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Economic Commission for Europe**Inland Transport Committee****World Forum for Harmonization of Vehicle Regulations****Working Party on General Safety Provisions****113th session**

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Item 6(a) of the provisional agenda

Amendments to gas-fuelled vehicle regulations:**Regulation No. 67 (LPG vehicles)****Proposal for the 02 series of amendments to Regulation No. 67
(LPG vehicles)****Submitted by the experts from the Netherlands and the European
Liquefied Petroleum Gas Association ***

The text reproduced below was prepared by the experts from the Netherlands and the European Liquefied Petroleum Gas Association (AEGPL) to introduce the possibility to use non-seamless gas tube(s), gas tube(s) made of materials other than copper, stainless steel, and steel with corrosion-resistant coating, and their couplings in Liquefied Petroleum Gas (LPG) vehicles. It is mainly based on ECE/TRANS/WP.29/GRSG/2017/3, as amended by informal documents GRSG-111-19-Rev.1 and GRSG-112-19 distributed during the 111th and 112th sessions of the Working Party on General Safety Provisions (GRSG) (see reports ECE/TRANS/WP.29/GRSG/90, para. 24 and ECE/TRANS/WP.29/GRSG/91, para. 21). The modifications to the current text of UN Regulation No. 67 are marked in bold characters.

* In accordance with the programme of work of the Inland Transport Committee for 2016–2017 (ECE/TRANS/254, para. 159 and ECE/TRANS/2016/28/Add.1, cluster 3.1), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

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I. Proposal

Table of Contents, Annexes, insert a reference to the new Annex 15 to read (and renumber the references to Annexes 15 to 17 to read Annexes 16 to 18):

"15 Provisions regarding the approval of gas tube(s) of non-seamless type, gas tube(s) made of materials other than copper, stainless steel, and steel with corrosion-resistant coating, and their couplings"

Paragraph 2.2., amend to read:

"2.2. *"Specific equipment"* means:

- (a) The container;
- (b) The accessories fitted to the container;
- (c) The vaporizer/pressure regulator;
- (d) The shut-off valve;
- (e) The gas injection device or injector or gas mixing piece;
- (f) The gas dosage unit either separate or combined with the gas injection device;
- (g) Flexible hoses;
- (h) Filling unit;
- (i) Non-return valve;
- (j) Gas-tube pressure relief valve;
- (k) Filter unit;
- (l) Pressure or temperature sensor;
- (m) Fuel pump;
- (n) Service coupling;
- (o) Electronic control unit;
- (p) Fuel rail;
- (q) Pressure relief device;
- (r) Multi-component;
- (s) Non seamless gas tubes and their couplings;**
- (t) gas tubes made of materials other than copper, stainless steel, and steel with corrosion-resistant coating and their couplings."**

Insert a new paragraph 2.21. , to read:

"2.21. *"Gas tube"* means tubing made of metallic material which has been designed not to flex in normal operation and through which LPG flows."

Paragraphs 6.4. to 6.14., renumber as paragraphs 6.4. to 6.15. and amend to read:

"6.4. - 6.15. Provisions regarding other components

The other components, which are shown in Table 1, shall be type approved pursuant to the provisions laid down in the annexes which can be determined from the table.

Table 1

<i>Paragraph</i>	<i>Component</i>	<i>Annex</i>
6.4.	Fuel pump	4
6.5.	Vaporizer ¹ Pressure regulator ¹	6

<i>Paragraph</i>	<i>Component</i>	<i>Annex</i>
...
6.14.	Pressure relief device	3
6.15.	Gas tube(s) of non-seamless type, gas tube(s) made of materials other than copper, stainless steel, and steel with corrosion-resistant coating, and their couplings	15

¹ Either combined or separate.

² Only applicable when the gas dosage actuator is not integrated in the gas injection device.

³ Applicable only when the operating pressure of the gas mixing piece exceeds 20 kPa (Class 2)."

Paragraphs 6.15. to 6.15.13.2.4., renumber as paragraphs 6.16. to 6.16.13.2.4.

Paragraph 9.3., renumber the reference to "Annexes 8, 10 and 15" to read "Annexes 8, 10 and **16**".

Paragraph 17.1.7.5., renumber the reference to Annex 17 to read Annex **18**.

Paragraph 17.1.8.1., renumber the reference to Annex 16 to read Annex **17**.

Paragraph 17.7.1, amend to read:

"17.7.1. Gas tubes **of seamless type made of either copper or stainless steel or steel with corrosion-resistant coating.**"

Insert new paragraphs 17.7.1.1. and 17.7.1.2., to read:

"**17.7.1.1. If seamless copper is used the tube shall be protected by a rubber or plastic sleeve.**

17.7.1.2. The outer diameter of gas tubes made of copper shall not exceed 12 mm with a wall thickness of at least 0.8 mm, gas tubes from steel and stainless steel shall not exceed 25 mm with, for gas services, an appropriate wall thickness."

Paragraph 17.7.2., amend to read:

"17.7.2. **Gas tubes of seamless type made of materials other than those of paragraph 17.7.1. shall comply with the applicable tests according to the provisions of Annex 15"**

Paragraph 17.7.3., amend to read:

"17.7.3. **Gas tubes of non-seamless type shall comply with the applicable tests according to the provisions of Annex 15."**

Paragraph 17.7.4, amend to read:

"17.7.4. **Gas tubes made of a non-metallic material shall comply** with the requirements of this Regulation, paragraph 6.7."

Annex I

Insert new items 1.2.4.5.19. to 1.2.4.5.19.3, to read:

"**1.2.4.5.19. Non-seamless gas tubes and their couplings**

1.2.4.5.19.1. Make(s):

1.2.4.5.19.2. Type(s):

1.2.4.5.19.3. Description and drawings: "

Insert new items 1.2.4.5.20. to 1.2.4.5.20.3., to read:

"1.2.4.5.20. Seamless gas tubes made of materials other than copper, stainless steel and steel with corrosion-resistant coating and their couplings

1.2.4.5.20.1. Make(s):

1.2.4.5.20.2. Type(s):

1.2.4.5.20.3. Description and drawings: "

Items 1.2.4.5.19. to 1.2.4.5.19.5. (former), renumber as items 1.2.4.5.21. to 1.2.4.5.21.5.,

Annex 2B, item 1, amend to read (keeping the reference to footnote ² unchanged):

"1. LPG equipment considered:²

.....

Pressure/temperature sensor

LPG filter unit

Non-seamless gas tubes and their couplings

Gas tubes made of materials other than copper, stainless steel and steel with corrosion-resistant coating and their couplings

Multi-component"

Annex 3

Paragraph 1.6., renumber the reference to Annex 15 to read Annex 16 (13 times).

Paragraph 2.6., renumber the reference to Annex 15 to read Annex 16 (10 times).

Paragraph 3.6., renumber the reference to Annex 15 to read Annex 16 (13 times).

Paragraph 4.6., renumber the reference to Annex 15 to read Annex 16 (13 times).

Paragraph 4.7., renumber the reference to Annex 15 to read Annex 16.

Paragraph 5.6., renumber the reference to Annex 15 to read Annex 16 (10 times).

Paragraph 6.6., renumber the reference to Annex 15 to read Annex 16 (4 times).

Paragraph 7.6., renumber the reference to Annex 15 to read Annex 16 (11 times).

Annex 4

Paragraph 6.1., renumber the reference to Annex 15 to read Annex 16.

Paragraph 6.2., renumber the reference to Annex 15 to read Annex 16 (10 times).

Annex 5

Paragraph 6.1., renumber the reference to Annex 15 to read Annex 16 (10 times).

Paragraph 6.2., renumber the reference to Annex 15 to read Annex 16 (6 times).

Annex 6

Paragraph 6.1., renumber the reference to Annex 15 to read Annex **16** (12 times).

Paragraph 6.2., renumber the reference to Annex 15 to read Annex **16** (6 times).

Annex 7

Paragraph 1.6., renumber the reference to Annex 15 to read Annex **16** (12 times).

Paragraph 1.7., renumber the reference to Annex 15 to read Annex **16**.

Paragraph 2.6., renumber the reference to Annex 15 to read Annex **16** (12 times).

Paragraph 3.6., renumber the reference to Annex 15 to read Annex **16** (12 times).

Paragraph 4.6., renumber the reference to Annex 15 to read Annex **16** (12 times).

Annex 8, paragraph 6., renumber the reference to Annex 15 to read Annex **16** (12 times).

Annex 11

Paragraph 1.6., renumber the reference to Annex 15 to read Annex **16** (10 times).

Paragraph 2.6., renumber the reference to Annex 15 to read Annex **16** (6 times).

Paragraph 3.6.1., renumber the reference to Annex 15 to read Annex **16** (10 times).

Paragraph 3.6.2., renumber the reference to Annex 15 to read Annex **16** (6 times).

Annex 12, paragraph 6., renumber the reference to Annex 15 to read Annex **16** (6 times).

Annex 13

Paragraph 6.1., renumber the reference to Annex 15 to read Annex **16** (10 times).

Paragraph 6.2., renumber the reference to Annex 15 to read Annex **16** (6 times).

Insert a new Annex 15, to read:

"Annex 15

Provisions regarding the approval of gas tube(s) of non-seamless type, gas tube(s) made of materials other than copper, stainless steel, and steel with corrosion-resistant coating, and their couplings

1. **Definitions:**
Gas tube: gas tube as defined in paragraph 2.21. of this Regulation.
2. **Component classification (according to paragraph 2., Figure 1):**
Gas tube and its coupling(s) can be of Class 0, 1, 2 or 2A.

3. **Classification pressure:**
Parts of Class 0: WP declared
Parts of Class 1: 3,000 kPa
Parts of Class 2: 450 kPa
Parts of Class 2A: 120 kPa
4. **Design temperatures:**
-20 °C to 120 °C
For temperatures exceeding the above-mentioned values, special tests conditions are applicable.
5. **General design rules:**
The couplings shall be compatible with the gas tube.
Specific care shall be taken against galvanic corrosion.
Stainless steel gas tube shall only be used in combination with stainless steel couplings.
Only longitudinal welding (in the direction of the tube itself) is permitted in gas tubes of non-seamless type.
6. **Applicable test procedures:**
- 6.1. **For parts of Classes 0 and 1:**
- | | |
|-------------------------------|------------------------------|
| Overpressure test | Annex 16, para. 4. |
| External leakage | Annex 16, para. 5. |
| High temperature | Annex 16, para. 6. |
| Low temperature | Annex 16, para. 7. |
| LPG compatibility | Annex 16, para. 11.** |
| Corrosion resistance | Annex 16, para. 12.* |
| Resistance to dry heat | Annex 16, para. 13.** |
| Ozone ageing | Annex 16, para. 14.** |
- 6.2. **For parts of Class 2 or 2A:**
- | | |
|-----------------------------|------------------------------|
| Overpressure test | Annex 16, para. 4. |
| External leakage | Annex 16, para. 5. |
| High temperature | Annex 16, para. 6. |
| Low temperature | Annex 16, para. 7. |
| LPG compatibility | Annex 16, para. 11.** |
| Corrosion resistance | Annex 16, para. 12.† |

* **Only for metallic parts.**

** **Only for non-metallic parts.**

6.3. Specific requirements on the gas tube and its couplings:**6.3.1. Endurance test**

The gas tube and its coupling(s) shall be tested for an endurance test consisting out of 100,000 cycles.

One cycle consist out of pressure ramp from 15 per cent WP up to WP.

After the endurance test, the gas tube and its coupling(s) need to comply with the leakage test of Annex 16, paragraphs 5., 6. and 7 and with the overpressure test according to Annex 16, paragraph 4.

6.3.2. Bending test on the gas tube

Test the gas tube according to the following procedure and acceptance criteria.

(a) Select a mandrel with an external diameter from the below table:

<i>External diameter</i>	<i>Mandrel diameter</i>
≤ 8 mm	3 times the external gas tube diameter
> 8 mm	5 times the external gas tube diameter

(b) Bend the gas tube over this mandrel once, forming a "U" shape.

(c) Close the ends of the gas tube and subject it to the overpressure test according to Annex 16, paragraph 4.

At the completion of the overpressure test, the gas tube shall be tested according to the leakage test of Annex 16, paragraphs 5., 6. and 7.

6.3.3. Excess torque resistance

A coupling designed to be connected directly to threaded fittings shall be capable of withstanding, without deformation, breakage or leakage, a torque effort of 150 per cent of the rated installation value delivered by the manufacturer, according to the following test procedure:

(a) Test an unused component, applying the torque adjacent to the fitting.

(b) For a component having a threaded connection or threaded connections, apply the turning effort for 15 minutes, release the turning effort, then remove the component and examine it for deformation and breakage.

(c) Perform the leakage test according to Annex 16, paragraphs 5., 6. and 7.

(d) Perform the overpressure test according to Annex 16, paragraph 4.

† Only for metallic parts.

** Only for non-metallic parts.

6.3.4. Vibration test

Vibrate the gas tube and its coupling(s) according to the test described in Annex 16, paragraph 10.5.4., procedure A.

After this test the gas tube and its coupling(s) need to comply with the leakage test of Annex 16, paragraphs 5., 6. and 7. and with the overpressure test according to Annex 16, paragraph 4.

6.3.5. Pull-off

Test the gas tube and its coupling(s) according to the following procedure and acceptance criteria.

Secure the subject specimen in an appropriate test fixture, then statically apply a tensile load along the gas tube axis at a maximum rate of 250 N/min until the gas tube separates from the coupling(s).

The force (F), in Newton, required to pull apart the gas tube from its coupling(s) shall be that calculated as:

$$F = (\pi \cdot d^2 \cdot P) / 10$$

where

d is the internal diameter, in millimetres;

P is the maximum working pressure, in bar.

6.3.6. Brass material compatibility

All gas tubes and its couplings having brass components shall be subjected to the brass material compatibility test according to Annex 16, paragraph 12.2.

After this test the gas tube and its coupling(s) need to comply with the leakage test of Annex 16, paragraphs 5., 6. and 7 and with the overpressure test according to Annex 16, paragraph 4.

Annex 15 (former), renumber as Annex 16.

Annex 16 (former), renumber as Annex 17.

Annex 17 (former), renumber as Annex 18.

II. Justification

1. This proposal aims at adapting the provisions of UN Regulation No. 67 to the technical progress. Non-seamless double and single wall tubes are already known in brake and fuel tubing applications and allow a variety of end forms and coupling techniques. Their usage requires that they withstand high pressure and a high resistance for pressure pulses. UN Regulation No. 67 should allow this well-known technology, as long as the tube can withstand the applicable tests according to Annex 15. Paragraph 17.7.1. is modified accordingly.

2. This proposal aims for more flexibility in the UN Regulation and comprises a rapid commercialization process for LPG. Pre-qualification testing made by manufacturers shows positive results.

3. Detailed technical information behind this proposal was presented during the 109th session of GRSG (see informal document GRSG-109-14, slides 11-21).

4. During its 110th session, GRSG discussed the preference that fuel lines and couplings were part of the certification process instead of complying with the general definitions.
 5. During its 111th session, GRSG discussed the preference to have other materials added (for instance aluminium).
 6. During its 112th session, GRSG discussed a number of comments raised, which are taken into account in this updated proposal.
 7. This proposal implements the general test requirements for the gas tubes and their couplings through an amendment to UN Regulation No. 67. The specific tests added for the gas tubes and their couplings are based on the experience for fuel lines used in compressed natural gas equipment (standard ISO 15500 of the International Organization for Standardization) having a higher pressure as used in LPG.
 8. Annexes 15, 16 and 17 (and their references) are renumbered as Annexes 16, 17 and 18, respectively.
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