



Economic and Social Council

Distr.

GENERAL

TRANS/WP.29/1998/63
2 September 1998

Original: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

INLAND TRANSPORT COMMITTEE

Working Party on the Construction of Vehicles

(One-hundred-and-sixteenth session,
10-13 November 1998, agenda item 5.5.)

PROPOSAL FOR ADDITIONAL AMENDMENTS TO THE PROPOSAL FOR DRAFT SUPPLEMENT 2 TO REGULATION No. 67 (Equipment for liquefied petroleum gas)

Addendum 3 to document TRANS/WP.29/R.808

Transmitted by the Chairman of an ad hoc group on Regulation No. 67

Note: The text reproduced below was developed during an ad hoc meeting held in Rome on 21 July 1998 and endorsed by the participants of this meeting. It proposes provisions to be introduced in the Regulation, in order to prevent bursting of LPG containers during accidents involving fire. These provisions are based on a series of tests performed on vehicles fitted with LPG equipment and put on fire. The modifications refer to document TRANS/WP.29/1998/31 (TRANS/WP.29/ GRPE/36, para. 22).

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Paragraph 2.2., item "[(q) pressure relief device (fuse), temperature triggered]" should be deleted.

Paragraph 2.5., add at the end a new item (j), to read:

".....
(j) pressure relief device"

Paragraph 2.5.3.1. (new), amend to read:

"2.5.3.1. "Pressure relief device" means a device aimed to protect the container from burst which can occur in case of fire, by venting the LPG contained."

Insert a new paragraph 6.3.6., to read:

"6.3.6. The container shall be equipped with a pressure relief device (PRD). Devices or functions may be approved as PRD being:

- (a) A fusible plug (temperature triggered) (fuse), or
- (b) A pressure relief valve provided that it complies to paragraph 6.14.8.3., or
- (c) A combination of the two above devices, or
- (d) Any other equivalent technical solution, provided that it ensures the same degree of performance."

Paragraph 6.3.6. (former), renumber as paragraph 6.3.7.

Paragraph 6.14.8.3., amend to read:

".....
in which:

Q = flow of air in standard m³/min (100 kPa absolute and temperature of 15°C)
A = exterior surface of the container in m².

The flow test results must be corrected to standard conditions: air pressure of 3,000 kPa, and at temperature of 15°C.

When the pressure relief valve is considered as a pressure relief device (PRD), the flow shall be at least 17.7 standard m³/min."

Paragraph 6.14.8.6. (new), amend to read:

"6.14.8.6. The pressure relief device (fuse) shall be designed to have, when opened, a flow capacity of:

$$Q \geq 2.73 \sqrt{A}$$

in which:

Q = flow of air in standard m³/min (100 kPa absolute and temperature of 15°C)

A = exterior surface of the container in m².

The flow test results must be corrected to standard conditions: air pressure of 200 kPa absolute, and at temperature of 15°C."

Paragraph 6.14.8.7. (new), should be deleted.

Insert new paragraphs 6.14.8.7. to 6.14.8.9., to read:

"6.14.8.7. The pressure relief device shall be mounted on the container in the gaseous zone.

6.14.8.8. The pressure relief device shall be fitted to the container in such a manner that it can discharge into the gas tight housing, when its presence is prescribed.

6.14.8.9. The pressure relief device (fuse) shall be tested according to the provisions described in annex 3 paragraph 7."

Insert new paragraphs 17.12. and 17.12.1., to read:

"17.12. **Pressure relief device**

17.12.1. The pressure relief device shall be fitted to the fuel container(s) in such a manner that it can discharge into the gas tight housing, when its presence is prescribed, if that gas tight housing fulfils the requirements of paragraph 17.6.5."

Annex 1,

Add a new item 1.2.4.5.8.3.3. to read:

"1.2.4.5.8.3.3 Flow rate in standard conditions"

Insert new items 1.2.4.5.8.4. to 1.2.4.5.8.4.5., to read:

"1.2.4.5.8.4. Pressure relief device

1.2.4.5.8.4.1. Make(s)

1.2.4.5.8.4.2. Type(s)

1.2.4.5.8.4.3. Description and drawings

- 1.2.4.5.8.4.4. Operating temperature
- 1.2.4.5.8.4.5. Material
- 1.2.4.5.8.4.6. Flow rate in standard condition "

Items 1.2.4.5.8.4. to 1.2.4.5.8.7. (former), renumber as items 1.2.4.5.8.5. to 1.2.4.5.8.8.3.

Annex 3,

Add new paragraphs 7. to 7.7., to read:

"7. Provisions regarding the approval of the pressure relief device (fuse)

7.1. Definition: see paragraph 2.5.3.1 of this Regulation.

7.2. Component classification (according to figure 1, paragraph 2):
Class 3.

7.3. Classification pressure: 3,000 kPa.

7.4. Design temperature:

The fuse has to be designed to open at a temperature of $125^{\circ}\text{C} \pm 10^{\circ}\text{C}$

7.5. General design rules

Paragraph 6.14.2., Provisions regarding the electrical insulation

Paragraph 6.14.3.1., Provisions on valves activated by electrical power

Paragraph 6.14.7., Provisions regarding the gas tube pressure relief valve

7.6. Test procedures to be applied:

Overpressure test	Annex 15, par. 4
External leakage	Annex 15, par. 5
High temperature	Annex 15, par. 6
Low temperature	Annex 15, par. 7
Seat (if any) leakage	Annex 15, par. 8
Endurance	Annex 10, par. 2.7
LPG compatibility	Annex 15, par. 11 <u>**/</u>
Corrosion resistance	Annex 15, par. 12 <u>*/</u>
Resistance to dry heat	Annex 15, par. 13
Ozone ageing	Annex 15, par. 14 <u>**/</u>
Creep	Annex 15, par. 15 <u>**/</u>
Temperature cycles	Annex 15, par. 16 <u>**/</u>

*/ Only for metallic parts

**/ Only for non-metallic parts

7.7. Pressure relief device (fuse) requirements

Pressure relief device (fuse) specified by the manufacturer shall be shown to be compatible with the service conditions by means of the following tests:

- a) One specimen shall be held at a controlled temperature of not less than 90°C and a pressure not less than test pressure (3,000 kPa) for 24 hours. At the end of this test there shall be no leakage or visible sign of extrusion of any fusible metal used in the design.
- b) One specimen shall be fatigue tested at a pressure cycling rate not to exceed 4 cycles per minute as follows:
 - i) held at 82°C while pressured for 10,000 cycles between 300 and 3,000 kPa;
 - ii) held at -20°C while pressured for 10,000 cycles between 300 and 3,000 kPa.

At the end of this test there shall be no leakage, or any visible sign of extrusion of any fusible metal used in the design.

- c) Exposed brass pressure retaining components of pressure relief device shall withstand, without stress corrosion cracking, a mercurous nitrate test as described in ASTM B154^{1/}. The pressure relief device shall be immersed for 30 minutes in an aqueous mercurous nitrate solution containing 10 g of mercurous nitrate and 10 ml of nitric acid per litre of solution. Following the immersion, the pressure relief device shall be leak tested by applying an aerostatic pressure of 3,000 kPa for one minute during which time the component shall be checked for external leakage. Any leakage shall not exceed 200 cm³/h.
- d) Exposed stainless steel pressure retaining components of pressure relief device shall be made of an alloy type resistant to chloride induced stress corrosion cracking.

^{1/} This procedure, or other equivalent, is allowed until an international standard will be available."

Annex 10,

Add new paragraphs 1.6.4. and 1.6.4.1., to read:

"1.6.4. **Fire protection**

- 1.6.4.1. A container representative of the type of container, all accessories fitted on it and any added insulation or protective material, shall

be subjected to a bonfire test as specified in paragraph 2.6. of this annex."

Add new paragraph 2.6., to read:

"2.6. **Bonfire test**

2.6.1. General

The bonfire test is designed to demonstrate that a container complete with the fire protection system, specified in the design, will prevent the burst of the container when tested under the specified fire conditions.

2.6.2. Container set-up

Container shall be placed horizontally with the container bottom approximately 100 mm above the fire source;
Metallic shielding shall be used to prevent direct flame impingement on container valves, fittings, and/or pressure relief device. The metallic shielding shall not be in direct contact with the specified fire protection system (pressure relief device or container valve). Any failure during the test of a valve, fitting or tubing that is not part of the intended protection system for the design shall invalidate the result.

2.6.3. Fire source

A uniform fire source of 1.65 m length shall provide direct flame impingement on the container surface across its entire diameter. Any fuel may be used for the fire source provided that it supplies uniform heat sufficient to maintain the specified test temperatures until the container is vented. The arrangement of the fire shall be recorded in sufficient detail to ensure that the rate of heat input to the container is reproducible. Any failure or inconsistency of the fire source during a test shall invalidate the result.

2.6.4. Temperature and pressure measurements

Surface temperatures shall be monitored by at least three thermocouples located [along the bottom] of the container and spaced not more than 0.75 m apart. Metallic shielding shall be used to prevent direct flame impingement on the thermocouples. Alternatively, thermocouples may be inserted into blocks of metal measuring less than 25 mm square.
Thermocouple temperatures and the container pressure shall, during the test, be recorded at intervals of 30 seconds or less.

2.6.5. General test requirements

Container shall be filled with 80 per cent in volume of LPG (commercial propane) and tested in the horizontal position at working pressure.

Immediately following the ignition, the fire shall produce flame impingement on the surface of the container along the 1.65 m length of the fire source and across the container. Within 5 minutes of ignition the temperature of at least one thermocouple shall indicate at least 590EC. This minimum temperature shall be maintained for the remaining duration of the test, namely until when no overpressure is present in the container.

2.6.6. The centre of the container shall be positioned over the centre of the fire source;

2.6.7. Acceptable results:

The container shall vent through a pressure relief device, and no burst shall occur."
