

**INFORMAL GROUP ON GASEOUS FUEL VEHICLES**  
**Within the UN GRPE (WP29)**  
**PROPOSED AMENDMENT GFV-04-05**  
(REVISION OF THE AEGPL COMMENTS GFV-02-8)

**Name of Organisation submitting Amendment/Work Item:**  
AEGPL

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**Regulation name and reference number:** Regulation 115

**Name of Amendment/Work Item:**  
Comments to the proposals for Draft Amendment and Comments to Regulation 115 from the expert from Poland.

**Part 3 and 4 from the original document GFV-02-04 are in black and red:**  
**AEGPL comments are in blue:**

**3. Adaptation to technical progress and correction of provisions for M2, M3, N2, N3 vehicles**

It is proposed to amend provisions for M2, M3, N2, N3 vehicles in the following way.  
A13-mode test does not apply to Euro 3 and later vehicles.

This proposal refers only to the conversion of diesel engines to SI gas engines. It does not refer to dual-fuel engines.

**Paragraph 6.1.2.6, amend to read:**

“6.1.2.6. Exhaust emissions (M2, M3, N2 and N3 categories of vehicles)

The parent engine(s) are submitted to the tests indicated in Regulation No. 49 5/ as follows:

Measurements of emissions in the ~~13-mode-cycle~~ **ESC test** for the engine type approved pursuant to Regulation 49 or Directive 88/77/EEC row A or  
Measurements of emissions in the ~~13-mode-cycle~~ **ETC test** for the engine type approved pursuant to Regulation 49 or Directive 88/77/EEC row B1, B2, C

with each fuel:

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

The emissions of CO, HC and NOx ~~and particulates~~ are calculated according to Regulation No. 49 5/.

The parent engine(s) shall be tested with the reference diesel fuel before the retrofit. The total engine operation time between the tests before and after retrofit shall not exceed [20] hours. The ~~test~~ parent engine(s) with the reference diesel fuel shall comply with the limit values according to the type approval of the engine(s) applied during the type approval.

The requirements regarding emissions of the engine(s) equipped with the retrofit system, and with the LPG, shall be deemed to be fulfilled if the results meet for each regulated pollutant (CO, HC and NOx ~~and particulates~~) the following conditions:

- ~~(1)  $M < 0.85S + 0.4G$~~
- ~~(2)  $M < G$~~

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

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

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

- (1)  $(MA + MB)/2 < 0.85S + 0.4G$
- (2)  $MA$  and  $MB < G$

where:

$MA$ : value of the emissions of one pollutant (CO/HC/NO<sub>x</sub>)<sub>4/</sub> obtained from the ESC or ETC test with the retrofit system and with LPG A,

$MB$ : value of the emissions of one pollutant (CO/HC/NO<sub>x</sub>)<sub>4/</sub> obtained from the ESC or ETC test with the retrofit system and with LPG B,

$S$ : mean value of the emissions of one pollutant (CO/HC/NO<sub>x</sub>)<sub>4/</sub> obtained from the ESC or ETC test with the reference petrol,

$G$ : limit value of the emissions of one pollutant (CO/HC/NO<sub>x</sub>)<sub>4/</sub> according to the type approval of the engine in the ESC or ETC test."

#### 4. Correction of errors, unclear provisions etc.

Paragraphs 2.1.1 and 2.1.2, amend to read:

"2.1.1. Specific LPG retrofit system of an approved type may consist of several components as classified and approved according to Regulation No. 67, 01 series of amendments, Part I, ~~and~~ the specific vehicle ~~instruction~~ installation manual ~~and end-user manual~~."

"2.1.2. Specific CNG retrofit system of an approved type may consist of several components as classified and approved according to Regulation No. 110, Part

I, ~~and~~ the specific vehicle ~~instruction~~ installation manual and end-user manual."

**AEGPL comments for both paragraphs:**

Proposals: "....., Part I, and the specific vehicle instruction manuals"

Justification: Instruction manuals include installation manual and end-user manual (see par. 7 of the Regulation)

**Insert new paragraphs 2.xx, to read:**

"2.xx. "Safety device" means a pressure relief valve or fusible plug (fuse) or a combination of these two devices, as defined in Regulation 67, 01 series of amendments."

**AEGPL comments:** "safety device" is used in par. 2.2.5. together with the "fuel container accessories", that include "safety device" also. Therefore there is a redundancy; the introduction of this definition is not needed. As alternative, we agree on the GFV-02-04 proposal or to eliminate "safety device" wording from par 2.2.5.

"2.xx. "Original vehicle/engine" means a vehicle/engine before the installation of the retrofit system"

**Comments:** "original parent vehicle" is used only in par. 3.2.3. where it is required the "Description of all modifications applied to the original parent vehicle, only in case of bi-fuel configuration". In this case – that is the only one - , it is clear that the reference is to the vehicle before the installation of the retrofit system. In conclusion, Aegpl does not think a new definition is needed, but, if otherwise decided, we agree on the proposal of GFV-02-04.

"2.xx. "Gas injection device" means .....?"

**Comments:** "Gas injection device" is used several times in the text, so we agree to define it. In R. 67/01, the definition is:  
*"Gas injection device or injector or gas mixing piece" means a device which establishes the liquid or vaporized LPG to enter the engine;*

**Paragraph 2.2 needs correcting and clarifying:**

**General comments:**

**"Type":** In our view and taking into account what seems the most shared interpretation among TAA's, when "type" is not detailed with examples in brackets, "type" means "the same type-approval number".

**"The same manufacturer":** it is not a specific criterion, but the elimination of this characteristic could imply the risk to have "system assemblers" and not "system manufacturers". Leaving freedom to the "system assembler" to change different components of different

suppliers inside the same type-approval number poses some doubts on the fact that suitable arrangements exist between the system manufacturer and the components manufacturers for the supply and interchange of necessary technical information and documents.

- “2.2. retrofit system of an approved type” means systems, which do not differ in such respect as:
- 2.2.1. retrofit system manufacturer (responsible for retrofit approval application);
  - 2.2.2. pressure regulator/vaporiser type ~~by the same manufacturer~~ (only the type with which the parent vehicle(s)/engine(s) is(are) fitted can be used; different versions in respect of the maximum gas delivery are permitted);

#### Comments:

**Proposal:** *“pressure regulator/vaporiser type ~~by the same manufacturer~~ (different versions in respect of the maximum gas delivery are permitted);”*

**Justification:** the wording *“only the type with which the parent vehicle(s)/engine(s) is(are) fitted can be used”* is redundant.

In addition, for the specific case of par. 2.2.2., Aegpl agrees on the proposal of GFV-02-04 to cancel “by the same manufacturer” because “the same type approval” already includes “the same manufacturer”. So, “by the same manufacturer” is, in this case, redundant.

- 2.2.3. gas fuelling system type ~~by the same manufacturer~~ (i.e. induction mixer or gas injection device or injector ~~device~~, vapour or liquid, single or multi-point injection system, direct or indirect injection; for the gas injection device or injector only the type with which the parent vehicle(s)/engine(s) is(are) fitted can be used, different versions in respect of the maximum gas delivery are permitted);

#### Comments

**Proposal:** *“gas fuelling system type ~~by the same manufacturer~~ (i.e. induction mixer or gas injection device or injector ~~device~~, vapour or liquid, single or multi-point injection system, direct or indirect injection, different versions in respect of the maximum gas delivery are permitted);”*

**Justifications:** in this case, “type” is explained in brackets and, thus, it is not an administrative-related type but a technical-related one. Therefore, “by the same manufacturer” is a necessary additional characteristic (see general comments above);

- 2.2.4. sensors and actuators set types;
- 2.2.5. the fuel container type (i.e. ~~as amended by TRANS/WP.29/GRPE/2005/8~~ liquid take off/ vapour pressure, vapour take off, liquid take off / pressurized by pump), the safety devices and fuel container accessories, as required by Regulation No. 67, 01 series of amendments, or Regulation No. 110, where applicable. ~~(i.e. relief valve, ...);”~~

**Comments:** Aegpl agrees on the proposal above.

Aegpl agrees also on the proposal of GFV-02-04 to eliminate the wording *“the safety devices and fuel container accessories, as required by*

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*Regulation No. 67, 01 series of amendments, or Regulation No. 110, where applicable.”, as redundant (see comment (vi) of GVF-02-04)*

- 2.2.6. fuel container fitting devices;  
2.2.7. ECU (Electronic Control Unit) type ~~by the same manufacturer~~ (only the type with which the parent vehicle(s)/engine(s) is(are) fitted can be used; versions for different cylinder number/configuration are permitted);

#### Comments

**Proposal:** *“ECU (Electronic Control Unit) type by the same manufacturer (; versions for different cylinder number/configuration are permitted);”*

Deleted: *only the type with which the parent vehicle(s)/engine(s) is(are) fitted can be used*

**Justifications:** see justifications above

- 2.2.8. the same ~~basic~~ software ~~principles~~ and control strategy which are used in the parent vehicle(s)/engine(s) (software versions for different cylinder number/configuration are permitted);

#### Comments

**Proposal:** *“the same basic software principles and control strategy (software versions for different cylinder number/configuration are permitted);”*

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Deleted: *which are used in the parent vehicle(s)/engine(s)*

**Justifications:** basic software means all the settings that influence emissions (for instance, algorithm for the actuators control and the reading of emission-related sensors) excluding minor settings such as bug fixing and reading of non emission-related sensors.

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- 2.2.9. installation manual (see para. 7);  
2.2.10. end-user manual (see para. 7).

Note: With respect to paragraphs 2.2.4., 2.2.5. and 2.2.6., the manufacturer of the retrofit ~~system~~ can insert in his installation manual other components, included in the approval, as interchangeable items (see para. 7).”

#### Paragraphs 2.5.1 and 2.5.1.1 need correcting and clarifying:

- “2.5.1. According to this Regulation, “a member of the family” is a vehicle equipped with retrofit system type of which type approval is requested and sharing the following essential characteristics with its parent one:”

#### Comment.

(i) According to our interpretation this definition refers to a vehicle after the retrofit (“....a vehicle equipped with retrofit system type....”), but according to some technical services this definition refers to the situation before the retrofit, to the original vehicle. This problem should be clarified.

**AEGPL general comments:** the wording “....a vehicle equipped with retrofit system type....” is misleading.

In our view, the targets of this paragraph are the consistency and the simplification of the checks aimed at establishing whether a vehicle is or not a member of the family. In other words, if “a member of family” is considered a vehicle without the retrofit system, also the parent vehicle with which it shares the listed characteristics shall be taken without the retrofit system.

If this kind of consistency is ensured, there will be no substantial difference in the final results – individuation of the vehicle family - of the two solutions (with and without retrofit system applied).

Given that, with the view to ensure a simple and viable check, it is better to refer to the “original member-vehicle” (without retrofit system) in order to use the already available official information (M/N category, Euro category, power....) of the vehicle, and, thus, avoiding difficult and useless evaluation and/or tests on family cars.

(ii) The definition in the current paragraph 2.5.1.1 should apply only to M1 and N1 vehicles. It is not suitable for M2, M3, N2, N3 vehicles. According to Regulation 49, an engine type-approved under Regulation 49 can be used in any vehicle, irrespective of its manufacturer and category. **It is not justified that Regulation 115 should be more restrictive than Regulation 49.** That is why it is proposed to introduce separate definition for M2, M3, N2, N3 vehicles. Comment (i) above applies also to the proposed definition for M2, M3, N2, N3 vehicles.

**Comments: AEGPL agrees.**

**2.5.1.1. For M1 and N1 vehicles:**

(a) It is produced by the same vehicle manufacturer.

Comment. FIAT, Lancia, Alfa Romeo – the same family?  
VW, Skoda, Audi, Seat – the same family?  
Vauxhall, Opel – the same family?

**Comments: AEGPL agrees to refer to the same family and not to the single vehicle manufacturer - in his capacity of type-approval holder -, or by interpretation either by a proper amendment, if necessary.**

(b) It is classified in the same category M<sub>1</sub> ~~or M<sub>2</sub>~~ ~~or M<sub>3</sub>~~ or N<sub>1</sub> ~~or N<sub>2</sub>~~ ~~or N<sub>3</sub>~~. Vehicles of category M<sub>1</sub> and N<sub>1</sub> class I may belong to the same family.

Comment. It is not clear if it refers to the situation before or after the retrofit.

(c) It is subject to the same emission limits or those specified in earlier series of amendments of the applicable Regulation.

Comment. It is not clear if this provision refers to the limits before or after the retrofit. According to paragraph 6.1.2.5.1.3 vehicles fuelled with LPG should meet the requirements the original vehicle had to comply with at the date of its approval. All these provisions are not coherent.

**Comments: see general comments.**

(d) If the gas fuelling system has a central metering for the whole engine: it has an approved **maximum net** 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 **maximum net** 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).

Comment. It is not clear if it refers to petrol feed (original vehicle) or gas feed (after the retrofit). In paragraph 2.2.3 the single-point or multi-point injection is specified as a criterion for the retrofit system type. Does subparagraph (e) refer to the petrol feed?

- (f) It has the same pollution control system:
- same type of catalyst if fitted (three-way, oxidation, de NO<sub>x</sub>),
  - air injection (with or without),
  - exhaust gas recirculation (EGR) (with or without).

If the ~~tested parent~~ vehicle was not equipped with air-injection or EGR, ~~engines- vehicles~~ with these devices are allowed."

**Comments: Aegpl agrees.**

**Insert a new paragraph 2.5.1.x, to read:**

"2.5.1.x. For M2, M3, N2, N3 vehicles:

(a) Its engine is produced by the same manufacturer.

(b) It is subject to the same emission limits or those specified in earlier series of amendments of the applicable Regulation.

(c) If the gas fuelling system has a central metering for the whole engine: it has an approved maximum net 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 maximum net power output per cylinder between 0.7 and 1.15 times that of the engine of the parent vehicle.

(d) Fuel feed and combustion process (injection: direct or indirect, single-point or multi-point).

(e) It has the same pollution control system:

- same type of catalyst if fitted (three-way, oxidation, de NO<sub>x</sub>),
- air injection (with or without),
- exhaust gas recirculation (EGR) (with or without).

If the parent vehicle was not equipped with air-injection or EGR, vehicles with these devices are allowed."

**Comments: Aegpl agrees**

**Paragraph 2.5.1.2, this paragraph needs clarifying:**

"2.5.1.2. With regard to the requirement of paragraph 2.5.1.1.(a), the vehicle family can also cover vehicles produced by other vehicle manufacturers if it can be demonstrated to the type approval authority that the same engine type and emission strategy is used."

Comment. How can a technical service verify that the same strategy is used? What are criteria?

**Comments: ????**

**Paragraph 2.5.1.3, amend to read:**

- "2.5.1.3. With regard to requirement of paragraph 2.5.1.1.(d) and 2.5.1.x (c):
- in the case of a central metering for the whole vehicle where a demonstration shows that two gas fuelled vehicles could be members of the same family with the exception of their approved **maximum net** power output, respectively P1 and P2 ( $P1 < P2$ ), and both are tested as if they were parent vehicles, the family relation will be considered valid for any vehicle with an approved **maximum net** power output between  $0.7 \cdot P1$  and  $1.15 \cdot P2$ ;
  - in the case of an individual metering per cylinder where a demonstration shows two gas fuelled vehicles could be members of the same family with the exception of their approved **maximum net** power output **per cylinder**, respectively P1 and P2 ( $P1 < P2$ ), and both are tested as if they were parent vehicles, the family relation will be considered valid for any vehicle with an approved **maximum net** power output **per cylinder** between  $0.7 \cdot P1$  and  $1.15 \cdot P2$ ."

Justification. Self-evident.

**Chapter 3, amend to read:**

3. APPLICATION FOR APPROVAL
- 3.1. The application for approval of a specific retrofit system shall be submitted by **its** manufacturer or by his duly accredited representative.
- 3.2. It shall be accompanied by the under-mentioned documents in triplicate and by the following details:
- 3.2.1. Description of the retrofit system comprising all the relevant details, included the approval numbers of each component, referred to in **item 2 of Annex 3A** to this Regulation for LPG system and Annex 3B to this Regulation for CNG system.
- 3.2.2. Description of the parent vehicle(s) on which the requirements of this Regulation are going to be tested **and the vehicles for which the retrofit system is proposed to be qualified, comprising all the relevant details referred to in item 1 of Annex 3A to this Regulation for LPG system and Annex 3B to this Regulation for CNG system.**

**Comments:**

**Proposal:** *"3.2.2. Description of the parent vehicle(s) on which the requirements of this Regulation are going to be tested;*

*3.2.x. Description of vehicles for which the retrofit system is proposed to be qualified, comprising all the relevant details referred to in item X of Annex 3A to this Regulation for LPG system and Annex 3B to this Regulation for CNG system."*

**Justifications:** Aegpl agrees to insert the description of the vehicles for which the system is proposed to be qualified, but creating a new ad-hoc item X. This item will contain all the details that are necessary for the



qualification of the vehicle as a member of family (see amendment proposals to Annex 3A, item 1). In other words, Aegpl proposes to restrict the quantity of information to be provided for non-parent vehicle to the data related to paragraph 2.5.1.1.

3.2.3. Description of all modifications applied to the original parent vehicle. ~~only in case of bi-fuel configuration~~

~~3.2.4. Verification of compliance with the specifications prescribed in paragraph 6 of this Regulation;~~

**Comments: Aegpl agrees because verification of compliance is issued only after having tested the vehicles.**

3.2.4. Installation manual(s) for the retrofit system installation on the parent vehicle(s).

3.2.5. End-user manual.

3.2.6. If needed for the purpose of paragraph 5.3., notice of approval of the retrofit system for a parent vehicle which is different from those the approval is applied for, certifying that the retrofit system has been approved as a "master-slave" system, as defined in paragraph 2.1.6.

3.2.x. A list of vehicle type(s) for which the retrofit system is qualified, containing all the details specified in item 3 of Addendum to Annex 1A to this Regulation for LPG system or Annex 1B to this Regulation for CNG system.

**Comments: Aegpl does not agree to insert this new par (see proposal and relevant justifications to par.s 3.2.2. and 3.2.4.)**

3.3. A sample of the specific retrofit system, properly installed in the parent vehicle(s) ~~shall be submitted to the technical service.~~

**Paragraph 5.3, amend to read:**

"5.3. Notice of approval or of refusal ~~or of extension~~ of approval of a retrofit system type/~~part~~ pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation, by means of a form conforming to the model in annexes 1A and 1B to this Regulation."

Justification. Chapter 5 refers to the approval. Chapter 8 refers to the extension. Notice of extension – see paragraph 8.3.

**Paragraph 6.1.1.3, amend to read:**

"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 ~~cyllindrical~~ fuel container, the requirements of Regulation No. 67, 01 series of amendments shall be deemed to be met if the requirements of annex 5 to the present Regulation are satisfied."

**Paragraph 6.1.2, amend to read:**

"6.1.2. Pollutants emissions and CO<sub>2</sub> emissions ~~(for category M<sub>1</sub> and N1 vehicles only)~~ " "

**Paragraph 6.1.2.4, amend to read:**

"6.1.2.4. "Pollutants" means:  
(i) carbon monoxide  
(ii) hydrocarbons assuming a ratio:  
CH<sub>1.85</sub> for petrol,  
CH<sub>1.86</sub> for diesel fuel,  
~~CH<sub>2.52</sub>~~ CH<sub>2.55</sub> for LPG for vehicles of M1 and N1 categories, CH<sub>2.57</sub> for  
LPG for vehicles of M2, M3, N2 and N3 categories,  
CH (to be defined) for dual fuel;  
(iii) oxides of nitrogen, the latter being expressed in nitrogen dioxide (NO<sub>2</sub>)  
equivalent.  
(iv) particulates~~, etc.~~."

Justification. See the separate document "Regulations 49 and 83 – LPG reference fuel" related to the correction of LPG density in Regulations 49, 83, 101, 115, already transmitted to GFV.

**Paragraph 6.1.2.5.1.1, amend to read:**

"6.1.2.5.1.1. Three measurements of tailpipe emissions shall be performed after a cold start with each fuel:  
(i) reference petrol,  
(ii) reference LPG A,  
(iii) reference LPG B.

The reference mass of the parent vehicle equipped with the retrofit system and tested with petrol shall be equal to that of the original vehicle. The reference mass of the parent vehicle equipped with the retrofit system and tested with LPG shall be determined according to the provision of Regulation 83.

The emissions of CO, HC, NO<sub>x</sub> ~~and HC + NO<sub>x</sub>~~ are calculated according Regulation No. 83. 4/ "

Justification.

- (i) The reference mass of a vehicle ~~equipped with the retrofit system differs from that of the original vehicle. A question arises how to test vehicles after the retrofit.~~
- (ii) The sum HC + NO<sub>x</sub> is subject to limitation only for diesel vehicles of M1 and N1 category. Regulation 115 does not apply to such vehicles.

**Paragraph 6.1.2.5.1.2, amend to read:**

"6.1.2.5.1.2. 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 limit ~~divided by the deterioration factor.~~

Notwithstanding the provision of the first indent, the mono-fuel vehicle may be tested with the reference petrol before the retrofit if tests after the installation of the retrofit system are not possible or may result in false results. The total vehicle mileage between the tests before and after retrofit shall not exceed [200] km. "

**Comments: Aegpl agrees to insert the new sentence related to mono-fuel gas vehicle.**

**Paragraph 6.1.2.5.1.3, amend to read:**

"6.1.2.5.1.3. 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<sub>x</sub>) or~~ (CO, HC, NO<sub>x</sub>) 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<sub>x</sub>) 4/ ~~or the sum of two pollutants (HC + NO<sub>x</sub>)~~ 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<sub>x</sub>) 4/ ~~of the sum of two pollutants (HC + NO<sub>x</sub>)~~ 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<sub>x</sub>) 4/ ~~or the sum of two pollutants (HC + NO<sub>x</sub>)~~ obtained from the three Type I tests with the reference petrol,

G: limit value of the emissions of one pollutant (CO/HC/NO<sub>x</sub>) 4/ ~~or the sum of two pollutants (HC + NO<sub>x</sub>)~~ according to the type approval of the vehicle(s) divided by the deterioration factors."

**Paragraphs from 6.1.2.5.2 to 6.1.2.5.2.2 should be deleted.**

Justification. Regulation 115 is supposed to be applicable to Euro 3 and later vehicles. The CO limit value at idle for vehicles having a maximum mass exceeding 3500 kg is 3.5% vol. Such vehicles can hardly be regarded as Euro 3.

**Paragraph 6.1.2.5.3.2 and 6.1.2.5.3.3**

Comment. The calculation of fuel consumption does seem to be really required.  $K_{\text{cons}}$  is not specified in Annex 1.

**Paragraph 6.1.3.1, amend to read:**

"6.1.3.1. One LPG retrofit system sample as described in paragraph 2 of this Regulation, installed in the parent vehicle(s) or on the parent engine(s) shall be submitted to the test procedures of paragraph 6.1.3.2. or 6.1.3.3. The

measured **maximum** power with LPG shall be lower than that measured with petrol + 5 per cent.

Notwithstanding the provision of the first indent, mono-fuel vehicles of M1 and N1 categories may be tested with the reference petrol before the retrofit if tests after the installation of the retrofit system are not possible or may result in false results. The total vehicle mileage between the tests before and after the retrofit shall not exceed [200] km."

Notwithstanding the provision of the first indent, vehicles of M2, M3, N2, N3 categories or their engines shall be tested with the reference diesel fuel before the retrofit. The total vehicle mileage between the tests before and after the retrofit shall not exceed [500] km. The total engine operation time between the tests before and after the retrofit shall not exceed [20] h.

....."

Justification. Self-evident.

**Paragraph 6.1.3.2, amend to read:**

"6.1.3.2. Chassis dynamometer method:

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

- (i) reference petrol **or diesel fuel**,
- (ii) reference LPG A or B.

....."

Justification and comment.

(i) Paragraph 6.1.3.2 applies also to M2, M3, N2, N3 vehicles.

(ii) This paragraph needs complementing, for instance:

- two measurement methods on a chassis dynamometer may be used; constant speed method and acceleration method; which is supposed to be used in this case?
- measurement conditions,
- how many measurements have to be conducted?
- correction to standard ambient conditions etc.

**Paragraph 6.1.3.3, amend to read:**

"6.1.3.3. Engine dynamometer method:

The maximum power at the crankshaft is measured on an engine dynamometer according to Regulation No. 85 for each parent vehicle(s) with the following fuels:

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

The mean of power measurements shall be calculated as follows:

.....  
.....

where:

- n – number of parent vehicles/engines (i = 1 to n),  
Power<sub>petrol</sub> - mean value of maximum power measured with petrol, kW,  
Power<sub>LPG</sub> - mean value of maximum power measured with LPG A or B, kW.

.....”

**Paragraphs 8.1, amend to read:**

- 8.1. Every modification of the installation of the specific ~~equipment~~ retrofit system for the use of LPG and compressed natural gas in the propulsion system of the vehicle shall be notified to the authority, which granted the retrofit system type approval. The authority may then either:

**Annex 1A, item 11 and 11.1**

It is not clear what information should be given in these 2 items. A list of vehicle types for which the retrofit system is qualified and emission requirements for each of them? A list of vehicle types is given in item 3 of Addendum. As regards the emission requirements the following information are desirable:

“11.1. Emission requirements:

~~Has the retrofit system demonstrated to be "non-intrusive": yes/no 2/~~

Regulation 83, .....series of amendments, level A (2000), B (2005),  
Directive 70/220/EEC as amended by Directive ....., level A (2000), B (2005),  
Regulation 49, .....series of amendments, row A (2000), B1 (2005), B2 (2008), C (EEV),  
Directive 88/77/EEC as amended by Directive ....., row A (2000), B1 (2005), B2 (2008), C (EEV).”

Comment. These 2 items seem to be redundant. The emission requirements (item 11.1) may be specified in item 3 of Addendum.

**Aegpl comments: we do not agree to eliminate the wording “Has the retrofit system demonstrated to be "non intrusive": yes/no 2/ , while we do agree to amend the next indents as proposed above.**

**Annex 1A, Addendum, item 1 needs correcting and clarifying:**

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

Vehicle/ <del>engine</del> No.	1	2	n
Make:			
Type:			
Category, <del>class</del> :			
Emission limits *:			
Maximum net power:			
Pollution control system type**:			

\* according to the type-approval of the original vehicle ?

\*\* type of catalyst if fitted (three-way, oxidation, de NO<sub>x</sub>),  
 air injection (with or without),  
 exhaust gas recirculation (EGR) (with or without).

Justification and comment.

It is not clear – category, class, emission limits, power for the original vehicle or after the retrofit?

Engines not vehicles are tested for M2, M3, N2, N3 categories.

“Class” is required – see paragraph 2.5.1.1.

**Comments: Aegpl agrees on the proposal, eliminating the question mark from the end of the first footnote ( \* ).**

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

"3. Vehicles type(s) for which the retrofit ~~equipment~~ system type is qualified:

Fuel		Petrol (or diesel) 1/					LPG				
Vehicle type	Engine type	Power 4/ (kW)	CO 3/ (g/km)	HC 3/ (g/km)	NO <sub>x</sub> 3/ (g/km)	CO <sub>2</sub> 2/ (g/km)	Power 4/ (kW)	CO 3/ (g/km)	HC 3/ (g/km)	NO <sub>x</sub> 3/ (g/km)	CO <sub>2</sub> 2/ (g/km)

1/ Strike out what does not apply.

2/ Applicable to vehicles of category M1 and N1 only. **Type-approval values of the original vehicle multiplied by K<sub>CO2</sub> shall be specified for each vehicle type.**

3/ Applicable only to parent vehicle(s). **The mean test results shall be specified.**

4/ **Type-approval values of the original vehicle multiplied by K<sub>power</sub> shall be specified for each vehicle type.**

Justification. Footnotes clarify how to complete item 3.

**Comments: Aegpl does not agree to insert the wording in “Type-approval values of the original vehicle multiplied by K<sub>CO2</sub> shall be specified for each vehicle type” in the footnote 2/ and does not agree to add the footnote 4/.**

**Justification: there is only one Kratio for each parameter, CO2 and power, and they have to be reported in item 2 of Annex 3A. Therefore, the splitting of the two factors (CO2 official value and the Kfactor) is useless and could generate confusion for formal use/publication of final CO2 emissions or power data, for instance when reporting them into the registration documents.**

#### Annex 2A

Comment.

(i). Some approval authorities assign wrong approval numbers to the approved retrofit system. The assigned number is:

115R - 02xxxx

instead of:

115R – 00xxxx.

(ii). Nobody knows what technical information should be placed on the plate:

- names of all the components of the retrofit systems, or
- names of all the components of the retrofit systems and their manufacturer (points.....), or

- names of all the components of the retrofit systems and their make and type (points.....).

This problem needs clarifying.

### Annex 3A, item 1, amend to read:

1. Description of the parent vehicle/engine and vehicle/engine for which the retrofit system is qualified <sup>1)</sup>

<sup>1)</sup> Specify for each parent vehicle/engine and each vehicle/engine for which the retrofit system is qualified

1.1. Name and address of the manufacturer.....

1.2. Category, class and identification type.....

1.3. Chassis identification number .....

1.4. Certification number .....

Comment. It is understood that the number of the “holistic” type-approval should be specified. In the ECE system, there is no “holistic” type-approval. What number should be specified:

- for M1 – the number of EU “holistic” type-approval, Russian, Ukrainian certification etc?
- for M2, M3, N1, N2, N3 - the number of German, French, Polish etc. national type-approval?

1.x. Mass of the vehicle in running order (for M1, N1 vehicle).....

Comment. For the original vehicle or after the retrofit, depending on the decision of GFV.

1.x. Maximum mass of the vehicle

1.x. Emission requirements

- for M1, N1 vehicle: Regulation 83, .....series of amendments, level A (2000), B (2005); Directive 70/220/EEC as amended by Directive ..... level A (2000), B (2005),

-for M2, M3, N2, N3 vehicle: Regulation 49, .....series of amendments, row A (2000), B1 (2005), B2 (2008), C (EEV); Directive 88/77/EEC as amended by Directive ....., row A (2000), B1 (2005), B2 (2008), C (EEV).

1.5. Internal combustion engine identification type.....

1.5.1. Working principle and thermodynamic cycle: positive ignition/ compression ignition, four-stroke/two-stroke.....

1.5.2. Naturally aspirated or pressure charged .....

Comment. Is it really required?

~~1.5.3. Engine displacement .....~~

1.5.x. Engine maximum net power.....

Comment. Original vehicle or after the retrofit depending on the decision of GFV

1.5.x. Fuel feed and combustion process (single-point or multipoint or direct injection).  
Comment. For the original vehicle (petrol feed) or after the retrofit (LPG feed) depending on the decision of GFV.

1.5.4. Catalyst ~~system~~ type.....

1.5.x. Air injection (with or without).....

1.5.x. Exhaust gas recirculation (with or without).....

~~1.5.5. Ignition system type .....~~

Justification. In item 1 all particulars listed in paragraph 2.5.1 should be specified for all parent vehicles/engines and member of the family. As regards M2, M3, N2, N3 categories, those particulars should be specified for:

- parent engine(s),
- all members of the engine family,
- all vehicles for which the system is qualified.

**Comments: Aegpl agrees on the proposal above that implements item 1 with new information, but, at the same time, proposes to leave this item restricted to the description of the parent vehicle, before the installation of the retrofit system (see also comments to par. 2.5.1.)**

**Aegpl proposes a new item X for all vehicles for which the retrofit system is qualified. This item will contain all the details that are necessary for the qualification of the vehicle as a member of family (see amendment proposals to Annex 3A). In other words, Aegpl proposes to restrict the quantity of information to be provided for non-parent vehicle to the data related to paragraph 2.5.1.1.**

**Proposal:**

**Annex 3A, insert a new item X:**

***“Item X Description of each vehicle/engine for which the retrofit system is qualified***

***X.1. Name and address of the manufacturer.....***

***X.2. Category and class .....***

***X.3. Emission requirements***

***- for M1, N1 vehicle: Regulation 83, .....series of amendments, level A (2000), B (2005); Directive 70/220/EEC as amended by Directive ..... level A (2000), B (2005),***

***-for M2, M3, N2, N3 vehicle: Regulation 49, .....series of amendments, row A (2000), B1 (2005), B2 (2008), C (EEV); Directive 88/77/EEC as amended by Directive ....., row A (2000), B1 (2005), B2 (2008), C (EEV).***

***X.4. Maximum net power.....***

***X.5. Number of engine cylinders***



- X.6. Fuel feed and combustion process (single-point or multipoint or direct injection).
- X.7 Catalyst type. (three-way, oxidation, de NO<sub>x</sub>).....
- X.7.1. Air injection (with or without).....
- X.7.2. Exhaust gas recirculation (with or without).....”

Annex 3A, item 2, amend to read:

“2. Description of the LPG retrofit system <sup>2)</sup>  
.....”

<sup>2)</sup> Specify also for all alternative components, if applicable.

Annex 3A, insert a new item to read:

“2.19.x. Software and system strategy, all the settings included.”

Justification. See paragraph 2.2.6.