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PROPOSAL FOR DRAFT AMENDMENTS TO REGULATION No. 115

(Specific LPG and CNG retrofit systems)

Transmitted by the expert from the European Natural gas Vehicles Association (ENGVA)

Note: The document reproduced below has been prepared by the expert from ENGVA. It is based on TRANS/WP.29/GRPE/2005/7 (prepared by expert from AEGPL) regarding LPG applications and refers to amendments to be made to paragraphs dealing with specific provisions of CNG retrofit systems. This document refers to the amendments needed to be introduced in the existing text of the Regulation No. 115 to make its implementation applicable to the characteristics of the existing vehicles. This document is proposing amendments to be made to paragraphs dealing with specific provisions of CNG retrofit (see paragraph 6.2) in connection with amendment prepared by experts from AEGPL on the LPG applications.

The proposed modifications to the provisions of TRANS/WP.29/GRPE/2005/7 or to the current text of the Regulation (see amendments to paragraph 6.2.) are marked in **bold** characters.

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Note: This document is distributed to the Experts on Pollution and Energy only.

Paragraph 2.1.4., amend to read:

"2.1.4. operate on both petrol and LPG **or CNG**, with a petrol tank "

Paragraph 2.1.5., amend to read:

"2.1.5. a retrofit system in which the LPG **or CNG** fuelling system does not change
....."

Paragraph 2.1.6., amend to read:

"2.1.6. a retrofit system in which the LPG ECU **or CNG ECU** is able to translate the petrol ECU control strategy in LPG **or CNG** operation."

Paragraph 2.2.5., amend to read:

"2.2.5. the fuel container type (i.e. **LPG** liquid take off / vapour pressure, **LPG** vapour take off, **LPG** liquid take off / pressurized by pump, **pressurized CNG take off**), the safety device ... "

Paragraph 5.2., amend to read:

"5.2. with paragraph 6.1.2.2. **or 6.2.2.2.** of this Regulation."

Paragraph 5.3., amend to read:

"5.3. with paragraph 6.1.4.4.2.1. **or 6.2.4.4.2.1** of this Regulation."

Paragraph 6.2.1.1., amend to read:

"6.2.1.1. A CNG retrofit system shall **consist** at least **of** the following components:"

Paragraph 6.2.1.1.3., amend to read:

"6.2.1.1.3. End-user ~~service~~ manual."

Paragraph 6.2.2. amend to read:

"6.2.2. Pollutants emissions and CO₂ emissions (for category M₁ vehicles only)"

Paragraph 6.2.2.1. amend to read:

6.2.2.1. and No. 101 or No. 49 5/, where applicable, **in the limits of the requirements of paragraphs 6.2.2.5. and 6.2.2.6.**

.....

Insert a new paragraph 6.2.2.2., to read:

"6.2.2.2. In order to prove that the retrofit system is "non intrusive", as defined in paragraph 2.1.5., the system manufacturer shall provide data and/or engineering evaluations which adequately demonstrate that the original air and petrol feed process to the engine is not affected by the installation of the retrofit system."

Paragraph 6.2.2.2. (former), renumber as paragraph 6.2.2.3. and amend to read:

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

- (a) CNG only
- (b) both unleaded petrol or CNG
- (c) both diesel fuel or diesel fuel and CNG "**

Paragraph 6.2.2.3. (former), renumber as paragraph 6.2.2.4. and amend to read:

"6.2.2.4. "Gaseous pollutants" means:

.....

- (iii) oxides of nitrogen, the latter being expressed in nitrogen dioxide (NO₂) equivalent;
- (iv) particulates, etc. "**

Paragraph 6.2.4. (former), renumber as paragraph 6.2.2.5.

Insert new paragraphs 6.2.2.5.1. to 6.2.2.5.3.5., to read:

"6.2.2.5.1. Specific requirements on the Type I test (verifying the average exhaust emissions after a cold start) as defined in Regulation No. 83, 05 series of amendments (for vehicles having the maximum mass not exceeding 3,500 kg):

6.2.2.5.1.1. Three measurements of tailpipe emissions shall be performed after a cold start with each fuel:

- (i) reference petrol,
- (ii) reference G20 fuel,
- (iii) reference G25 fuel.

The emissions of CO, HC, NO_x and HC + NO_x are calculated according Regulation No. 83. 4/.

6.2.2.5.1.2. The test vehicle(s) equipped with the retrofit system, and with the reference petrol shall comply with the limit values according to the type approval of the

vehicle(s) including the deterioration factors applied during the type approval of the vehicle(s).

This condition is deemed to be met if the emissions values for each pollutant or combination of pollutants obtained in each test with reference petrol are less than the limits.

However, one of the three test values obtained may exceed, by not more than 10 per cent, the limit prescribed, provided that the arithmetical mean of the three values is below this limit.

Where the prescribed limits are exceeded for more than one pollutant or combination of pollutants, it is immaterial whether this occurs in the same test or different tests.

6.2.2.5.1.3. The requirements regarding emissions of the vehicle(s) equipped with the retrofit system, and with the two reference gases, shall be deemed to be fulfilled if the results meet the following conditions for each regulated pollutant (CO, HC + NO_x) or (CO, HC, NO_x) according to the requirements the petrol parent vehicle had to comply with at the date of its approval:

- (1) $(MA + MB)/2 < 0.85S + 0.4G$**
- (2) $MA \text{ and } MB < G$**

where:

MA: mean value of the emissions of one pollutant (CO/HC/NO_x) $\frac{4}{4}$ or the sum of two pollutants (HC + NO_x) obtained from the three Type I tests with the retrofit system and with LPG A,

MB: mean value of the emissions of one pollutant (CO/HC/NO_x) $\frac{4}{4}$ or the sum of two pollutants (HC + NO_x) obtained from the three Type I tests with the retrofit system and with LPG B,

S: mean value of the emissions of one pollutant (CO/HC/NO_x) $\frac{4}{4}$ or the sum of two pollutants (HC + NO_x) obtained from the three Type I tests with the reference petrol,

G: limit value of the emissions of one pollutant (CO/HC/NO_x) $\frac{4}{4}$ or the sum of two pollutants (HC + NO_x) according to the type approval of the vehicle(s) divided by the deterioration factors.

6.2.2.5.1.4. Notwithstanding the provisions of paragraphs 6.2.2.5.1.1. to 6.2.2.5.1.3., for non intrusive retrofit system as defined in paragraph 2.1.5., the Type I test shall be carried out only with CNG.

6.2.2.5.1.4.1. Subject to the requirements of paragraph 6.2.2.5.1.4.2. the tests shall be repeated three times.

The test vehicle(s) with each reference CNG shall comply with the limits values according to the type approval of the vehicle(s) including the deterioration factors applied during the type approval of the vehicle(s).

6.2.2.5.1.4.2. The number of emission tests to be performed on one CNG reference fuel can be reduced in the conditions hereinafter defined:

- only one test is performed if the result obtained for each pollutant or for the combined emission of two pollutants subject to limitation is less than or equal to 0.7 the emission limit (i.e. $M1 \leq 0.70 G$);
- only two tests are performed if, for each pollutant or for the combined emission of two pollutants subject to limitation the following requirements are met:

$$M1 \leq 0.85 G \text{ and } M1 + M2 \leq 1.70 G \text{ and } M2 \leq G$$

where:

- M1:** value of the emission of one pollutant obtained from the first test of the Type I performed;
- M2:** value of the emission of one pollutant obtained from the second 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.

6.2.2.5.1.5. Notwithstanding the provisions of paragraph 6.2.2.5.1.1., at the request of the system manufacturer, the Type I test on the CNG mode can be performed on only one CNG reference fuel, the choice of which is left at the discretion of the technical service responsible for the test.

6.2.2.5.1.5.1. The requirements regarding emissions of the vehicle equipped with the retrofit system as described in paragraph 6.2.2.5.1.3. will be deemed to be met if:

- (a) $M < G$
- (b) $M < 0.85 S + 0.4 G$

where M is the mean value of the emissions of one pollutant (CO/HC/NO_x) or the sum of two pollutants (HC + NO_x) obtained from the three type I tests with the CNG reference fuel chosen for the tests.

6.2.2.5.1.5.2. In the case of non intrusive retrofit system, the requirements of paragraph 6.2.2.5.1.4. shall be calculated with the value of the emission of one pollutant (CO/HC/NO_x) or the sum of two pollutants (HC + NO_x) obtained from the Type I test with the CNG reference fuel chosen for the tests.

- 6.2.2.5.2. Specific requirements on the Type II test (carbon monoxide emission test at idling speed) for vehicles having a maximum mass exceeding 3,500 kg:**
- 6.2.2.5.2.1. One CNG retrofit system sample, as described in paragraph 2. of this Regulation, installed into the parent vehicle, as described in paragraph 2. of this Regulation, shall be submitted to the type II test procedures described in Regulation No. 83.**
- 6.2.2.5.2.2. Notwithstanding the provisions of Annex 5 of Regulation No. 83, 05 series of amendments, the Type II test shall be performed at the request of the system manufacturer with only one CNG reference fuel chosen at the discretion of the type-approval technical service responsible for the test.**
- 6.2.2.5.3. Calculation of the CO₂ emissions and fuel consumption (for M1 and N1 category of vehicles)**
- 6.2.2.5.3.1. The emissions of CO₂ are calculated according to Regulation No. 101 for each parent vehicle, if applicable.**

The mean of CO₂ emissions shall be calculated as follows:

$$CO_{2CNG} = 1/n \sum_{i=1}^n (CO_{2G20i} + CO_{2G25i}) / 2$$

$$CO_{2petrol} = 1/n \sum_{i=1}^n CO_{2petrol.i}$$

where:

- i:** number of parent vehicles (i = 1 to n)
- CO_{2G20}:** mean value of the emissions of CO₂ obtained from the three Type I tests with the retrofit system and with CNG G20 for vehicle No. i,
- CO_{2G25}:** mean value of the emissions of CO₂ obtained from the three Type I tests with the retrofit system and with CNG G25 for vehicle No. i;
- CO_{2petrol.i}:** mean value of the emissions of CO₂ obtained from the three Type I tests with reference petrol for vehicle No. i.

- 6.2.2.5.3.2. The mean fuel consumption shall be calculated in the same way as for the mean of CO₂ emissions, as defined in paragraph 6.2.2.5.3.1.**
- 6.2.2.5.3.3. The ratios of CO₂ emissions and fuel consumption shall be calculated as follows:**

$$K_{CO_2} = CO_{2CNG} / CO_{2petrol}$$

$$K_{Cons} = Cons_{CNG} / Cons_{petrol}$$

for each vehicle of the family, the official values of CO₂ emissions and fuel consumption are multiplied by the above ratios.

- 6.2.2.5.3.4. Notwithstanding the provisions of paragraph 6.2.2.5.3.1. above, when the vehicle(s) equipped with the retrofit system is (are) tested with only one of the two reference gases, according to the provisions of paragraph 6.2.2.5.1.5., the mean of CO₂ emissions shall be calculated as follows:

$$CO_{2CNG} = 1 / n \sum^n CO_{2CNI}$$

where:

- i:** number of parent vehicles (i = 1 to n)
CO_{2CNGi}: mean value of the emissions of CO₂ obtained from the Type I test(s) with the retrofit system and with CNG for vehicle No. i.

- 6.2.2.5.3.5. Notwithstanding the provisions of paragraph 6.2.2.5.3.1., for non intrusive system, as defined in paragraph 2.1.5. of this Regulation, the value of the petrol CO₂ emission may be the official CO₂ emission value of the vehicle(s) No. i. "

Paragraph 6.2.2.5. (former), renumber as paragraph 6.2.2.6.

Paragraph 6.2.3.1., amend to read:

- "6.2.3.1. to the test procedures of paragraph 6.2.3.2. or 6.2.3.3. **The measured power with CNG shall be lower than that measured with petrol + 5 per cent.**"

Paragraph 6.2.3.2., amend to read:

- "6.2.3.2. Chassis dynamometer method:

The maximum power at the wheels is measured on a chassis dynamometer on each parent vehicle with the following fuels:

- (i) reference petrol,
- (ii) reference fuel G20 or G25,

The mean of power measurements shall be calculated as follows:

....."

Insert a new paragraph 6.2.3.4., to read:

- "6.2.3.4. Notwithstanding the provisions of paragraph 6.2.3.1., with regard to the way to calculate the mean of maximum power on petrol in paragraphs 6.2.3.2. and 6.2.3.3., for non intrusive system, as defined in paragraph 2.1.5. of this

Regulation, the value of maximum power on petrol of the vehicle(s) No. i may be the official value."

Insert new paragraphs 6.2.4. to 6.2.4.4.2.4., to read:

"6.2.4. OBD requirements and tests for vehicles retrofitted with CNG retrofit system.

6.2.4.1. For the purposes of this paragraph, the following definitions apply:

6.2.4.1.1. "original emission-related component" means any component in the air inlet, exhaust or evaporative system which supplies an input to or receives an output from the petrol controller;

6.2.4.1.2. "CNG emission-related component" means any component in the air inlet exhaust or evaporative system which supplies an input to or receives an output from the CNG controller.

6.2.4.2. In the case that there is a need, to fit properly the CNG retrofit system in the vehicle, it is allowed to simulate the right operation of the original emission-related components which are not in use on CNG mode.

6.2.4.3. The CNG retrofit system, as described in paragraph 2. of this Regulation, installed into the parent vehicle(s), shall comply with the requirements and tests of Annex 11 of Regulation No. 83, 05 series of amendments on both petrol and CNG modes.

6.2.4.4. Specific OBD requirements and tests for "master-slave" retrofit system:

6.2.4.4.1. Notwithstanding the requirements of paragraph 6.2.4.3., a "Master-slave" retrofit system shall fulfil the following requirements:

- a) the petrol ECU shall remain activated for engine management in both petrol and CNG modes**
- b) during petrol operations the petrol OBD system shall remain the only on-board diagnostic system of the vehicle**
- c) during CNG operations the petrol OBD system shall continue to monitor the original emission related components with the exception of those which are not in use**
- d) during CNG operations the CNG ECU shall only monitor for the CNG emission-related components as well as their electrical connections;**

6.2.4.4.2. Notwithstanding the requirements of paragraph 6.2.4.3., the CNG retrofit system shall be submitted to the following tests, which, in the case of Type I

tests, shall be performed according to Annex 11, Appendix 1, of Regulation No. 83, 05 series of amendments.

6.2.4.4.2.1. The following tests shall be carried out on one parent vehicle, equipped with the CNG retrofit system:

- the CNG ECU shall follow the petrol ECU on fuel strategies (e.g. injection and ignition strategies (e.g. spark plug advance)). This can be demonstrated by a monitoring (diagnostic) program, while modifying the signal of one of the petrol system's sensors with an impact on the injection time and on ignition spark plug advance
- during a Type I test on petrol the original MI shall activate due to the electrical disconnection of any original emission-related component.
- during a Type I test on CNG the original MI shall activate due to the electrical disconnection of any original emission-related component, which is in use during CNG operations.

6.2.4.4.2.2. The following tests shall be carried out on the parent vehicle(s), equipped with the CNG retrofit system, only on CNG operating mode:

- a) during a Type I test, electrical disconnection of one CNG emission-related component;
- b) during a Type I, test replacement of one CNG emission-related component with a deteriorated and defective one or electronic simulation of such a failure.

The original MI or automatic switch from CNG mode to petrol mode shall activate before the end of the tests under any of the conditions above.

6.2.4.4.2.3. Fault codes due to malfunctions of the CNG emission-related components and their electrical connections shall be stored in the CNG ECU.

6.2.4.4.2.4. The system manufacturer shall provide specific instructions as to read out the CNG fault codes referred to in paragraph 6.2.4.4.2.3."

Annex 1B

Item 11.1., amend to read:

"11.1. Emission requirements:
Has the retrofit system demonstrated to be "non intrusive": yes/no 2/
Regulation No. 83, series of amendments 3/
Regulation No. 49, series of amendments 3/"

Insert a new item 11.2., to read:

**"11.2. OBD requirements:
Has the retrofit system demonstrated to be "master-slave": yes/no 2/ "**

Annex 1B, Addendum

Item 1., amend to read:

"1. Vehicles on which the retrofit equipment has been tested:

Vehicle No.	1	2	n
Make:			
Type:			
Category:			
Emission limits:			
Power:			
Pollution control system type:			

Item 3., amend to read:

"3. Vehicle type(s) for which the retrofit equipment type is qualified:

Fuel		Petrol (or diesel) <u>1/</u>					CNG				
Vehicle type	Engine type	Power (kW)	CO (g/km)	HC (g/km)	NOx (g/km)	CO ₂ <u>2/</u> (g/km)	Power (kW)	CO (g/km)	HC (g/km)	NOx (g/km)	CO ₂ <u>2/</u> (g/km)

1/ strike out what does not apply.

2/ Applicable to category M₁ vehicle only."

Annex 2B, the example of the plate, delete "Date:" from the figure.

Annex 3B

Insert new items 2.4. and 2.5., to read:

"2.4. "Non intrusive" system: yes/no 1/

2.5. "Master-slave" system: yes/no 1/"

Items 2.4. to 2.19.1. (former), renumber as 2.6. to 2.21.1.
