

## Proposals on ECE/TRANS/WP.29/GRSG/2013/29

### Amendments to UN Regulation No. 67/01 (LPG equipment)

The text reproduced below was prepared by the expert from the European Liquefied Petroleum Gas Association (AEGPL) to correct an essential requirement of the document ECE/TRANS/WP.29/GRSG/2013/29 and to complete it with new provisions principally aimed at inserting more detailed testing procedures as requested by the experts from Germany (see report ECE/TRANS/WP.29/GRSG/84, para. 36). The modifications to the existing text are marked in underlined, bold and blue characters. The comments refer to the modifications.

Part II, insert new paragraphs 17.1.97-6. to 17.1.107-9., to read:

Comment: The paragraphs have been renumbered more appropriately keeping them in the general session of para.17

"17.1.97-6. Means shall be provided to prevent any flow of gaseous fuel into the petrol or diesel tank under all operating temperature **and** , pressure conditions as well as in case of a fault. These measures shall be demonstrated during the type approval.

17.1.107-7. Means shall be provided to prevent flows of petrol or diesel into the LPG fuel tank which could lead to:

- (a) An overfilling of the LPG tank (i.e. above 80 per cent of its capacity);
- (b) **And/or** a content of petrol or diesel higher than **respectively 12-16 or 14** per cent of the **actual liquid volume contained in the LPG tank capacity**.

Comment: the limit of 12% of tank capacity would allow the presence of pure petrol or diesel in the LPG tank, even if limited. Therefore, the correct limit has to be expressed as percentage blending of petrol or diesel into the actual liquid volume. The equivalent value of 20% in energy (as prescribed by Regulations Nos. 83 and 115) of petrol or diesel blending in the actual liquid volume corresponds respectively to 16% or 14% in volume (see table below).

~~17.1.7.8.~~ The **present provisions of paragraph 17.1.7.7.** shall be considered under all operating temperature and pressure conditions as well as in case of a fault, e.g. by use of redundant components, activation of limp home mode or of a malfunction indication to the driver. These measures shall be demonstrated during the type approval **in accordance with the procedure laid down in the following subparagraphs 17.1.10.1, 17.1.10.2 and 17.1.10.3.**

Comment: the additional sentence is to introduce the procedures to demonstrate compliance with points (a) and (b) of paragraph 17.1.10.

- 17.1.10.1. requires the manufacturer to provide the Technical Service with documentation suitable to describe the means and the related functioning and strategies used to avoid the excess of the limits set out in the aforesaid points;

- 17.1.10.2 provides the procedures to verify compliance with point (a) of para. 17.1.10;
- 17.1.10.3 provides the procedures to verify compliance with point (b) of para. 17.1.10;
- Procedures proposed in paragraphs 17.1.10.2 and 17.1.10.3 are based on weighing measurement system of the LPG container in order to ensure more precise and independent measuring to the technical service, rather than, for instance, relying on manufacturer's liquid level indicator.

**17.1.10.1. The following documentation shall be provided to the Technical Service:-**

- two comprehensive documents that include the description of all equipment, monitored parameters, relevant factors, criteria and actions used to ensure compliance with the requirements set out respectively in point (a) and (b) of paragraph 17.1.7.7;**
- two detailed flowcharts that depict the strategies used for the purposes of meeting the requirements set out respectively in point (a) and (b) of paragraph 17.1.7.7;**

**17.1.10.2. In order to verify compliance with point (a) of paragraph 17.1.10., a vehicle shall be tested as follows:**

**Test procedure**

- install the LPG equipment other than the container on the vehicle;**
- place the container on a weighing system;**
- fill up the LPG tank with LPG until the 80 per cent stop valve activates;**
- record the reading of the weighing system ( $W_1$ );**
- simulate the operation or the working condition that triggers a flow of petrol or diesel into the LPG tank (for instance, the switch over from LPG to petrol, or vice versa, in the case of direct injection LPG-system);**
- record the reading of the weighing system ( $W_2$ );**

**Test interpretation**

**The criteria adopted for the interpretation of the test is as follows:**

$$W_2=W_1$$

**17.1.10.3. In order to verify compliance with point (b) of paragraph 17.1.7.7., a vehicle shall be tested as follows:**

**Test procedure**

- install the LPG equipment other than the container on the vehicle;**
- place the container on a weighing system;**
- record the reading of the weighing system ( $W_{tare}$ )**

*Comment:* *the weight of the tare includes the weight of the container, its accessories and piping connected to it, so as to be measured.*

- fill up the LPG tank with LPG below 60% of its nominal capacity;**

Comment: the limitation to 60% ensures that the reverse flows induced by the simulated operations of point (f) do not make the liquid level reach 80% maximum filling, thus avoiding the activation of strategies of par. 17.1.10.2.

(e) after having pressurized the LPG-system up to the normal operating conditions, record the reading of the weighing system ( $W_1$ );

Comment: the first measure of the container weight has to be carried out after having pressurized the LPG-system, operation that reduces the LPG volume contained in the tank.

(f) simulate the operation or the working condition that triggers a flow of petrol or diesel into the LPG tank (for instance, the switch over from LPG to petrol, or vice versa, in the case of direct injection LPG-system);

(g) repeat the action (f) until no petrol or diesel flow into the LPG tank occurs;

(h) record the reading of the weighing system ( $W_2$ );

#### Test interpretation

The criteria adopted for the interpretation of the test is as follows:

$$1/[1 + (W_1 - W_{tare})/(W_2 - W_1) * d_{petrol}/d_{lpg}] \leq 0,16 \text{ for petrol}$$

or

$$1/[1 + (W_1 - W_{tare})/(W_2 - W_1) * d_{diesel}/d_{lpg}] \leq 0,14 \text{ for diesel}$$

Comment: The formula above has been determined as follows (the example refers to petrol):

$$V_{petrol}/V_{tot} \leq 0,14 \quad (1)$$

Where:

$$V_{petrol} = (W_2 - W_1)/d_{petrol} \quad (2)$$

In facts, the difference between  $W_2$  and  $W_1$  is the weight of petrol flown in the LPG tank during the test.

$$V_{tot} = V_{petrol} + V_{lpg} = (W_1 - W_{tare})/d_{lpg} + (W_2 - W_1)/d_{petrol} \quad (3)$$

In facts, the difference between  $W_1$  and  $W_{tare}$  is the weight of LPG contained in the tank before inducing reverse flows of petrol in the tank by way of the simulated operations of point (f) above.

So, replacing  $V_{petrol}$  and  $V_{tot}$  with (2) and (3), formula (1) will be as follows:

$$(W_2 - W_1)/d_{petrol} / [(W_1 - W_{tare})/d_{lpg} + (W_2 - W_1)/d_{petrol}] \leq 0,14 \quad (1a)$$

Dividing numerator and denominator by the denominator, formula (1a) will become as follows:

$$1/[1 + (W_1 - W_{tare})/(W_2 - W_1) * d_{petrol}/d_{lpg}] \leq 0,14$$

Where:

$d_{petrol}$ : density of petrol  $d_{petrol} = 743\text{kg/m}^3$ ;

Comment: this is the minimum density of petrol E5 as specified by R. No. 83; in this case, the minimum value represents the most conservative condition.

$d_{diesel}$ : density of diesel  $d_{diesel} = 833\text{kg/m}^3$

Comment: this is the minimum density of petrol B5 as specified by R. No. 83; in this case, the minimum value represents the most conservative condition.

**$d_{\text{LPG}}$ : density of LPG  $d_{\text{LPG}}=538\text{kg/m}^3$ ;**

Comment: this is the LPG density as specified by R 101; no specific density is indicated in R. No. 83.

**17.1.10.4 7.9. If flows of petrol or diesel into LPG tank are likely to occur under the provisions of paragraph 17.1.7.7, non-metallic LPG components, [including flexible hoses and their elements,] and non-metallic parts of LPG components which may come into contact with petrol or diesel shall meet the requirements set out, respectively, in paragraphs 1. or 2. of Annex 18 to this Regulation."**

Comment: The first sentence can be deleted since this paragraph has been renumbered as a subparagraph of the new 17.1.10.

Fuel	CV [MJ/kg]	Density [kg/l]	CV [MJ/liter]	Max. energy ratio [%]	Max blending percentage of petrol in the actual liquid volume [%]
Petrol	43.6	0.75	33	20	16
LPG	46.1	0.538	25	20	84

Fuel	CV [MJ/kg]	Density [kg/l]	CV [MJ/liter]	Max. energy ratio [%]	Max blending percentage of diesel in the actual liquid volume [%]
Diesel	44.4	0.835	37	20	14
LPG	46.1	0.538	25	20	86