Submitted by the expert from AEGPL

Informal document **GRSG-112-19**
(112th GRSG, 24-28 April 2017
agenda item 7)

Proposal for Supplement 15 to the 01 series of amendments to Regulation No. 67 (LPG vehicles)

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 tubes of non-seamless type and gas tubes of materials other than copper, stainless steel, and steel with corrosion-resistant coating, and their couplings**"

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

"**2.21.** ***"Gas tube "*** **means tubing 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

Paragraph	*Component*	*Annex*
6.4.	Fuel pump	4
6.5.	Vaporizer[1] Pressure regulator[1]	6
…	……	…
6.14.	Pressure relief device	3
6.15.	**Gas tubes of non-seamless type and gas tubes 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 17.3.1.9., amend to read:

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 paragraph 17.7.1.1., to read

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

Insert new paragraph 17.7.1.2., to read

"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 1.2.4.5.19.4, to read:

"**1.2.4.5.19. Non-seamless gas tube**

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: .....

1.2.4.5.19.4. Tube coupling(s)

1.2.4.5.19.4.1 Make(s): .....

1.2.4.5.19.4.2 Type(s): .....

1.2.4.5.19.4.3 Description and drawings: ....."

Insert new items 1.2.4.5.20. to 1.2.4.5.20.4., to read:

"**1.2.4.5.20. Seamless gas tube of materials other than copper, stainless steel and steel with corrosion-resistant coating**

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: ……

1.2.4.5.20.4 Tube coupling(s)

1.2.4.5.20.4.1 Make(s): ……

1.2.4.5.20.4.2 Type(s): …….

1.2.4.5.20.4.3 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 gas tube

Seamless gas tube of materials other than copper, stainless steel and steel with corrosion-resistant coating

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 tubes of non-seamless type and gas tubes 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, of non-seamless type and gas tube of materials other than copper, stainless steel, and steel with corrosion-resistant coating.

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.

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 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.

1 Cycle consist out of pressure ramp from 15%·WP up to WP.

The coupling(s) shall only be tested using a compatible gas tube.

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

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* **Only for metallic parts.**

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

6.3.2. **Bending test on the gas tube**

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

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

External diameter	*Mandrel diameter*
≤ 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.

6.3.4. **Vibration test**

Vibrate the coupling connected according to the manufacturer's specification to a compatible gas tube 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 gas tube 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 gas tube axis at a maximum rate of 250 N/min until the gas tube 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 gas tubes and its couplings having brass components shall be subjected to the brass material compatibility test according to ISO 15500-2:2012.

After this test the gas tube and its 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.