0.90 G$);

Where:

M₁ value of the emission of one pollutant obtained from the first test of the Type I performed;

G limit value of the emissions of one pollutant (CO/HC/NO_x) or the sum of two pollutants (HC + NO_x) according to the type approval of the vehicle(s) divided by the deterioration factors."

Paragraph 6.2.2.4.3.1., amend to read:

"6.2.2.4.3.1. The emissions of CO₂ are calculated according to UN Regulation No. 101 **or to UN GTR No. 15 as applicable**, for each parent vehicle, if applicable.

The mean of CO₂ emissions shall be calculated as follows:

...."

Annex 2A

Paragraph 2., amend to read:

"2. Calculation of the LPG energy ratio

....

FC_{norm}: the fuel consumption (l/100 km) calculated in accordance with paragraph 1.4.3. (b) of Annex 6 to UN Regulation No. 101 **or with paragraph 6 of Annex 7 to UN GTR No. 15, as applicable**. If applicable, the correction factor cf in the equation used to determine FC_{norm} shall be calculated using the H/C ratio of the gaseous fuel;

...."

Annex 2B

Paragraph 2., amend to read:

"2. Calculation of the CNG energy ratio

....

FC_{norm}: the fuel consumption (m³/100 km) calculated in accordance with paragraph 1.4.3. (c) of Annex 6 to UN Regulation No. 101 **or with paragraph 6 of Annex 7 to UN GTR No. 15, as applicable**;

...."

II. Justification

1. This proposal amends UN Regulation No. 115 introducing the provisions regarding the type approvals of retrofit systems for vehicles originally tested with WLTC according to **UN GTR No. 15**.

2. In the text above the provisions for both LPG retrofit systems and for CNG retrofit systems are reported.

3. To improve the readability of the text, this proposal introduces the definitions of NEDC and WLTC test cycles (see paras. 2.8 and 2.9). The provisions of Regulation 115 before the present amendment refer to vehicles approved according to NEDC test cycle, while the new provisions included in this amendment refer to vehicles approved according to WLTC test cycle.

4. The main concept, discussed in the seventy-sixth and in the seventy-seventh sessions of GRPE, is that the modified vehicle should fulfil all the provisions of the Regulation for which the type approval has initially been granted. Therefore this amendment simply duplicates the paragraphs related to type I test, including both NEDC and WLTC provisions. The test cycle (NEDC or WLTC) shall be chosen according to the initial type approval of the vehicle.

5. This amendment refer to WLTC test procedure, as defined in **UN GTR No. 15** with minimum adaptations due to the context of retrofit systems. The text of amendment therefore introduces the references to the above mentioned Regulations, as applicable.
 6. No changes are made to test procedure for NEDC vehicles.
 7. The only adaptation in the WLTC test procedure regards the number of repetitions. One single test is required if, for each pollutant, the measured value is below 90% of the applicable limit. Two test are required in all other cases. This because LPG and CNG fuel CO₂ figures are smaller than petrol CO₂ from 8% to 20%, making the dCO₂ coefficient specified in **UN GTR No. 15** inappropriate, because always satisfied.
 8. The ATCT and the RDE procedures included in EU Regulation 2017/1151 and following amendments, are not currently applicable to UNECE Regulations.
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