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**1958 Agreement – Consideration of draft amendments
to existing Regulations submitted by GRPE**

Proposal for Supplement 5 to Regulation No. 115 (LPG and CNG retrofit systems)

Submitted by the Working Party on Pollution and Energy*

The text reproduced below was adopted by the Working Party on Pollution and Energy (GRPE) at its sixty-fourth session (ECE/TRANS/WP.29/GRPE/64, para. 64). It is based on ECE/TRANS/WP.29/GRPE/2012/7/Rev.1, as amended by informal document GRPE-64-21. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee AC.1 for consideration.

* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and 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.

Paragraphs 2.1.3. and 2.1.4., amend to read:

"2.1.3. "A vehicle is considered mono-fuel", when, after the retrofit operation, it is designed primarily for permanent running on LPG or CNG, but may still have a petrol system for emergency purposes, where the capacity of the petrol tank does not exceed 15 litres.

2.1.4. "A vehicle is considered bi-fuel", when after the retrofit operation, it is equipped with a gas storage and a separate petrol storage with a capacity exceeding 15 litres, and is designed to run on only one fuel at a time. The simultaneous use of both fuels is limited in amount or duration."

Paragraph 6.1.2.2., amend to read:

"6.1.2.2. Fuel requirements by the engine: the type of fuel normally used by the engine could be:

- (a) LPG only (LPG model) in case of mono-fuel⁴;
- (b) Either unleaded petrol (petrol mode) or LPG (LPG mode) in case of bi-fuel;
- (c) Both diesel fuel or diesel fuel and LPG (dual fuel).

(Provisions for dual fuel have still to be defined)."

Paragraph 6.1.2.4.1.3., add a title to read:

"6.1.2.4.1.3. Exhaust emissions test in petrol mode

Subject to the requirements of paragraph 6.1.2.4.1.5., the tests shall be repeated three times using reference petrol. 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)."

Paragraph 6.1.2.4.1.6., add a title to read:

"6.1.2.4.1.6. Exhaust emissions test in LPG mode

Subject to the requirements of paragraph 6.1.2.4.1.8., the tests shall be repeated three times with each reference LPG. 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).

..."

Insert new paragraphs 6.1.2.4.1.6.1. to 6.1.2.4.1.6.3., to read:

"6.1.2.4.1.6.1. Engine starting-up

It is permissible that the engine is started on petrol and switched to LPG after a predetermined period of time which cannot be changed by the driver.

6.1.2.4.1.6.2. 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 later series of amendments to Regulations Nos. 83 and 49, or later amending Directives or European Regulations, this period shall not exceed 60 seconds.

6.1.2.4.1.6.3. Special provisions for petrol direct injection engines

Notwithstanding the paragraph 6.1.2.4.1.6.2, in case of vehicles with petrol direct injection engines, it is permissible to use petrol only or simultaneously with LPG during the entire test cycle provided that the energy consumption of gas is higher than 80 per cent of the total amount of energy consumed during the test.

This percentage shall be calculated in accordance with the method set out in Annex 6A."

Paragraph 6.2.2.2., amend to read:

"6.2.2.2. Fuel requirements by the engine, the type of fuels normally used by the engine:

- (a) CNG only (CNG mode) in case of mono-fuel⁴;
- (b) Either unleaded petrol (petrol mode) or CNG (CNG mode) in case of bi-fuel;
- (c) Both diesel fuel or diesel fuel and CNG (dual fuel).

(Provisions for dual fuel have still to be defined)."

Paragraph 6.2.2.4.1.3., add a title to read:

"6.2.2.4.1.3. Exhaust emissions test in petrol mode

Subject to the requirements of paragraph 6.2.2.4.1.5. the tests shall be repeated three times using reference petrol. 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)."

Paragraph 6.2.2.4.1.6., add a title to read:

"6.2.2.4.1.6 Exhaust emissions test in CNG mode

Subject to the requirements of paragraph 6.2.2.4.1.8., the tests shall be repeated three times with each reference CNG. 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)."

Insert new paragraphs 6.2.2.4.1.6.1. to 6.2.2.4.1.6.3., to read:

"6.2.2.4.1.6.1. Engine starting-up

It is permissible that the engine is started on petrol and switched to CNG after a predetermined period of time which cannot be changed by the driver.

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 later series of amendments to Regulations Nos. 83 and 49, or later amending Directives or European Regulations, this period shall not exceed 60 seconds.

6.2.2.4.1.6.3. Special provisions for petrol direct injection engines

Notwithstanding the paragraph 6.2.2.4.1.6.2, in case of vehicles with direct injection petrol engines, it is permissible to use petrol only or simultaneously with CNG during the entire test cycle provided that the energy consumption of gas is higher than 80 per cent of the total amount of energy consumed during the test.

This percentage shall be calculated in accordance with the method set out in Annex 6B."

Insert a new Annex 6A, to read:

"Annex 6A

Bi-fuel vehicles with petrol direct injection engines - Calculation of LPG energy ratio

1. Measurement of the LPG mass consumed during the cycle

Measurement of the LPG mass consumed during the Type I test cycle shall be done by a fuel weighing system capable of measuring the weight of the LPG storage container during the test in accordance with the following:

an accuracy of ± 2 per cent of the difference between the readings at the beginning and at the end of the test or better.

Precautions shall be taken to avoid measurement errors.

Such precautions shall, at least, include the careful installation of the device according to the instrument manufacturers' recommendations and to good engineering practice.

Other measurement methods are permitted if an equivalent accuracy can be demonstrated.

2. Calculation of the LPG energy ratio

The fuel consumption value shall be calculated from the emissions of hydrocarbons, carbon monoxide, and carbon dioxide determined from the measurement results assuming that only LPG is burned during the test.

The LPG ratio of the energy consumed in the cycle is then determined as follows:

$$G_{LPG} = M_{LPG} * 10,000 / (FC_{mean} * dist * d)$$

Where:

G_{LPG} : the LPG energy ratio (%);

M_{LPG} : the LPG mass consumed during the cycle (kg);

FC_{mean} : the mean fuel consumption (l/100 km) calculated in accordance with paragraph 6.1.2.4.3.2.;

dist: distance travelled during the cycle (km);

d: density $d=0.538\text{kg/liter}$."

Insert a new Annex 6B, to read:

"Annex 6B

Bi-fuel vehicles with petrol direct injection engines - Calculation of CNG energy ratio

1. Measurement of the CNG mass consumed during the cycle

Measurement of the CNG mass consumed during the Type I test cycle shall be done by a fuel weighing system capable of measuring the weight of the CNG storage container during the test in accordance with the following:

an accuracy of ± 2 per cent of the difference between the readings at the beginning and at the end of the test or better.

Precautions shall be taken to avoid measurement errors.

Such precautions shall, at least, include the careful installation of the device according to the instrument manufacturers' recommendations and to good engineering practice.

Other measurement methods are permitted if an equivalent accuracy can be demonstrated.

2. Calculation of the CNG energy ratio

The fuel consumption value shall be calculated from the emissions of hydrocarbons, carbon monoxide, and carbon dioxide determined from the measurement results assuming that only CNG is burned during the test.

The CNG ratio of the energy consumed in the cycle is then determined as follows:

$$G_{\text{CNG}} = M_{\text{CNG}} * cf * 10,000 / (FC_{\text{mean}} * \text{dist} * d)$$

Where:

G_{CNG} : the CNG energy ratio (%);

M_{CNG} : the CNG mass consumed during the cycle (kg);

FC_{mean} : the mean fuel consumption ($\text{m}^3/100 \text{ km}$) calculated in accordance with paragraph. 6.2.2.4.3.2.;

dist: distance travelled during the cycle (km);

d: density $d=0.654\text{kg/m}^3$;

cf: correction factor, assuming the following values:

cf = 1 in case of G20 reference fuel;

cf = 0.78 in case of G25 reference fuel."