

Submitted by Castagnini
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Changes to supplement 4 to Regulation 115 are made on bold characters and/or via strikethroughs :

Clarification of the definitions via:

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2. Definitions

...

2.1.3. "A vehicle is considered mono-fuel", when, after the retrofit operation, **it is designed primarily for permanent running on LPG or CNG, but may also have a petrol system for emergency purposes or starting only, where the capacity of the petrol tank does not exceed 15 litres.** ~~it is equipped with a petrol tank of capacity \leq 15 litres, that can only be used to "limp-home".~~

2.1.4. "A vehicle is considered bi-fuel" when, after the retrofit ~~, it is equipped to operate on both petrol and LPG or CNG, with a petrol tank capacity exceeding 15 litres.~~ **operation, it is equipped with a gas storage and a separated petrol storage, with a capacity exceeding 15 litres, and it can run on petrol (petrol mode) and also on either LPG or CNG (gas mode)**

2.1.4.1. "A vehicle is considered bi-fuel Type A" when, after the retrofit operation it is a bi-fuel vehicle that is **designed to run on only one fuel at a time; (the simultaneous operation on both fuels is permitted during the fuel switch over for a short period of time-** *Mr Radzimirski*)

2.1.4.2 "A vehicle is considered bi-fuel Type B" when, after the retrofit operation, it is a bi-fuel vehicle that in gas mode is **designed to make a limited use of petrol also simultaneously with gas.**

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Clarification of the requirements for each running mode:

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

- (a) LPG only (**LPG mode**) in case of ~~(mono-fuel)~~⁴
- (b) ~~Both~~ **either** unleaded petrol (**petrol mode**) or LPG (**LPG mode**) in case of ~~(bi-fuel)~~
- (c) Both diesel fuel or diesel fuel and LPG (dual fuel)

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

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6.1.2.4.1.3. **Exhaust emissions test in petrol mode**

Subject to the requirements of paragraph 6.1.2.4.1.5., the tests shall be repeated three times using reference petrol. The parent vehicle(s), equipped with the retrofit system, shall comply with the limit values according to the type approval of the original vehicle(s) including the deterioration factors applied during the type approval of the original vehicle(s).

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6.1.2.4.1.6. **Exhaust emissions test in LPG mode**

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

The parent vehicle, equipped with the retrofit system, shall comply with the limit values according to the type approval of the original vehicle(s) including the deterioration factors applied during the type approval of the original vehicle(s).

6.1.2.4.1.6.1 **Additional requirements for mono-fuel and bi-fuel Type A vehicles**

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

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

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

6.1.2.4.1.6.2 **Additional requirements for bi-fuel Type B vehicles**

It is permissible to use petrol during the entire test cycle and also simultaneously with LPG provided that the consumption of LPG in energy unit is equal or higher than 80% of the total energy consumed during the test.

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

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

(a) CNG only (CNG mode) in case of {mono-fuel}⁴

(b) ~~Both~~ **either** unleaded petrol (petrol mode) or CNG (CNG mode) in case of {bi-fuel}

(c) Both diesel fuel or diesel fuel and CNG (dual fuel)

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

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6.2.2.4.1.3. Exhaust emissions test in petrol mode

Subject to the requirements of paragraph 6.2.2.4.1.5., the tests shall be repeated three times using reference petrol. The parent vehicle(s), equipped with the retrofit system, shall comply with the limit values according to the type approval of the original vehicle(s) including the deterioration factors applied during the type approval of the original vehicle(s).

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6.2.2.4.1.6. Exhaust emissions test in CNG mode

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

The parent vehicle(s), equipped with the retrofit system, shall comply with the limit values according to the type approval of the original vehicle(s) including the deterioration factors applied during the type approval of the original vehicle(s).

6.1.2.4.1.6.1 Additional requirements for mono-fuel and bi-fuel Type A vehicles

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

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

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

6.1.2.4.1.6.2 Additional requirements for bi-fuel Type B vehicles

It is permissible to use petrol during the entire test cycle and also simultaneously with CNG provided that the consumption of CNG in energy unit is equal or higher than 80% of the total energy consumed during the test.

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

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Addition of a new paragraph 1.a in Annex 1A “Communication” (renumbering to be done in due time):

“

1. LPG retrofit equipment considered:

...

1.a. Retrofit system for mono-fuel/bi-fuel Type A vehicles/ bi-fuel Type B vehicles ²

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Addition of a new paragraph 2.1.a in Annex 3A “Complete list of information for the purpose of the LPG retrofit system installed on vehicle type approval” (renumbering to be done in due time):

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- 2. Description of the LPG retrofit system
- 2.1. Trade name or mark holder
- 2.1.a Retrofit system for mono-fuel/bi-fuel Type A vehicles/bi-fuel Type B vehicles ¹**

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Addition of a new paragraph 1.a in Annex 1B “Communication” (renumbering to be done in due time):

“

- 1. CNG retrofit equipment comprising:
 - ...
 - 1.a. Retrofit system for mono-fuel/bi-fuel Type A vehicles/ bi-fuel Type B vehicles ²**

“

Addition of a new paragraph 2.1.a in Annex 3B “Complete list of information for the purpose of the CNG retrofit system installed on vehicle type approval” (renumbering to be done in due time):

“

- 2. Description of the CNG retrofit system
- 2.1. Trade name or mark holder
- 2.1.a Retrofit system for mono-fuel/bi-fuel Type A vehicles/bi-fuel Type B vehicles ¹**

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Addition of a new Annex 6A “Bi-fuel Type B vehicle - Calculation of LPG energy consumption”:

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Annex 6A

Bi-fuel Type B vehicle - Calculation of LPG energy consumption

1. Measurement of the LPG mass consumed during the cycle

Measurement of the LPG mass consumed during the Type 1 test cycle shall be done by a fuel weighing system capable to measure the LPG storage container at the beginning and at the end of the test in accordance with the following:

- (a) an accuracy of ± 2 per cent of the difference between the two readings at the beginning and the end of the test or better;
- (b) a precision of ± 1 per cent of full scale or better.

Precautions shall be taken to avoid measurement errors.

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

2. Calculation of energy percentage of LPG use on total energy consumed

The following condition shall be fulfilled:

$$M_{lpg} * 100 / (FC_{mean} * dist * d) \geq 80\%$$

Where

M_{lpg}: the LPG mass consumed during the cycle

FC_{mean}: the mean fuel consumption calculated in accordance with par. 6.1.2.4.3.2

dist= distance travelled during the cycle.

d=0.538kg/liter

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[Addition of a new Annex 6B “Bi-fuel TypeB vehicle - Calculation of CNG energy consumption”](#):

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Annex 6B

Bi-fuel Type B vehicle - Calculation of CNG energy consumption

1. Measurement of the CNG mass consumed during the cycle

Measurement of the CNG mass consumed during the cycle shall be done by a fuel weighing system capable to measure the CNG storage container at the beginning and at the end of the test in accordance with the following:

- (a) an accuracy of ± 2 per cent of the difference between the two readings at the beginning and the end of the test or better;
- (b) a precision of ± 1 per cent of full scale or better.

Precautions shall be taken to avoid measurement errors.

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

2. Calculation of energy percentage of CNG use on total energy consumed

The following condition shall be fulfilled:

$$M_{\text{CNG}} \cdot 100 / (FC_{\text{mean}} \cdot \text{dist} \cdot d) \geq 80\%$$

Where

M_{CNG} : the CNG mass consumed during the cycle

FC_{mean} : the mean fuel consumption calculated in accordance with par. 6.2.2.4.3.2

dist = distance travelled during the cycle.

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

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