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Economic Commission for Europe**Inland Transport Committee****World Forum for Harmonization of Vehicle Regulations****Working Party on General Safety Provisions****112th session**

Geneva, 24-28 April 2017

Item 7 of the provisional agenda

Regulation No. 67 (LPG vehicles)**Proposal for Supplement 15 to the 01 series of amendments
to Regulation No. 67 (LPG vehicles)****Submitted by the expert from the Netherlands***

The text reproduced below was prepared by the expert from the Netherlands to introduce the possibility to use non-seamless gas tubes in Liquefied Petroleum Gas (LPG) vehicles. It is based on informal document GRSG-111-19-Rev.1 distributed during the 111th session of the Working Party on General Safety Provisions (GRSG) (see report ECE/TRANS/WP.29/GRSG/90, para. 24). The modifications to the current text of UN Regulation No. 67 are marked in bold characters for new and strikethrough for deleted 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.

GE.17-01501(E)



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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 non-seamless fuel line and/or couplings"

Insert new paragraphs 2.21. to 2.23., to read:

"2.21. "Non-seamless fuel line" means tubing which has been designed not to flex in normal operation and through which LPG flows.

2.22. "Coupling" means a connector used in joining a piping, tubing or hose system.

2.23. "Gas tube" means seamless fuel line made out of copper or stainless steel or steel with corrosion-resistant coating."

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 |
| ... | | ... |
| 6.14. | Pressure relief device | 3 |
| 6.15. | Non-seamless fuel lines and couplings¹ | 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 17.3.1.9., amend to read:

"17.3.1.9. Gas tubes, **non-seamless fuel line** and/or hoses;"

Paragraph 17.7.1., amend to read:

"17.7.1. Gas tubes shall be made of ~~seamless material~~: either copper or stainless steel or steel with corrosion-resistant coating **of:**

- (a) Seamless material; or
- (b) Non-seamless material, complying with the applicable test according to the provisions of Annex 15 on the approval of non-seamless fuel line and/or couplings."

Annex I

Insert new items 1.2.4.5.19. to 1.2.4.5.20.3., to read:

- "1.2.4.5.19. **Non-seamless fuel line**
- 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:**
- 1.2.4.5.20. **Coupling(s)**
- 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:

- "1. LPG equipment considered:2
-
- Pressure/temperature sensor
- LPG filter unit
- Non-seamless fuel line**
- Coupling**
- Multi-component"

Annex 2B – Appendix, item 1, amend to read:

- "1. Container characteristics from the parent container (configuration 00):
- (a) Trade name or mark:
-
- (i) Configuration of accessories fitted to container: see Table 1.

Table 1

| No. | Item | Type | Approval No. | Extension No. |
|----------|------------------------|------|--------------|---------------|
| a | 80 per cent stop valve | | | |
| ... | | | | |
| j | Pressure relief device | | | |
| k | Coupling | | | |

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 the non-seamless fuel line and/or couplings

1. **Definitions:**
Fuel line: See paragraph 2.21. of this Regulation.
Coupling: See paragraph 2.22. of this Regulation.
2. **Component classification (according to Paragraph 2 Figure 1):**
Fuel line and coupling 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 fuel line.
Specific care shall be taken against galvanic corrosion.
Stainless steel fuel line shall only be used in combination with stainless steel couplings.
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.** |
| 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.* |
- 6.3. Specific requirements on the fuel line and/or couplings or combination:**
- 6.3.1. The fuel line and/or coupling shall be tested for an endurance test consisting out of 100,000 cycles.**
- 1 Cycle consist out of pressure ramp from 0 up to WP.
- The coupling shall only be tested using a compatible fuel line.
- After the endurance test, the fuel line and or coupling need to comply with the leakage test of Annex 16, paragraphs 4., 5., 6. and 7.
- 6.3.2. Bending test on the fuel line**
- Test the rigid fuel line according to the following procedure and acceptance criterion.
- (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 fuel line diameter |
| > 8 mm | 5 times the external fuel line diameter |
- (b) Bend the rigid fuel line over this mandrel once, forming a "U" shape.
- (c) Close the ends of the rigid fuel line and subject it to the overpressure test according to Annex 16, paragraph 4.

* Only for metallic parts.

** Only for non-metallic parts.

At the completion of the overpressure test, the rigid fuel line 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.

6.3.4. Vibration test

Vibrate the coupling connected according to the manufacturer's specification to a compatible fuel line using the test described in Annex 16, paragraph 10.5.4., procedure A.

After this test the tested sample shall comply with the test described in Annex 16, paragraphs 4, 5, 6 and 7.

6.3.5. Pull-off

Test the coupling, attached to compatible fuel line and coupled to its mating part or parts, according to the following procedure and acceptance criterion.

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

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

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

where

d is the internal diameter, in millimetres;

P is the maximum working pressure, in bar.

6.3.6. Brass material compatibility

All fuel line and couplings having brass components shall be subjected to the brass material compatibility test according to ISO 15500-2:2012.

After this test the fuel line and couplings shall comply with the Annex 16 paragraph 4, 5, 6 and 7 tests."

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 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 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 as currently.
 5. This proposal implements the general test requirements for the fuel lines and couplings through an amendment to UN Regulation No. 67. The specific tests added for the fuel line and couplings are based on the experience for fuel lines used in compressed natural gas equipment (standard 15500 of the International Organization for Standardization) having a higher pressure as used in LPG.
 6. Annexes 15, 16 and 17 (and their references) are renumbered as Annexes 16, 17 and 18, respectively.
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