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PROPOSAL FOR DRAFT AMENDEMENTS TO REGULATION No. 115
(specific LPG and CNG retrofit systems)

Transmitted by the expert from the European Liquefied Petroleum Gas Association (AEGPL)

Note: This document reproduced below has been prepared by the expert from AEGPL and is based on informal document No. GRPE-47-6, distributed during the forty-seventh GRPE session in January 2004. In comparison with the text of informal document No. GRPE-47-6, this document only 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. In addition and with the view of speeding up the process of adoption of these amendments, it shall be emphasized that the remarks and/or clarifications suggested and/or requested by some national authorities during the consultation period have already been taken into account when drafting this new document. Nevertheless, there are still some pending issues for which discussions are still in progress between the LPG industry and the authorities' representatives and which might need to be debated during the next GRPE meeting and eventually voted at a later stage in the GRPE. This is, in particular, the case for the introduction of the possibility to allow, under specific conditions, the retrofit system manufacturer to perform un-witness emissions tests in its own laboratory under the responsibility of the type-approval authority (see the requirements of the paragraphs 2.7.1.3., 2.7.1.5., 3.2.2.1., 3.2.2.2. and annex 6 highlighted in grey colour). The amendments to the existing text are marked in **bold** characters.

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

A. PROPOSAL

Paragraphs 1.4. and 1.5., amend to read:

- "1.4. This Regulation applies to retrofit systems intended to be fitted on vehicles of categories M and N **with the exception of:**
- a) **vehicles type-approved pursuant to Regulation No. 83, approval A and C,**
 - b) **vehicles type-approved pursuant to Regulation No. 83, other than M1 and N1 categories,**
 - c) **vehicles type-approved pursuant to Regulation No. 83, series of amendments 01 or 02 or 03 or 04 series,**
 - d) **vehicles type-approved pursuant to Regulation No. 49, series of amendments 01 or 02 or 03 series.**

The requirements for the different categories (M₁, N₁ or others) are defined in paragraphs 2. to 7.

The modified vehicle shall remain conform to all the provisions of the Regulation for which the type approval has been initially granted.

Note: Regarding safety requirements, it is recommended that the minimum requirements of Regulation No. 67, 01 series of amendments shall apply to all retrofitted vehicles."

Paragraph 1.5., should be deleted (including the footnotes 1/ and 2/).

Paragraphs 2.1.1. and 2.1.2., correct the reference to "instructions manual" to read "installation manual".

Paragraph 2.1.3., amend to read:

- "2.1.3. "A vehicle is considered mono-fuel", when, **after the retrofit operation**, it is equipped with a petrol tank of capacity ≤ 15 litres, that can only be used to "limp-home".

Insert new paragraphs 2.1.4. and 2.1.5., to read (definition of bi-fuel and dual-fuel vehicles):

- "2.1.4. **"A vehicle is considered bi-fuel"**, when after the retrofit, it is equipped to operate on both petrol and LPG, with a petrol tank capacity exceeding 15 litres.

- 2.1.5. **"A vehicle is considered dual-fuel"**, when after the retrofit, it is equipped to operate with mixture of either petrol/LPG or diesel/LPG."

At the bottom of the page, in the note, amend the reference to "paragraphs 2.2.5., 2.2.6., 2.2.7. and 2.2.8.," to read "paragraphs 2.2.4., 2.2.5. and 2.2.6.,".

Paragraph 2.2.3., amend to read (deletion of the points "... " at the end of the sentence):

"2.2.3. gas fuelling system or multi-point injection **system**);"

Paragraph 2.2.4., amend to read:

"2.2.4. sensors and actuators set ~~types from the same manufacturer~~ **(any type meeting the requirements of the Regulation No. 67 or the Regulation No. 110, where applicable, and listed in annex 3A or 3B to this Regulation)**);"

Paragraph 2.2.5., amend to read:

"2.2.5. **the fuel container type (i.e. liquid take off/ vapour pressure, vapour take off, liquid take off/ pressurised by pump), the safety devices type by the same manufacturer and fuel container accessories**, as required by Regulation No. 67, 01 series of amendments, or Regulation No. 110, where applicable (i.e. relief valve);"

Paragraphs 2.2.6. and 2.2.7., should be deleted.

Paragraphs 2.2.8. and 2.2.9., renumber as paragraphs 2.2.6. and 2.2.7.

Paragraph 2.2.10., renumber as paragraph 2.2.8. and amend to read:

"2.2.8. basic software principles and ~~system~~ **control strategy (i.e. stand alone, master-slave)**);"

Paragraph 2.2.11., renumber as paragraph 2.2.9.

Paragraph 2.2.12., renumber as paragraph 2.2.10. and amend to read:

"2.2.10. end-user manual (see para.7)."

Insert new paragraphs 2.3. and 2.4., to read:

"2.3. **"Master-slave system" means a retrofit system in which the LPG/CNG ECU is able to translate the petrol ECU control strategy in LPG/CNG operation.**

2.3.1. A "master-slave" retrofit system shall fulfil the following requirements:

- a) **the petrol ECU shall remain activated for engine management in both petrol and LPG/CNG modes.**
- b) **the petrol OBD system shall remain the only on-board diagnostic system of the vehicle during petrol operations.**

- c) **the petrol OBD system shall remain the only on-board diagnostic system of the vehicle during LPG/CNG operations, excluding the detection of the LPG/CNG emissions related components malfunctions, and shall continue to monitor the original emission related components with the exception of those petrol fuel supply components that are not in use when the engine is operated on LPG/CNG.**

2.3.1.1. The requirements above shall be demonstrated on a vehicle according to the following tests:

- **For requirement a) as shown above: the LPG ECU shall follow the petrol ECU on fuel strategies (e.g. injection). This can be demonstrated by a monitoring (diagnostic) program.**
- **For requirement b) during a Type I test on petrol as described in the Regulation No. 83, 05 series of amendments, the original MI shall activate due to the electrical disconnection of any petrol emission related component.**
- **For requirement c) during a Type I test on LPG/CNG as described in the Regulation No. 83, 05 series of amendments, the original MI shall activate due to the electrical disconnection of any petrol emission related component, which is in use during LPG/CNG operations.**

2.3.2. Information proving the "master-slave" characteristic of the retrofit system shall be communicated according to the communication form required in the annex 7.

2.4. "Non intrusive system" means a retrofit system in which the LPG/CNG fuelling system does not change the original air and petrol feed to the engine.

2.4.1. Information proving the "non intrusive" characteristic of the retrofit system shall be communicated according to the communication form required in the annex 8."

Paragraph 2.3. (former), renumber as paragraph 2.5. and amend to read:

"2.5. "**System manufacturer**" means an organization which can assume technical responsibility for the manufacturing of LPG and CNG retrofit systems and can demonstrate that it possesses the features required and the necessary means to achieve quality assessment and conformity of production **of the retrofit system.**"

Insert a new paragraph 2.6., to read:

"2.6. "**Installer**" means an organization, authorized by the system manufacturer, which can assume technical responsibility for the correct and safe installation of the approved LPG/CNG retrofit system including the conformity with respectively paragraphs 6.1.1.3. and 6.2.1.3. of this Regulation.

2.6.1. The installer shall:

- **be authorized by the system manufacturer or his duly accredited representative to install the retrofit system in a vehicle in which it can be installed according to the type approval communication.**
- **have personnel who have a valid training certificate issued by the system manufacturer or its duly accredited representative;"**

Paragraphs 2.4. to 2.4.1.(former), renumber as paragraphs 2.7. to 2.7.1.

Paragraphs 2.4.1.1. (former), renumber as paragraph 2.7.1.1. and amend to read:

- "2.7.1.1. a) It is produced by the same vehicle manufacturer.
 b) It is classified in the same category M₁ or M₂ or M₃ or N₁ or N₂ or N₃. Vehicles of category **M₁ and N₁ class I** may belong to the same family of category M₁ (~~parent vehicle~~)."
 c) It is subject to the same emission limits **or those specified in earlier series of amendments of the applicable Regulation.**"
 d) If the gas fuelling system has a central metering for the whole engine: it has **an approved** power output between 0.7 and 1.15 times that of the engine of the parent vehicle. If the gas fuelling system has an individual metering per cylinder: it has **an approved** power output per cylinder between 0.7 and 1.15 times that of the engine of the parent vehicle.
 e) Fuel feed and combustion process (injection: direct or indirect, single-point or multi-point).
 f) It has the same pollution control system:
 - same type of catalyst if fitted (three-way, oxidation, de NO_x).
 - ~~air injection (with or without)~~
 - ~~exhaust gas recirculation (EGR) (with or without)~~**If the tested vehicle was not equipped with air injection or EGR, engines with these devices are allowed."**

Paragraph 2.4.1.2. (former), should be deleted.

Paragraph 2.4.1.3. (former), renumber as paragraph 2.7.1.2. and amend the wording "certified power output" to read "an approved power output" (2 times).

Insert new paragraphs 2.7.1.3. to 2.7.1.5., to read:

"2.7.1.3. Upon request of the LPG or CNG system manufacturer, in the case the type approval of a retrofit system is requested for a parent vehicle(s) having the characteristics (b) to (f) in common with the parent vehicle(s) of a different family, for which the same retrofit system has been already approved, emission tests may

be carried out directly by the LPG or CNG system manufacturer provided that the requirements shown in the annex 6 of this Regulation are met.

2.7.1.4. With regard to the paragraph 2.7.1.1.a), the vehicle family shall also cover the vehicle for which it can be demonstrated (e.g. by type approval documentation) that it is produced by collaborating vehicle manufacturer(s) having installed the same or very similar engine.

2.7.1.5. Upon request of the LPG or CNG system manufacturer, in the case the type approval of a retrofit "master-slave" system, as defined in the paragraph 2.3. of this Regulation, is requested for a parent vehicle(s) having the characteristics (b) to (f) in common with the parent vehicle(s) of a different family, for which the same retrofit system has been already approved, OBD tests may be carried out directly by the LPG or CNG system manufacturer provided that the requirements shown in the annex 6 of this Regulation are met."

Paragraphs 2.5. and 2.6.(former), renumber as paragraphs 2.8. and 2.9.

Insert new paragraphs 3.2.2.1. and 3.2.2.2., to read:

"3.2.2.1. In the case the approval is granted according to the requirements of the paragraphs 2.7.1.3., the following documents shall be submitted by the system manufacturer:

- the list of vehicle(s) for which the retrofit system has already been approved comprising all the relevant details as mentioned in the Table 1 of the annexes 1A and 1B;
- the results of emissions tests as described in the paragraph 6.1.2.4. or 6.1.2.5. in accordance with the communication form required in the emission regulation applicable.

3.2.2.2. In the case the approval is granted according to the requirements of the paragraphs 2.7.1.5., the following documents are required:

- the list of vehicle(s) for which the retrofit system has already been approved comprising all the relevant details as mentioned in the Table 1 of the annexes 1A and 1B;
- the results of OBD tests as required in paragraph 6.1.4. in accordance with the communication form required in the emission regulation applicable."

Paragraph 3.2.3., amend to read:

"3.2.3. Description of all modifications applied to the original parent vehicle, only in case of bi-fuel **and dual-fuel** configuration;"

Paragraphs 3.3. to 3.5., renumber as paragraphs 3.2.5. to 3.2.7. and amend to read:

"3.2.5. **Part 1 of the installation instruction** manual for the retrofit **system** installation on **the parent** vehicle(s)

3.2.6. End-user ~~service~~ manual

3.2.7. A sample of the specific retrofit **system**, properly installed in the parent vehicle(s)."

Paragraph 6.1.1.1., amend to read:

"6.1.1.1. An LPG retrofit system shall ~~contain~~ **consist** at least of the following components:"

Paragraph 6.1.1.1.3., amend to read:

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

Paragraph 6.1.2., amend the title to read:

"6.1.2. Gaseous Pollutants emissions and CO₂ emissions (~~for category M₁ vehicles only~~)"

Paragraph 6.1.2.1., amend to read:

"6.1.2.1. One LPG retrofit system sample, as described in paragraph 2. of this Regulation, installed into the parent vehicle(s), as described in paragraph 2. of this Regulation, shall be submitted to the test procedures described in Regulations Nos. 83 4/ and 101, or 49 5/, where applicable **in the limits of the requirements of paragraphs 6.1.2.4. and 6.1.2.5.** 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 6.1.2.2., 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
- (b) both unleaded petrol or LPG
- ~~(c) both leaded petrol or LPG~~
- (c) both diesel fuel or diesel fuel and LPG."

Paragraph 6.1.2.3., amend to read:

"6.1.2.3. "Gaseous pollutants" means:

- (i) ...
-

(iv) **particulates, etc"**

Paragraph 6.1.2.4., amend to read:

"6.1.2.4. Exhaust emissions (M₁ and N₁ categories of vehicles) and CO₂ emissions (M₁ category vehicles):

6.1.2.4.1. Specific requirements on the Type I test (verifying the average exhaust emissions after a cold start) as defined in the paragraph 5.3.1. of the Regulation No. 83, 05 series of amendments (for vehicles having the maximum mass not exceeding 3500 kg):

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

- (i) reference petrol,
- (ii) reference LPG A,
- (iii) reference LPG B.

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

6.1.2.4.1.2. The test vehicle(s) **tested** 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 more than 10 per cent, the limit prescribed, provided 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.

4/ According to Regulation No. 83, the series of amendments in force during the initial type approval of the engine.

6.1.2.4.1.3. 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) $\frac{4}{4}$ of 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.

6.1.2.4.1.4. **Notwithstanding the provisions of the paragraphs 6.1.2.4.1.1. to 6.1.2.4.1.2., for non intrusive retrofit system as defined in the paragraph 2.4., the type I test shall be carried out only with LPG.**

The number of emission tests to be performed on one LPG 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. $V_1 \leq 0.70 G$);**
- **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:**

$$V_1 \leq 0.85 G \text{ and } V_1 + V_2 \leq 1.70 G \text{ and } V_2 \leq G$$

where:

- V1:** value of the emission of one pollutant obtained from the first test of the Type I performed;
- V2:** 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.

6.1.2.4.1.5. Notwithstanding the provisions of the paragraph 6.1.2.4.1.1., at the request of the system manufacturer, the Type I test on the LPG mode can be performed on only one LPG reference fuel, the choice of which is left at the discretion of the technical service responsible for the test.

6.1.2.4.1.5.1. In the case of compliance with the paragraph 6.1.2.4.1.3., the requirements regarding emissions of the vehicle fitted with the retrofit system as described in the paragraph 6.1.2.4.1.3. will be deemed to be met if:

$$M_A \text{ or } M_B < G$$

$$M < 0.85 S + 0.4 G$$

where M is the mean value 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 retrofit system for the LPG reference fuel chosen for the test.

6.1.2.4.1.5.2. In the case of non intrusive retrofit system, the requirements of the paragraph 6.1.2.4.1.4. shall be calculated with V1 and V2 as the value of the emission of one pollutant obtained from the Type I test with the chosen reference fuel.

6.1.2.4.2. Calculation of the CO₂ emissions and fuel consumption (for M1 and N1 category of vehicles)

6.1.2.4.2.1. The emissions of CO₂ are calculated according to Regulation No. 101 for each parent vehicle.

The mean of CO₂ emissions shall be calculated as follows:

$$CO_{2LPG} = 1/n \sum_{i=1}^n (CO_{2Ai} + CO_{2Bi}) / 2$$

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

where:

- i: number of parent vehicles (i = 1 to n)
- CO_{2Ai}: mean value of the emissions of CO₂ obtained from the three Type I tests with the retrofit system and with LPG A for vehicle No. i;
- CO_{2Bi}: mean value of the emissions of CO₂ obtained from the three Type I tests with the retrofit system and with LPG B 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.

6.1.2.4.2.2. The mean fuel consumption shall be calculated in the same way as for the mean of CO₂ emissions, see the paragraph 6.1.2.4.2.1.

6.1.2.4.2.3. The ratios of CO₂ emissions and fuel consumption shall be calculated as follows:

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

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

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

6.1.2.4.2.4. Notwithstanding the provisions of the paragraph 6.1.2.4.2.1. 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 the paragraph 6.1.2.4.1.5., the mean of CO₂ emissions shall be calculated as follows:

$$CO_{2LPG} = 1 / n \sum^n CO_{2LPGi}$$

where:

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

6.1.2.4.2.5. Notwithstanding the provisions of the paragraph 6.1.2.4.2.1., for non intrusive system, as defined in the paragraph 2.4. of this Regulation, the value of the petrol CO₂ emission shall be the official CO₂ emission value of the vehicle(s) No. i or the CO₂ value of the vehicle No. i tested on petrol, if tested.

6.1.2.4.3. Specific requirements on the Type II test (carbon monoxide emission test at idling speed) for vehicles having a maximum mass exceeding 3,500 kg:

6.1.2.4.3.1. One LPG 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 the Regulation No. 83.

6.1.2.4.3.2. Notwithstanding the provisions of the paragraph 2.2.1. of annex 5 of the Regulation No. 83, 05 series of amendments, the Type II test shall be performed at the request of the system manufacturer with only one LPG reference fuel chosen at the discretion of the type-approval technical service responsible for the test."

Paragraph 6.1.2.5., amend to read:

"6.1.2.5. Exhaust emissions

....

Measurements of emissions in the ~~13-mode~~ **ETC** cycle with each fuel:

- (i) reference diesel fuel,
- (ii) ~~commercial reference~~ **LPG A or B**
- (iii) **reference LPG/diesel mixture.**

The emissions CO, HC, NO_x and particulates

.....

M: value of the emissions of one pollutant obtained from the ~~13-mode~~ **appropriate** test with the retrofit system and with LPG,

S: value of the emissions of one pollutant obtained from the ~~13-mode~~ **appropriate** test with the reference diesel fuel,

G: limit value of the emissions of one pollutant according to the type approval of the engine(s)."

Paragraph 6.1.3.2., amend to read:

"6.1.3.2. Chassis dynamometer method:

The maximum power at the ~~wheels~~ **roller(s)** is measured on a chassis dynamometer on each parent

....."

Insert a new paragraph 6.1.3.2.1., to read:

"6.1.3.2.1. Notwithstanding the provisions of the paragraph 6.1.3.2., for non intrusive system as defined in the paragraph 2.4. of this Regulation, the mean power

measurements for petrol shall be the official value of the power for the vehicle No. i or the value of the power on the vehicle No. i tested on petrol, if tested."

Introduce a new paragraph 6.1.3.3.1., to read:

"6.1.3.3.1. Notwithstanding the provisions of the paragraph 6.1.3.3., for non intrusive system as defined in the paragraph 2.4. of this Regulation, the mean power measurements for petrol shall be the value of the power recorded for the vehicle No. i at the initial type-approval of the vehicle, corrected by the proper deterioration factors, if applicable."

Introduce new paragraphs 6.1.4. to 6.1.4.4., to read:

"6.1.4. **OBD systems requirements and tests for vehicles retrofitted with LPG fuelling systems:**

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

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

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

6.1.4.2. The OBD system of one LPG retrofit system sample, as described in paragraph 2. of this Regulation, installed into the parent vehicle, as described in the paragraph 2. of this Regulation, shall comply with the requirements of the annex 11 of the Regulation No. 83, 05 series of amendments on both petrol and LPG modes.

6.1.4.3. In the case there is a need, to fit properly the LPG/CNG retrofit system in the vehicle, it is allowed to disconnect and simulate the original emission-related components.

6.1.4.4. Specific OBD requirements for "master-slave" retrofit system:

Notwithstanding the requirements of the paragraphs 6.1.4.2. and 6.1.4.2. above, in the case of "master-slave" retrofit system, the following requirements shall apply for what concern the compliance with OBD provisions:

a) when the vehicle is operating on LPG, the LPG computer shall only monitor the emission-related components of the LPG retrofit system as well as their electrical connections;

- b) **The OBD test shall be performed only to test the LPG operating mode of the LPG retrofit system;**
- c) **The malfunctions detection, when the vehicle is operating in the LPG mode, shall be demonstrated on the parent vehicle, only by electrical disconnecting or partly interrupting, during a Type I test, the signal emitted by one of the LPG emission-related component connected to the LPG ECU;**
- d) **Fault codes due to malfunctions of the LPG emission-related components and their electrical connections shall be stored in the LPG computer. The retrofit system manufacturer shall provide specific instructions as to how to readout the LPG fault codes concerning the emission-related components and their connections;**
- e) **In alternative to the requirements shown in the paragraph d) above, malfunctions of the LPG emission-related components and their electrical connections shall activate the switch from gas operating mode to petrol mode, indicating clearly and undoubtedly such a situation."**

Paragraph 7.1., correct to read:

"7.1. ~~Instruction~~ **Installation** manual for the retrofit installation on the vehicle."

Paragraphs 7.1.3.3. to 7.1.3.5., amend to read:

7.1.3.3. The installation manual is part of the retrofit system and shall therefore be ~~contained in the~~ **provided for each** conversion kit.

7.1.3.4. The installation manual ~~included in the kit~~ must be written in the language of the country to which the conversion retrofit will be delivered, **or at least in English.**

7.1.3.5. The installation manual can be divided in two parts:

Part I: (i) Part containing the description of the sample of retrofit installed on the parent vehicle(s), and submitted to the tests and inspections of the Authority that grants the type approval.

(ii) Part containing the list of components indicated by the retrofit manufacturer as alternatives.

Part II: (i) Part containing **specific** installation instructions, for ~~all the~~ **each** vehicle belonging to the family of the parent vehicle(s)."

Paragraphs 7.1.3.6. and 7.1.3.7., correct the words "instruction manual" to read "installation manual".

Paragraphs 7.1.4. to 7.1.4.1.11., amend to read (deletion of paras. 7.1.4.1.3. to 7.1.4.1.12.):

"7.1.4. Contents of Part I section (i) of installation manual

7.1.4.1. Retrofit system description

7.1.4.1.1. ~~Retrofit system approval number~~ **Operational principles of the retrofit system**

7.1.4.1.2. ~~Vehicle manufacturer (s)~~ **Operational principles of each component of the retrofit system."**

Paragraphs 7.1.4.2. to 7.1.4.2.4., should be deleted.

Paragraphs 7.1.5. to 7.1.8.1. (former), renumber as paragraphs 7.1.4.2. to 7.1.4.5.1.

Paragraphs 7.1.9. and 7.1.9.1. (former), renumber as paragraphs 7.1.4.6. and 7.1.4.6.1., and amend to read:

"**7.1.4.6. Maintenance diagnosis**

7.1.4.6.1. If a **maintenance** diagnosis system is ~~included~~ **provided in the conversion kit to the installer**, the installation manual shall contain a detailed description of such a system together with the corrective actions which may be taken in case of malfunctioning."

Insert new paragraphs 7.1.5. to 7.1.5.2.3., to read:

"**7.1.5. Contents of Part II of installation manual**

7.1.5.1. Retrofit system identification

7.1.5.1.1. Retrofit system approval number

7.1.5.1.2. Vehicle manufacturer

7.1.5.1.3. Vehicle category

7.1.5.1.4. Vehicle type

7.1.5.1.5. Engine type

7.1.5.1.6. Engine displacement

7.1.5.1.7. Transmission type

7.1.5.1.8. Vehicle model

7.1.5.1.9. Type of conversion retrofit (LPG or CNG)

7.1.5.1.10. Assembly instruction number

7.1.5.1.11. General scheme of the retrofit system containing the following information of each component:

(a) **identification number;**

(b) **manufacturer's code;**

(c) **type approval , if it exists;**

(d) **for the containers: capacity/manufacturer/type/date of expiry or replacement date, if it exists.**

- 7.1.5.1.12. **Description (including drawings, if applicable) of the fitting devices of the container installation on the vehicle**
- 7.1.5.2. **Installation instructions**
- 7.1.5.2.1. **Assembly instructions of all components together with diagrams or photographs showing clearly the layout of the single components within the engine compartment.**
- 7.1.5.2.2. **Diagram or photograph showing the exact position where the installer shall place the retrofit system type approval plate (contained in the conversion kit).**
- 7.1.5.2.3. **Clear wiring diagram of the electrical system containing the mechanical components to which the wires shall be connected."**

Paragraph 7.2., amend to read:

"7.2. End-user manual"

Paragraphs 7.2.4.5. to 7.2.4.7., renumber as paragraphs 7.2.2.5. to 7.2.2.7.

Paragraph 7.2.5., renumber as paragraph 7.2.3. and amend to read:

"7.2.3. Contents of the end-user manual"

Paragraphs 7.2.5.1. to 7.2.5.5.7., renumber as paragraphs 7.2.3. to 7.2.3.5.7.

Paragraph 8.1., amend to read:

"8.1. Every modification of the installation of the specific equipment for the use of **LPG/CNG** ~~compressed natural gas~~ in the propulsion system of the"

Paragraph 9., amend to read:

"9. CONFORMITY OF PRODUCTION

The conformity of production procedures shall comply with those set out in the Agreement, appendix 2 (E/ECE/324 – E/ECE/TRANS/505/Rev 2.).

The authority which has granted the type-approval may at any time verify that the system manufacturer has the conformity control of the production of all the components as listed in the paragraph 2.2. of this Regulation in the retrofit system. The normal frequency of these verifications shall be once every year."

Annex 1A, Addendum, item 1., amend to read:

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

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

Annex 1A, Addendum, item 3., amend to read:


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

Fuel		Petrol (or diesel) 1/					LPG				
Vehicle type	Engine type	Power (kW)	CO (g/km)	HC (g/km)	NOx (g/km)	CO ₂ 2/ (g/km)	Power (kW)	CO (g/km)	HC (g/km)	NOx (g/km)	CO ₂ 2/ (g/km)

1/ strike what does not apply.

2/ Applicable to category M1 vehicle only."

Annex 2A, the figure of the plate, amend to read (deletion of the figure "Date:"):

 #115R-000000	
NAME OR TRADE MARK:.....	
TYPE: LPG/CNG	
<ul style="list-style-type: none"> • VAPORIZER / REGULATOR • GAZ FUELLING SYSTEM • SAFETY DEVICE • CONTAINER..... • • • 	

Insert a new annex 6, to read:

"Annex 6

MINIMUM RULES TO ALLOW A LABORATORY TO CARRY OUT UNDER THE RESPONSIBILITY OF THE LPG/CNG RETROFIT SYSTEM MANUFACTURER AN EMISSION TEST (INCLUDING COMPLIANCE WITH REGARD TO E-OBD REQUIREMENTS) OF A RETROFIT SYSTEM FITTED ON A PARENT VEHICLE.

Scope:

This annex sets out the minimum rules to be complied with by a laboratory so that it can be trusted to carry out un-witnessed emission tests under the responsibility of the system manufacturer, of a retrofit system fitted on a parent vehicle, in the case the system manufacturer requests testing according to the provisions shown in the paragraphs 2.7.1.3. and 2.7.1.5. of this Regulation.

The purpose of this annex is also to provide guidance for the setting up and operation of an accreditation body to initially grant an accreditation to the laboratory and to facilitate agreements on mutual recognition of accreditation of laboratories between technical service responsible for approval tests on the national as well as on the international levels.

The requirements of this annex cover initial assessments, partial assessments (to appraise new equipment, procedures and legislative standards) and monitoring assessments (monitoring assessments taking place latest three years after the first assessment).

Note: the requirements of this annex are based on the following standards commonly used by testing laboratories in the automotive industry:

EN 45003: 1995, Calibration and testing laboratory accreditation systems: General requirements for operation and recognition;

EN ISO/CEI 17025: 1999, General requirements for the competence of testing and calibration laboratories (replacing the previous EN 45001 dated December 1989);

FD ISO/TS 16949: 2002, Quality management systems - Particular requirements for the application of ISO 9001:2000 for automotive production and relevant service part organizations.

1. Definitions

1.1. "Laboratory" means the body under which responsibility the test is performed.

Note 1: in the case where a laboratory forms part of an organization that carries out other activities besides testing, the term "laboratory" refers only to those parts of that organization that are involved in the testing process.

Note 2: the term "laboratory" refers to a body that carries out testing:

- at or from a permanent location; or
- at or from a temporary facility; or
- in or from a mobile facility.

1.2. "Accreditation" means a procedure administered in a non-discriminatory manner, by which an authoritative body gives formal recognition that a body or person is competent to carry out specific tasks.

Note: accreditation does not in itself qualify the laboratory to approve any particular product. However, accreditation may be relevant to approval and certification authorities when they decide whether or not to accept data produced by a given laboratory in connection with their own activities.

1.3. "Accreditation Body" is the technical service appointed by the authority responsible for the test of the retrofit system.

2. Provisions relative to the laboratory management

Provisions of this paragraph shall ensure that the laboratory facilities:

- have the required equipment available,
- are correctly managed,
- have trained and competent personnel including complete knowledge and records of the standards that they will be dealing with,
- maintain proper records and reporting forms,
- operate equipment maintenance and calibration schemes, including specification checking procedures.

2.1. Organization

2.1.1. The laboratory or the organization managing its activity shall be made of only one entity juridically responsible.

2.1.2. The laboratory shall employ a sufficient number of personnel having the necessary education, training, technical knowledge and experience for handling the type, range and volume of work performed, under a senior executive who is responsible to the organization to which it reports.

2.1.3. The laboratory shall demonstrate some evidence of formal organization and have a quality system, including an organizational structure that enables it to give confidence in its ability to operate testing satisfactorily.

In the case the laboratory is part of a global organization having activities in other fields than those directly linked to testing, the responsibility of all the key personnel

involved in the testing activities shall be clearly defined to avoid any conflicts with other activities of the organization.

2.1.4. It is the responsibility of all test engineers operating in the laboratory to ensure that any facilities used for either witnessed or un-witnessed testing are still covered by an accreditation (proper reference in the accreditation certificate and within the validity period).

Lead Engineers of the laboratory are responsible for producing equipment checklists for their specialist subjects, laying down the minimum acceptable equipment requirements.

2.2. Quality system

The quality system shall be operated appropriately to the type, range and volume of work performed.

2.2.2. The laboratory shall have documented policies and procedures for the operation of the quality system that include:

- policies and decision-making procedures that distinguish between the laboratory accreditation and any other activities in which the body is engaged;
- policies and procedures for the resolution of complaints and appeals received about the handling of accreditation matters or any other matters.

This documentation shall be available for use by all the laboratory staff. It shall also designate a person having direct access to its highest executive level, to take responsibility for the quality system and the maintenance of the quality system documentation.

2.2.3. The quality system shall be documented in a quality manual and associated quality procedures.

The quality manual shall contain or refer to at least the following:

- a quality policy statement;
- the organization structure of the laboratory;
- the operational and functional duties and services pertaining to quality, so that each person concerned will know the extent and the limits of their responsibility;
- administrative procedures including document control;
- policies and procedures to have the accreditation granted;
- procedures to perform the tests including test record system with authorized signatories;
- arrangements for feedback and corrective actions whenever discrepancies are detected;
- the policy and procedures for dealing with appeals, complaints and disputes;
- the policy and the procedures for conducting internal audits;

- the policy and the procedures for conducting quality systems reviews;
- the policy and the procedures for the recruitment and training of personnel and monitoring their performance.

2.2.4. The quality system shall be reviewed to ensure its continued effectiveness. Audits and reviews shall be carried out systematically and periodically and recorded together with details of any corrective actions taken.

2.3. Documentation

2.3.1. The laboratory shall make available through publications, electronic media or other means, on request:

- information about the accreditation process specifying that it was based on a voluntary process;
- a document containing all requirements to be complied with to get the accreditation;
- information about the assessment and accreditation process.

2.3.2. The laboratory shall maintain and update regularly all documents part of its quality system such as regulatory texts, standards, testing procedures, drawings, software, specifications and instruction manuals.

2.3.3. Specific procedures shall be introduced to ensure that :

- the authorized version of the documents are made available at any place required for the proper operation of the testing facilities,
- the documents are regularly reviewed and if appropriate duly revised to ensure the continuity with the applicable requirements;
- non valid or expired documents are immediately withdrawn at all consultation or operating points or are treated properly to avoid any non-intended usage;
- expired documents preserved for legal reasons or to maintain the knowledge, are properly marked.

2.4. Service and furniture purchases

2.4.1. The laboratory shall have in place specific policies and procedures for the selection and purchase of services and furniture, which might impact the quality of the testing capabilities of the laboratory.

2.4.2. The laboratory shall ensure that the furniture or other products bought which might impact the quality of the testing capabilities of the laboratory, are only used after being controlled and checked as conform to the standards specifications and the requirements defined in the concerned testing procedures.

2.5. Records management

2.5.1. Specific provisions shall be taken to ensure that observations, data and calculations during testing operations are recorded at the moment they are performed and can be linked to the operation concerned.

2.5.2. In case of errors in the records, each error shall be crossed and not deleted or made illegible. The correct value shall be written nearby. The person who made the correction shall sign all changes made on the records. In case of electronic storage of the data, equivalent specific measures shall be taken to prevent the loss or the modification of the original data.

2.5.3. The laboratory shall maintain records to demonstrate that accreditation procedures have been effectively fulfilled, particularly with respect to:

- application forms;
- assessment reports;
- reports relating to granting, maintaining, extending, suspending or withdrawing accreditation.

2.5.4. The laboratory shall have a policy and procedures for retaining records for a period consistent with its contractual and legal obligations.

Specific provisions shall be taken to protect and save all records electronically stored and avoid any non-authorized access or changes in the records.

The laboratory shall ensure proper control of computer systems, data collection, software and hardware. Systematic review of the storage procedures shall be undertaken regularly.

2.6. Internal assessment

2.6.1. The laboratory shall perform on a regular basis (at least once per year) and in conformity with an internal procedure, internal assessment of its activities to check that all its operations are still in conformity with its quality system and the requirements of this annex.

This internal assessment shall be managed by the quality manager of the laboratory and performed with trained personnel, when possible independent of the activity to be assessed.

2.6.2. Assessment reports including resulting corrective measures shall be recorded. Follow-up activities of the assessment shall be undertaken to ensure the implementation and efficiency of the corrective measures taken.

2.7. Accreditation procedure

2.7.1. The laboratory shall provide the accreditation body with information on the nature of the facility, the type of tests to be conducted and the relevant standards.

The accreditation body shall send to the applicant laboratory a detailed description of the assessment and accreditation procedure, the documents containing the requirements for accreditation and documents describing the rights and duties of accredited laboratories.

All information gathered shall be used for the preparation of the on-site assessment and shall be treated with appropriate confidentiality.

2.7.2. A duly authorized representative of the laboratory shall be required to sign an official application form, in which or attached to which:

- a) the scope of the desired accreditation is clearly defined;
- b) the applicant's representative agrees to fulfil the accreditation procedure, especially to receive the assessment team, to pay the fee charged to the applicant laboratory whatever the result of the assessment may be, and to accept the charges of subsequent maintenance of the accreditation of the laboratory;
- c) the applicant agrees to comply with the requirements for accreditation and to supply any information needed for the evaluation of the laboratory.

All trained test engineers specially trained can complete appraisals of the laboratory's facilities.

2.7.3. The laboratory prior to the on-site assessment shall provide the following minimum information:

- a) the general features of the applicant laboratory (corporate entity: name, address, legal status, human and technical resources);
- b) general information concerning the laboratory to be covered by the application, such as primary function, relationship in a larger corporate entity and, if applicable, physical location of the laboratories involved;
- c) a definition, for the tests concerned, of the methods used and the tests performed;

In this context, a check-list of the laboratory's equipment may be prepared (usually by the lead engineer for the subject). It shall include reference to the pertinent regulations and directives.

- d) a copy of the laboratory's quality manual and, where required, the associated documentation.

The assessor of the accreditation body is free to ask as few or as many questions as are necessary to establish the suitability of the facility.

2.7.4. The date of assessment shall be mutually agreed between the accreditation body and the applicant laboratory. The latter shall be informed of the name(s) of the qualified assessor(s) nominated to carry out the assessment, with sufficient notice so that the laboratory is given an opportunity to appeal against the appointment of any particular assessor.

2.7.5. The on-site appraisal, the assessor(s), in the order best suited to the circumstances, will consider the following issues:

- review of the management systems;
- check of the equipment;
- witness of any tests.

2.7.6. At the end of the appraisal and prior to leaving the laboratory, for the closing meeting which shall take place between the assessor or assessment team and the laboratory management, the assessor(s) shall prepare and provide a written or oral detailed assessment report of the deficiency records and any other notes regarding the compliance of the laboratory with the accreditation requirements.

2.7.7. A report on the outcome of the assessment is promptly brought to the laboratory's notice by the accreditation body, identifying any non-compliances that have to be discharged in order to comply with all the accreditation requirements.

The laboratory shall be invited to present its comments on this report and to describe the specific action taken, or planned to be taken within a defined time, to remedy any non-compliances with the accreditation requirements identified during the assessment.

Note: Deficiencies may be classified as either advisory or obligatory:

- an advisory deficiency is one where, in the opinion of the assessor, the operation or performance of the laboratory may be enhanced by the implementation of a change to the equipment or an operational procedure, but the laboratory does nevertheless satisfy the requirements of the relevant technical standard for competent operation.
- an obligatory deficiency is one where the requirements of the relevant technical standard for competent operation cannot be satisfied until such time as the deficiency is rectified. In this case, the report will state that use of the laboratory for witnessed tests will not be possible until things are put right.

Depending upon the nature of the deficiency the endorsement of the corrective action may require one of a number of different actions by the assessor:

- acceptance of a written statement that the agreed corrective action has been carried out;
- consideration of a photograph showing a modification to a piece of equipment;
- consideration of a test report demonstrating a revision in method of calculation of presentation of results;
- a repeat visit to the laboratory.

2.7.8. The final report authorized by the accreditation body and submitted to the laboratory, if it is different shall include as a minimum:

- a) date(s) of assessment(s);
- b) the name(s) of the person(s) responsible for the report;
- c) the name(s) and address(es) of all laboratory sites assessed;
- d) the assessed scope of accreditation or reference thereto;

- e) **comments of the assessor(s) or assessment team on the compliance of the laboratory with the accreditation requirements.**

The report shall take cover the following aspects:

- a) **the technical qualification, experience and authority of the staff encountered, especially the persons responsible for the technical validity of test reports or test certificates;**
- b) **the adequacy of the internal organization and procedures adopted by the laboratory to give confidence in the quality of its services, and of the physical facilities (i.e. the environment and the test equipment of the laboratory), including maintenance having regard to the volume of work undertaken;**
- c) **any proficiency testing or other inter-laboratory comparison performed by the laboratory, the results of this proficiency testing, and the use of these results by the laboratory;**
- d) **the actions taken to correct any non-compliances identified at previous assessments.**

2.7.9. The accreditation body on the basis of the information gathered during the accreditation process shall take the decision whether or not to accredit a laboratory.

2.7.10. An officer who has been assigned such responsibility by the accreditation body shall sign the accreditation document. It shall permit at least the identification of:

- a) **the name and address of the laboratory that has been accredited;**
- b) **the scope of the accreditation, including :**
 - **the tests, or types of test, for which accreditation has been granted;**
 - **the materials or products tested, the methods used and the tests performed;**
 - **for specific tests for which accreditation has been granted, the methods used defined by written standards or reference documents that have been accepted by the accreditation body;**
- c) **where appropriate, the persons recognised by the accreditation body, as being responsible for the test certificates or test reports;**
- d) **the effective date of accreditation, and the term of the accreditation if applicable;**
- e) **the accredited laboratory by a unique number.**

2.8. Surveillance and reassessment of accredited laboratories

A document programme, consistent with the accreditation granted, shall be established between the laboratory and the accreditation body for carrying out periodic surveillance and re-assessment at sufficient close intervals to ensure that the laboratory continues to comply with the accreditations requirements.

2.9. Notification of changes in the accreditation

2.9.1. The laboratory shall advise the accreditation body without any delay on any changes affecting either the scope of accredited activities or the laboratory's capability, activity and operation, such as :

- legal, commercial or organizational status;
- organization and management, e.g. key managerial staff;
- policies or procedures, where appropriate;
- premises;
- personnel, equipment, facilities, working environment or other resources, where significant;
- analysis of a complaint or any other information indicating that the laboratory no longer complies with the requirements of the accreditation body.

2.9.2. Upon receipt of due notice of any intended changes, the accreditation body shall ensure that the laboratory carries out the necessary adjustments to its procedures within reasonable time. The laboratory shall notify the accreditation body when such adjustments have been made.

3. Technical provisions

3.1. General

Several factors are determining the accuracy and reliability of the tests performed by a laboratory. These factors may be linked to the following elements:

- human factors;
- installations and ambient conditions;
- test methods and validation of these methods;
- the equipment;
- traceability of the measure;
- calibration;
- maintenance of the testing facilities.

All these factors shall be taken into account when elaborating the testing methods and procedures, in the training of the personnel and in the selection of the equipment to be used.

3.2. Provisions on the personnel

3.2.1. The personnel operating the tests in the laboratory shall :

- a) be familiar with the relevant legal regulations, accreditation procedures and accreditation requirements;
- b) have a thorough knowledge of the relevant testing methods and documents, including all relevant standards and regulations;

- c) have appropriate technical knowledge of the specific tests or types of tests for which accreditation is sought and, where relevant, with the associated sampling procedures;
- d) be trained to operate properly the test equipment including maintenance and calibration system;
- e) be able to communicate effectively, both in writing and orally.

3.2.2. The laboratory management shall formulate objectives with regard to education, training and competence of the laboratory's personnel. The laboratory shall implement proper policy and procedures to identify and ensure adequate formation of its personnel.

3.2.3. The laboratory shall establish and regularly update the descriptions of the functions of the laboratory's management staff, the technical staff involved in the testing operations.

As a minimum, the following description shall be provided:

- responsibilities with regard to the test;
- responsibilities with regard to the planning of the laboratory's activities;
- responsibilities with regard to the evaluation and the interpretation of the tests - results and the way to report about them;
- responsibilities with regard to changes in the procedures and their validation process;
- competence and expertise required;
- qualifications and training programme;
- staff management.

3.3. Provisions on installations and ambient conditions

3.3.1. The testing facilities, including at least the laboratory's energy, light, water supplies sources and the ambient conditions shall be made such to allow a correct execution of tests.

The laboratory shall ensure that the ambient conditions are such not to invalidate the results or jeopardize the quality required for the measurements.

The laboratory shall check, monitor and record the ambient conditions according to the relevant requirement of the specifications, methods and procedures or if then they are likely to influence the test results.

3.3.2. The technical requirements relative to the installation and to the ambient conditions, which might affect the quality of the measurement, shall be recorded in writing.

3.3.3. Specific measures shall be undertaken to ensure proper maintenance of the laboratory's facilities.

3.4. Testing methods

3.4.1. The laboratory shall implement adequate methods and procedures for conducting the testing in its field of activity.

The laboratory shall be provided with specific instructions for the use, operation and maintenance of each pertinent device in the laboratory, for the preparation of the objects to be submitted to the testing procedures.

All these information shall be clearly referenced and easily accessible to the personnel involved in the relevant activities.

3.4.2. The laboratory shall ensure it is using the latest version of the standards or regulations required, unless it is felt inappropriate or useless. If needed, further to the Agreement of the accreditation body, proper adaptation of the standard can be made to ensure its correct implementation.

3.4.3. Methods and procedures specific to the laboratory can also be used if they adapted to the specific need of the laboratory and if they have been validated (including proper availability of proper documentation).

3.4.4. The laboratory shall also implement procedures to estimate the measurement uncertainty. A reasonable estimation shall be based on knowledge of the performance of the method and on the scope and validity range of the measurement method. It may also refer to experience granted or data gathered through previous validation process.

3.5. Equipment

3.5.1. The facility must have all of the equipment specified by the standard Regulation. When no particular equipment is specified by the technical standard, then the test engineer must use his judgement and test experience to determine the minimum level of equipment necessary to satisfactorily complete the tests in question.

3.5.2. The equipment must be subjected to regular maintenance and calibration.

3.5.3. Only authorized personnel shall use the equipment. Clear and updated instructions relative to the use and the maintenance of the equipment (including any manual(s) supplied by the manufacturer) shall be easily accessible to any relevant personnel of the laboratory.

3.5.4. Specific record shall be made of each equipment which might have a significant influence on the test results.

These records shall at least report on the following:

- identity of the equipment part including its relevant software, if any;**
- the name of the manufacturer, the type and identification number and/or any other relevant identification code;**
- the conformity check of the equipment conform to the specifications;**

- its current siting, if relevant;
- the manufacturer's instructions, if available, or indication on the place where they could be found;
- dates, results and copies of the reports and certificates relative to its approval, calibration and the planned date of its next review;
- the maintenance instructions, if relevant, and the list of all the maintenance operations already performed.

3.6. Test report

Each test report shall contain at least the following information:

- a title;
- the name and address of the laboratory, including the place where the test has been performed, if they differ from the address of the laboratory;
- the unique identification of the report with on each page of the report an indication ensuring that each page is part of the report and a clear indication of the end of the report;
- identification of the method(s) and procedure(s) used and if any, any indications on the changes in these methods and procedures;
- clear identification of the object submitted to the test;
- date of reception of each object submitted to the test, when this is relevant for the validity and the interpretation of the results, and the date at which the test has been performed;
- the results, with if appropriate the measurements units;
- if appropriate, advices or interpretations of the results including if relevant, the technical background on which these statements are made;
- the name(s), function(s) and signature(s) or any relevant indication advising on the person(s) allowing the diffusion of the test report."

Insert a new annex 7, to read:

"Annex 7

**COMMUNICATION FORM DEMONSTRATING THE "MASTER-SLAVE"
CHARACTERISTIC OF A CNG/LPG RETROFIT SYSTEM**

**COMMUNICATION relating to the demonstration of
"Master-Slave" characteristic of an CNG/LPG retrofit system**

Issued by: Name of Administration
.....
.....

**Concerning: 1/ APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINUED**

of a type of LPG / CNG 1/ retrofit system pursuant to Regulation No. 115.

Approval No.: Extension No.:

- 1. Description of the LPG/CNG retrofit system considered:**
 - a) Trade name or mark holder:**
 - b) Manufacturer's name and address:**
 - c) Name and address of manufacturer's representative, if applicable:**
 - d) Identification type:**

- 2. Description of the vehicle on which the "master-slave" characteristic of the CNG/LPG 1/ retrofit system has been demonstrated:**
 - a) Name and address of the manufacturer:**
 - b) Category and identification type:**
 - c) Chassis identification number:**
 - d) Certification number:**
 - e) Internal combustion engine identification type:**
 - f) Catalyst system type:**
 - g) Ignition system type:**

- 3. Submitted for approval on:**

- 4. Technical service responsible for conducting approval tests:**

- 5. Date of report issued by that service:**

- 6. No. of report issued by that service:**
- 7. Approval granted/refused/withdrawn 1:**
- 8. Reason(s) of extension (if applicable):**
- 9. Vehicle types in which the retrofit system can be installed to operate according to the "master-slave" principle:**
- 10. Place**
- 11. Date**
- 12. Signature**
- 13. The documents filed with the application or extension of approval can be obtained upon request**

1/ Strike out what does not apply"

Insert a new annex 8, to read:

"Annex 8

**COMMUNICATION FORM DEMONSTRATING THE "NON INTRUSIVE"
CHARACTERISTIC OF A LPG/CNG RETROFIT SYSTEM**

**COMMUNICATION relative to the demonstration of
"Non intrusive" characteristic of an CNG/LPG retrofit system**

Issued by : **Name of Administration**
.....
.....

**Concerning: 1/ APPROVAL GRANTED
APPROVAL EXTENDED
APPROVAL REFUSED
APPROVAL WITHDRAWN
PRODUCTION DEFINITELY DISCONTINUED**

of a type of LPG / CNG 1/ retrofit system pursuant to Regulation No. 115.

Approval No.:

Extension No.:

- 1. Description of the LPG/CNG retrofit system considered:**
 - a) Trade name or mark holder:**
 - b) Manufacturer's name and address:**
 - c) Name and address of manufacturer's representative, if applicable:**
 - d) Identification type:**
 - e) Detailed description of the modifications to the original air and fuel feed system (drawings, schemes, diagrams, ...):**

- 2. Description of the vehicle on which the "non intrusive" characteristic of the CNG/LPG 1/ retrofit system has been demonstrated:**
 - a) Name and address of the manufacturer:**
 - b) Category and identification type:**
 - c) Chassis identification number:**
 - d) Certification number:**
 - e) Internal combustion engine identification type:**
 - f) Catalyst system type;**
 - g) Ignition system type:**

- 3. Submitted for approval on:**

- 4. Technical service responsible for conducting approval tests:**

5. **Date of report issued by that service:**
6. **No. of report issued by that service:**
7. **Approval granted/refused/withdrawn 1:**
8. **Reason(s) of extension (if applicable):**
9. **Place**
10. **Date**
11. **Signature**
12. **The documents filed with the application or extension of approval can be obtained upon request**

1/ **Strike out what does not apply"**

B. JUSTIFICATION

On 30 October 2003, the Regulation No. 115, so-called "retrofit Regulation" entered into force with the objective to set up harmonized rules between the Contracting Parties for the recognition of type-approval of LPG/CNG retrofit systems on families of vehicles covering both safety and emissions aspects. The elaboration of this Regulation has taken several years during which the automotive equipment fitted on the vehicles, including LPG/CNG retrofit systems pursue their adaptation to the technical progress. This is, for example, the case with the introduction of OBD systems on the vehicles.

Therefore, some provisions of this new Regulation, particularly those related to the emission aspects of the retrofitted vehicles, need to be updated to make the Regulation fully applicable.

Draft amendments to Regulation No. 115

Paragraph 1.4.:

By the time this Regulation is implemented, the vast majority of conversions will be carried out on Euro 3 vehicles.

Furthermore, new cars complying with EURO 1 or 2 emission limits are not marketable any more, so the Regulation, in particular the requirements set in the paragraphs 2.4.1. and 6.1.2.4.1.2. of this Regulation, is not applicable to them.

Only for vehicles from EURO 3, the durability of emissions performance is required, see the provisions on in-use conformity shown in the Regulations Nos. 83 and 49 as latest updated.

Paragraph 1.5. - first requirement:

The first requirement is deleted to ensure consistency in the requirements: according to the change made in the paragraph 1.4., vehicles complying with emissions requirements earlier than EURO 3 have only to comply with Regulation No. 67-01 and national rules.

With the view of harmonizing the scope of this Regulation, it is recommended to grant Regulation No. 115 label only to equipment complying with both safety and emissions requirements of this Regulation.

Nevertheless, a note has been introduced at the end of the paragraph 1.4. to draw the attention of any Authority to apply Regulation No. 67-01 requirements as minimum requirements for all conversions.

Paragraphs 2.1.4. and 2.1.5.:

These 2 definitions are needed to make proper distinction between the 2 existing technologies.

Paragraphs 2.2.2. to 2.2.4. and 2.2.7.:

It should be allowed to change a component, except for the emissions related components, by one with the same characteristics, which does not affect the safety level, otherwise this clause is unreasonably restrictive. Anyway, the system manufacturer has to list each interchangeable item equivalent to the component with which the type-approval was granted (see annex 3A or 3B).

In this regard, it is highlighted that the system manufacturer (see definition in paragraph 2.5.) is now responsible for his suppliers. In practice, he will deliver a complete kit, leaving no freedom to the installer to mix components.

The note at the bottom of the page of the Regulation referring to paragraphs 2.2.5. to 2.2.8. shall be changed accordingly.

Paragraphs 2.2.5. to 2.2.7.:

The paragraphs 2.2.5. to 2.2.7. have been merged as the size and the manufacturer of the fuel container, its safety devices and accessories do not affect the emissions as long as the container is of the same type and does not affect the safety aspects as long as it complies with the applicable regulation.

The same remark also applies to the safety device and accessories of the fuel container.

Paragraphs 2.2.8. to 2.2.12. need then to be renumbered in paragraphs 2.2.6. to 2.2.10.

Paragraph 2.2.8. (new):

The right wording is "*control strategy*" (see annex XII of the Regulation No. 83, 02 series of amendments).

Note at end of the paragraph 2.2.10. (new):

Sensors and actuators shall be included in the note listing the interchangeable items, as different sensors settings are compensated by the calibration of the ECU.

Paragraph 2.3. (new):

A "master-slave" retrofit system translates the petrol injector signal generated by the petrol ECU, produced by petrol ECU, into an appropriate signal for either the LPG or CNG injectors.

Then, the master-slave retrofit system has to be able:

- to keep the original "energy feeding strategy" of the engine, strategy designed by the car manufacturers to enable the best performance of the car,
- to leave the petrol OBD system, remains the only on-board diagnostic system also during gas operation, monitoring for any deviation of the expected emissions and monitoring any petrol emission related components during gas operation.

In practice, this will allow the Authority to grant approval related to OBD compliance of a master-slave system performing only the OBD test on the gas mode (see paragraph 6.1.3.4.).

The paragraph 2.3.1.1. shows specific provisions for demonstration of the master-slave characteristic of the retrofit system for a specific vehicle type.

Paragraph 2.4. (new):

According to this definition, a retrofit system is "not intrusive" if its devices do not change the original petrol operation, so that the car's environmental performances are not affected when the engine is powered on petrol.

Paragraph 2.5. (new):

This is the previous paragraph 2.3. renumbered due to the introduction of 2 new definitions in paragraphs 2.3. and 2.4., respectively "master-slave system" and "not intrusive system".

The wording "system" has been added to "manufacturers" to avoid any confusion between the responsibilities of the vehicle manufacturer, the system manufacturer and the system installer.

Paragraphs 2.6. (new):

This new definition is absolutely necessary to individuate the responsible of the retrofit system installation.

Furthermore the amendment imposes installation to comply with the requirements of paragraph 6.1.1.3.:

"The LPG retrofit system installed in the vehicle, in a proper way as defined in the above installation manual, shall comply with the installation requirements of Regulation No. 67, 01 series of amendments. Concerning the fixation of the fuel container, the requirements of Regulation No. 67, 01 series of amendments shall be deemed to be met if the requirements of annex D to the present Regulation are satisfied."

This way the Regulation will give clear indications to national rules to which defers the check of the correct and safe installation of retrofit system (see paragraph 1.3.)

Thus, the installer has to be aware of the requirements of Regulations No. 67-01 and annex 4 of the present Regulation and install the retrofit system in compliance with them.

Paragraphs 2.4. to 2.6. need to be renumbered in 2.7. to 2.9.

Paragraph 2.7.1.1.c) (new):

If this amendment is not introduced it will be impossible to retrofit a vehicle which, at the approval time of the retrofit system, is not marketed any longer.

For example, when EURO III vehicle is not marketed any longer (after 2006) manufacturers will be obliged to find a second-hand EURO 3 car still meeting the EURO 3 emission limits (see paragraph 6.1.2.4.1.1.), if a system manufacturer decides to develop a system for that particular car.

With this amendment, manufacturers will be able to sell a system for a Euro 3 vehicle approved on an EURO 4 vehicle belonging to the same vehicle family.

Paragraph 2.7.1.1.f) (new):

Characteristics of the parent vehicle with regard to the inlet system shall also be taken into account:

Paragraph 2.7.1.1.g) (new):

Air injection and EGR types shall be removed from the characteristics of the pollution control system of the parent vehicle as these are not affecting the basic pollution system.

Paragraph 2.4.1.2. (previous):

The requirements of this paragraph are superfluous as the requirement is better covered by the paragraph 2.4.1.3. previous (now 2.7.1.2.):

- the power range round the parent vehicle power output is quite limited – especially for the bigger value +15% - so the choice of two parent vehicles in the same family is not justified;
- requirements of paragraph 2.7.1.2. ensure that in case of a considerable power range the number of parent vehicles is two.

Paragraphs 2.7.1.3. and 2.7.1.5. (new):

With the view to simplifying the type-approval process when type-approval is required for a vehicle of a different family but having the characteristics of paragraph 2.7.1.1. b) to f) in common, the provisions of these paragraphs allow the system manufacturer, on a voluntary basis, to carry out the tests in its own laboratory upon control of the Authority.

The quality of the emissions tests is ascertained by the following facts:

- a very similar parent vehicle (*same category, same emission limits, same power range, same fuel feed and combustion process, same pollution control system*) must have been tested previously directly by the type approval authority;
- the laboratory (facilities and personnel) shall comply with the requirements of annex 6;
- the system manufacturer shall provide a report of the tests for evaluation by the type-approval authority.

Moreover, this procedure allows the retrofit system industry to limit the homologation costs as otherwise generated by this Regulation.

Paragraph 2.7.1.4. (new):

System manufacturers are of the opinion that if one engine is made for different makes of vehicles and it can be demonstrated that the engines are very similar, the second vehicle shall be covered by the first family.

Paragraphs 2.5. and 2.6. to be renumbered in paragraphs 2.8. and 2.9.

Paragraphs 3.2.2.1. (new) and 3.2.2.2. (new):

Adaptation of the list of the documents to be supplied to the Authorities in the case of tests (emissions or OBD tests) defined in the paragraphs 2.7.1.3. and 2.7.1.5.

Paragraph 3.3.:

The wording "Installation" is more consistent with the definition used in the paragraph 7.1. Only the part I of the installation manual has to be approved, according to paragraph 7.1.3.6. and 7.1.3.7.

Paragraphs 3.3. to 3.5. shall be renumbered in paragraphs 3.2.5. to 3.2.7. further to a typing error.

Paragraph 6.1.1.1.

The verb "contain" has a physical meaning.

Paragraph 6.1.2.

The reference to M₁ vehicles only shall be deleted as the requirements of the paragraph also cover other types of vehicles: HDV applications (with the reference to Regulation No. 49) and N1 vehicles.

Paragraph 6.1.2.1.

There is a need to clarify to the system manufacturer, the tests to be performed according to the vehicle type.

Paragraph 6.1.2.4.

- need for an editorial correction in the title as some brackets are missing;
- According to the provisions of Regulation No. 83 a bi-fuel car has only to comply with the following tests on LPG: Type I, Type II and OBD tests (see requirements in Regulation No. 83 – paragraph 5.2.1. for bi-fuelled vehicles).

Paragraphs 6.1.2.4.1. (new), 6.4.1.2.4.2. (new) and 6.4.1.2.4.3. (new)

The initial paragraph 6.1.2.4. has been split into specific sub-paragraphs to clarify the requirements to be complied with for each test.

Paragraph 6.1.2.4.1.2.

Addition has been made to avoid any misinterpretation.

Paragraph 6.1.2.4.1.3.

As for other conventional vehicles, LPG vehicles have to comply with the type-approval emission limits as defined in Regulations Nos. 83 or 49, where applicable.

Paragraph 6.1.2.4.1.4.:

- If a retrofit system is of a "not intrusive" type, it does not affect the petrol operation and, therefore, it cannot change the environmental performances of the car when running on petrol. In this case, the petrol test is not relevant.
- The method for the determination of the number of tests to be performed is equivalent to the one prescribed in the paragraph 5.3.1.5. of the Regulation No. 83, 02 series of amendments.

Paragraph 6.1.2.4.1.5.:

Introduction of an adapted procedure that might be requested by the system manufacturer when asking for the type-approval: test with only one LPG reference fuel chosen at the discretion of the Authority during the test.

This obliges the retrofit system manufacturer to make the emissions calibration on both reference fuels, as he does not know before the test on which fuel the type-approval test will finally be performed.

To summarize, 3 options are offered to the system manufacturer for the type-approval of the retrofit system according to its characteristics:

- **normal procedure: 9 tests – 3 on each reference fuels: petrol, LPGA, LPGB:** see the provisions of the paragraph 6.1.2.4.1.1.;
- **specific procedure for not intrusive system** for which the tests have to be performed on LPG reference fuels only: **maximum 6 tests – 3 on each reference fuels; the number of tests could even be reduced to 2 tests (one on each LPG reference fuel) according to some validation criteria:** see the provisions of the paragraph 6.1.2.4.1.4.;
- **adapted procedure** that might be requested by the system manufacturer when asking for the type-approval: test with only one LPG reference fuel chosen at the discretion of the Authority during the test (this obliged the retrofit system manufacturer to make the emissions calibration on both reference fuels as he does not know before the test which fuel will be selected – **6 tests – 3 on petrol and 3 on one LPG reference fuel**, see the provisions of the paragraph 6.1.2.4.1.5.

Paragraph 6.1.2.4.2.3. (new):

See justifications for the paragraph 6.1.2.4.1.4.

Paragraph 6.1.2.4.4. (new):

According to the provisions of this Regulation, the retrofit system has to comply with the provisions of Regulation No. 83. This means that the following tests have to be performed: type I, type II and OBD tests. Thus, the purpose of this new paragraph is to clarify for the system manufacturer, the requirements to be complied with for the type II test.

Paragraph 6.1.2.5.:

The same justification as for the paragraph 6.1.2.4.1.3.

13-mode test is not applicable to gas engine. Currently, only the ETC test cycle applies. In the case of a CI retrofitted engine to gas feed (SI principle), it will not be possible to test the engine with diesel after the retrofit operation. The engine would have to be submitted for testing twice: before and after retrofit operation. Specific provisions should also be described to cover the case of retrofitting a CI engine to dual fuel feed (use of a diesel/gas mixture).

Paragraph 6.1.3.2.:

To ensure consistency between the results recorded on the 2 test procedures relative to the power requirements, it is suggested to refer only to commercial LPG as testing fuel.

Paragraph 6.1.3.2.1. (new) and 6.1.3.3.1. (new)

As explained in the paragraph 6.1.2.4.1.4., in the case of a "non intrusive system", the Type I test is not carried out on petrol. Thus, it is suggested for the calculation of the ratio of engine power to refer to the type-approval data.

New paragraph 6.1.4. (new):

As already stated in the justification relative to the new paragraph 6.1.2.4.3., this Regulation shall also introduce specific provisions regarding the OBD system of the retrofitted vehicle.

Since the Directive 2001/1/EC requires that after the first January 2003 bi-fuel cars have to comply with OBD requirements, installation of a retrofit system on a vehicle already fitted with an OBD system, shall guarantee:

- the compatibility of the retrofit system with the car's original OBD system, when operating on petrol;
- the detection and storage of any failure which can cause the excess of the emissions limits, when operating on gas.

Paragraph 6.1.4.3. (new):

For the proper installation of the retrofit system, it might be necessary to disconnect in the gas mode, some original emission-related components, which operation on the gas mode could affect the car's performance. The disconnection of the petrol injectors is the typical example.

Nevertheless, proper actions shall be taken to ensure this operation will not significantly affect the operation of the vehicle on the petrol mode.

Paragraph 6.1.4.4. (new):

Due to its inherent properties of design and installation (see the definition of a master-slave system characteristics in the paragraph 2.3.1.), a retrofit system of a master-slave type shall not affect the original OBD performances when operating on petrol and shall partially use the original OBD system when operating on gas. The other gas OBD diagnostics shall be completed by a specific gas computer, which shall monitor for the gas emission related components and detect their possible failures (see paragraph 6.1.4.4.a.).

In conclusion, the diagnostic activities on a bi-fuelled vehicle fitted with a retrofit system of a master-slave type, will be ensured by:

- the original OBD, when operating on petrol;
- the original OBD + gas ECU, when operating on gas.

With regard to the testing procedure, the master-slave characteristics of the system shall be properly taken into account to avoid any duplication of tests, like in particular these made on the original OBD system during the approval of the petrol car.

Thus, the following provisions are suggested:

- on petrol, the compatibility of the retrofit system with the original OBD shall be proven only *once*;
- on gas, the diagnostic of original emission related components malfunctions shall be proven only once;
- on gas, the diagnostic of gas emission related components malfunctions is proven on each parent vehicle, as required in the paragraph 6.1.4.4.c.

Provisions of the paragraphs 6.1.4.4. d) to e), give equivalent instructions which incontrovertibly signals to the customer a failure in gas operation.

Paragraphs 7.1., 7.1.3.6. and 7.1.3.7.:

The "Instructions Manuals" (par. 7.) include:

- the installation manual (par 7.1.)
- the end user manual (par 7.2.)

The present text seems to confuse this necessary distinction.

Paragraph 7.1.3.3.:

This way the kit manufacturer is obliged to provide the installer with the installation manual but is not obliged to deliver physically the installation manual. The final target is fulfilled anyway but no additional costs are assigned to the manufacturer.

He can, indeed, supply the installation manual through any desired channel and not physically in each conversion kit.

Paragraph 7.1.3.4.:

Provisions added to improve the diffusion of information by the system manufacturer.

Paragraph 7.1.3.5.:

A family might be represented by more than one parent vehicle.

Paragraph 7.1.4.:

The present text is not very clear with regard to the contents of the two Installation Manual parts. So it is necessary to precisely clarify the following.

Part I section (i) shall contain:

- the operational principles description of the whole retrofit system (seen as an assembly);
- the operational principles description of the single components;
- any other information which regard the sample of retrofit, i.e. information common to each specific version to be installed on different vehicles: proper assembly check, start-up procedures, service instructions, system malfunctions and diagnosis.

Thus, most requirements currently mentioned in the paragraph 7.1.4.1. and 7.1.4.2. shall be moved to the new paragraph 7.1.5. as they are addressing an issue now covered by Part II of the installation manual.

Paragraphs 7.1.5. to 7.1.9.1. shall be renumbered in 7.1.4.2. to 7.1.5.2.3.

Paragraph 7.1.4.6.:

The addition is needed to clarify that this requirement refers only to maintenance operation.

Paragraph 7.1.5. (new):

Part II of the installation manual shall contain installation instructions for all the vehicles belonging to the family of the parent vehicle(s):

- Retrofit system identification to make the installer understand on which car the system can be installed;
- Clear installation instructions related to components, type approval plate, wiring and electrical system.

Paragraph 7.1.5.2.2. (new):

New requirement to help the installer to identify the correct position of a component.

Paragraph 7.1.5.2.3. (new):

"Clear" is the appropriate word to make sure that the installation manual gives unmistakable information (by comparison to initial provision shown in the paragraph 7.1.4.2.3.).

Paragraph 7.2.:

The title shall be changed in accordance with justifications given for the paragraph 7.1.

Paragraphs 7.2.4.5. to 7.2.5.5.7. to be renumbered in paragraphs 7.2.2.5. to 7.2.3.5.7. further to an editorial mistake in the numbering of initial paragraph 7.2.4.5.

Paragraph 7.2.3. (new):

Change the title to be consistent with the paragraph 7.2.

Paragraph 8.:

- Editorial, the title shall read: "... and_extension ..."
- Editorial, the requirements shall address both LPG and CNG systems.

Paragraph 9., Conformity in production:

Requirements of the Regulation were considered too weak: need to clarify the responsibilities between the system manufacturer and the components suppliers.

Annex 1A:

The indications of vehicle category, emissions limits, and pollution control system type shall be shown in the Table 1 as they are important to refer properly to the vehicle family(ies).

The Table 3 shall also clearly mention the emission performance of the tested vehicles in the family for which a retrofit system is qualified.

Annex 2A:

Reference to the date on the marking plate is not requested for LPG components.

Annex 6:

This is a new annex introduced with the view to give minimum guidelines for the Authority to allow a laboratory to carry out under the responsibility of the system manufacturer an emission test (including OBD compliance) of a retrofit system fitted on a parent vehicle and/or a member of the vehicle family. See also the justifications given for the paragraphs 2.7.1.3. (emission test) and 2.7.1.5. (OBD test).

The requirements of this Annex are based on the following standards commonly used by testing laboratories in the Automotive Industry:

- EN 45003: 1995, calibration and testing laboratory accreditation systems: General requirements for operation and recognition;
 - EN ISO/CEI 17025: 1999, General requirements for the competence of testing and calibration laboratories (replacing previous EN 45001 dated December 1989);
 - FD ISO/TS 16949: 2002, quality management systems – Particular requirements for the application of ISO 9001:2000 for automotive production and relevant service part organizations.
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