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**Road vehicles — Liquefied petroleum  
gas (LPG) fuel systems components —**

**Part 18:  
Hose**

*Véhicules routiers — Équipements pour véhicules utilisant le gaz de  
pétrole liquéfié (GPL) comme combustible —*

*Partie 18: Tuyauterie*

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 41, *Specific aspects for gaseous fuels*.

A list of all parts in the ISO 20766 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

# Road vehicles — Liquefied petroleum gas (LPG) fuel systems components —

## Part 18: Hose

### 1 Scope

This document specifies general information regarding the hose component of liquefied petroleum gas fuel, intended for use on the types of motor vehicles as defined in ISO 3833. It provides general design principles and specifies requirements for instructions and marking. It also specifies test requirements for the hose.

This document is applicable to vehicles (mono-fuel, bi-fuel or dual-fuel applications) using gaseous fuels in accordance with ISO 9162. It is not applicable to the following:

- a) fuel containers;
- b) stationary gas engines;
- c) container mounting hardware;
- d) electronic fuel management;
- e) refuelling receptacles.

Fully metal bendable hoses are excluded from this document.

NOTE 1 It is recognized that miscellaneous components not specifically addressed herein can be examined for compliance with the criteria of any applicable part of ISO 20766, including testing to the appropriate functional tests.

NOTE 2 All references to pressure in this document are considered gauge pressures unless otherwise specified.

NOTE 3 This document applies to devices which have a service pressure in the range of 110 kPa (Butane rich at 20 °C) and 840 kPa (Propane at 20 °C), hereinafter referred to in this document. Other service pressures can be accommodated by adjusting the pressure by the appropriate factor (ratio).

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 37, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*

ISO 527-2, *Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics*

ISO 1307:2006, *Rubber and plastics hoses — Hose sizes, minimum and maximum inside diameters, and tolerances on cut-to-length hoses*

ISO 1436, *Rubber hoses and hose assemblies — Wire-braid-reinforced hydraulic types for oil-based or water-based fluids — Specification*

ISO 4080, *Rubber and plastics hoses and hose assemblies — Determination of permeability to gas*

ISO 20766-1, *Road vehicles — Liquefied petroleum gas (LPG) fuel systems components — Part 1: General requirements and definitions*

ISO 20766-2, *Road vehicles — Liquefied petroleum gas (LPG) fuel systems components — Part 2: Performance and general test methods*

DIN 7643, *Compression couplings — Hollow screws for ring-type banjos*

### **3 Terms and definitions**

For the purposes of this document, the terms and definitions given in ISO 20766-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

### **4 Markings**

Every hose shall bear, at intervals of not greater than 0,5 m, the following clearly legible and indelible identification markings consisting of characters, figures or symbols:

- a) the manufacturer's or agent's name, trademark or symbol;
- b) the model designation (part number);
- c) the working pressure and temperature range;
- d) the year and month of fabrication;
- e) the size and type-marking.

The following additional markings are recommended:

- the direction of flow (when necessary for correct installation);
- the type of fuel;
- the electrical ratings (if applicable);
- the symbol of the certification agency;
- the type approval number;
- the serial number or date code;
- a reference to this document.

NOTE Every coupling bears the trade name or mark of the assembling manufacturer.

## **5 Construction and assembly**

### **5.1 General specifications**

**5.1.1** The hose shall be so designed as to withstand maximum operating pressure as applicable.

**5.1.2** The hose shall be so designed as to withstand temperatures between the minimum operating temperature and the maximum operating temperature.

**5.1.3** The inside diameter of the hose shall be in compliance with of ISO 1307:2006, Table 1.

## **5.2 Rubber hose construction**

**5.2.1** The hose shall embody a smooth-bore tube and a cover of suitable synthetic material, reinforced with one or more interlayer(s).

**5.2.2** The reinforcing interlayer(s) shall be protected by a cover against corrosion. If for the reinforcing interlayer(s) corrosion-resistant material is used (i.e. stainless steel) a cover is not required.

**5.2.3** The lining and cover shall be smooth and free from pores, holes and strange elements. An intentionally provided puncture in the cover shall not be considered as an imperfection.

**5.2.4** The cover shall be intentionally perforated to avoid the forming of bubbles.

**5.2.5** When the cover is punctured, and the interlayer is made of a non-corrosion resistant material, the interlayer shall be protected against corrosion.

## **5.3 Synthetic hose construction**

**5.3.1** The synthetic hose shall embody a thermoplastic tube and a cover of suitable thermoplastic material, oil and weatherproof, reinforced with one or more synthetic interlayer(s). If for the reinforcing interlayer(s) a corrosion-resistant material is used (i.e. stainless-steel) a cover is not required.

**5.3.2** The lining and the cover shall be free from pores, holes and strange elements. An intentionally provided puncture in the cover shall not be considered as an imperfection.

**5.3.3** If the synthetic hose is made out of one material and/or one layer it shall comply with all testing listed in [Table 1](#) for both liner and cover.

## **5.4 Couplings for rubber hoses**

**5.4.1** The couplings shall be made from steel or brass and the surface shall be corrosion resistant.

**5.4.2** The coupling burst pressure in mounted position shall never be less than the tube or hose burst pressure. The coupling leakage pressure in mounted position shall never be less than the tube or hose leakage pressure.

**5.4.3** The couplings shall be of the crimp-fitting type.

**5.4.3.1** The swivel-nut shall be provided with Unified National Fine (UNF) thread.

**5.4.3.2** The sealing cone of swivel-nut type shall be of the type with a half vertical angle of 45°.

**5.4.3.3** The couplings can be made as swivel-nut type or as quick-connector type.

**5.4.3.4** It shall be impossible to disconnect the quick-connector type without specific measures or the use of dedicated tools.

## 5.5 Couplings for synthetic hoses

5.5.1 The couplings shall be made from steel or brass and the surface shall be corrosion resistant.

5.5.2 The couplings shall be of the crimp-fitting type and made up of a hose-coupling or banjo bolt. The sealing shall be resistant to LPG and comply with non-metallic synthetic immersion test.

5.5.3 The banjo bolt shall comply with DIN 7643.

## 5.6 Assembly of hose and couplings

5.6.1 The construction of couplings shall be such, that it is not necessary to peel the cover unless the reinforcement of the hose consists of corrosion resistant material.

5.6.2 If hose and couplings are not assembled by the approval holder, the approval shall consist of:

- (a) hose,
- (b) couplings, and
- (c) hose assembly and assembly instruction.

The assembly instruction shall be written in the language of the country to which the type of hose or coupling will be delivered, or at least in English. It shall include detailed characteristics of equipment used for the assembly operation.

## 6 Tests

### 6.1 Applicability

The tests required to be carried out are indicated in [Table 1](#).

**Table 1 — Applicable tests**

Test	Applicable	Test procedure as required by ISO 20766-2	Specific test requirements of this document
Hydrostatic strength	X	X	X (See <a href="#">6.2</a> )
External leakage	X	X	
High temperature	X		X (See <a href="#">6.3</a> )
Low temperature	X		X (See <a href="#">6.4</a> )
Non-metallic material immersion (LPG compatibility)	X	X	
Corrosion resistance	X	X	
Resistance to dry heat	X	X	
Ozone ageing	X	X	
Creep	X	X	
Temperature cycle	X	X	
Oxygen ageing	X	X	
Tensile strength and elongation	X		X (See <a href="#">6.5</a> )
Permeability	X		X (See <a href="#">6.6</a> )

Table 1 (continued)

Test	Applicable	Test procedure as required by ISO 20766-2	Specific test requirements of this document
Bending test	X		X (See 6.7)
Impulse test	X		X (See 6.8)
Gas tightness	X		X (See 6.9)

## 6.2 Hydrostatic strength

Test the flexible hose according to the procedure for testing hydrostatic strength specified in ISO 20766-2. The test pressure shall be 2,25 times the working pressure.

## 6.3 Low temperature

The LPG flexible hose shall not leak more than 15 cm<sup>3</sup>/h at a room temperature of 20 °C ± 5 °C when subjected to leakage test specified in ISO 20766-2 at the minimum operating temperature (−40 °C or −20 °C as applicable) and pressure equal to 150 % of working pressure. The component shall be conditioned for at least 8 h at this temperature.

## 6.4 High temperature

The LPG flexible hose shall not leak more than 15 cm<sup>3</sup>/h at room temperature of 20 °C ± 5 °C when subjected to leakage test specified in ISO 20766-2 at the maximum operating temperature (65 °C, 85 °C or 120 °C as applicable) and pressure equal to 150 % of working pressure. The component shall be conditioned for at least 8 h at this temperature.

## 6.5 Tensile strength and elongation

**6.5.1** The tensile strength and elongation of the rubber hose (both lining and cover) shall be in accordance with ISO 37. Tensile strength shall not be less than 10 MPa and elongation at break not less than 250 %.

**6.5.2** The tensile strength and elongation of the synthetic hose (lining) shall be in accordance with ISO 37. Tensile strength shall not be less than 20 MPa and elongation at break not less than 200 %.

**6.5.3** The tensile strength and elongation specific for a polyamide 6 lining material shall be in accordance with ISO 527-2 and with the following conditions:

- a) specimen type: type 1 BA, and
- b) tensile speed: 20 mm/min.

The material shall be conditioned for at least 21 d at 23 °C and 50 % relative humidity prior to testing.

Requirements:

- a) tensile strength that is not less than 20 MPa, and
- b) elongation at break that is not less than 50 %.

**6.5.4** The tensile strength and elongation of synthetic hose (cover) shall be in accordance with ISO 37. Tensile strength shall not be less than 20 MPa and elongation at break not less than 250 %.

**6.5.5** The tensile strength and elongation specific for a polyamide 6 cover material shall be in accordance with ISO 527-2 and with the following conditions:

- (a) specimen type: type 1 BA, and
- (b) tensile speed: 20 mm/min.

The material shall be conditioned for at least 21 d at 23 °C and 50 % relative humidity prior to testing.

Requirements:

- (a) tensile strength that is not less than 20 MPa, and
- (b) elongation at break that is not less than 100 %.

## **6.6 Permeability**

**6.6.1** This test shall be performed on uncoupled flexible hoses.

**6.6.2** A hose at a free length of 1 m shall be connected to a container filled with liquid propane, having a temperature of 23 °C ± 2 °C.

**6.6.3** The test shall be carried out in compliance with the method described in ISO 4080.

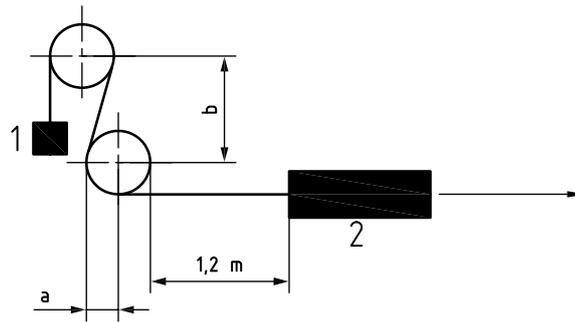
**6.6.4** The leakage through the wall of the hose shall not exceed 95 cm<sup>3</sup> of vapour per meter of hose per 24 h.

## **6.7 Bending test**

### **6.7.1 Bending test for rubber hoses**

**6.7.1.1** This test shall be performed on uncoupled flexible hoses.

**6.7.1.2** An empty hose, at a length of approximately 3,5 m shall be able to withstand 3 000 × the hereafter prescribed alternating-bending-test without breaking. After the test the hose shall be capable of withstanding hydrostatic test pressure of 2,25 × working pressure applied during 10 min, without any leakage.

**Key**

- 1 mass  
2 propulsion mechanism

**Figure 1 — Example of a bending test machine for rubber hoses**

Hose inside diameter (mm)	Bending radius (mm) (Figure 1)	Distance between centres (mm) (Figure 1)	
		Vertical b	Horizontal a
Up to 13	102	241	102
13 to 16	153	356	153
16 to 20	178	419	178

**6.7.1.4** The testing machine (see Figure 1) shall consist of a steel frame, provided with two wooden wheels, with a rim-width of approximately 130 mm.

The circumference of the wheels shall be grooved for the guidance of the hose. The radius of the wheels, measured to the bottom of the groove, shall be as indicated in 6.7.1.3.

The longitudinal median planes of both wheels shall be in the same vertical plane and the distance between the wheel-centres shall be in accordance with 6.7.1.3.

Each wheel shall be able to rotate freely round the pivot-centre.

A propulsion mechanism pulls the hose over the wheels at a speed of four complete motions per minute.

**6.7.1.5** The hose shall be S-shape like and installed over the wheels (see Figure 1).

The end that runs over the upper wheel shall be furnished with a sufficient mass as to achieve a complete snuggling of the hose against the wheels. The part that runs over the lower wheel is attached to the propulsion mechanism.

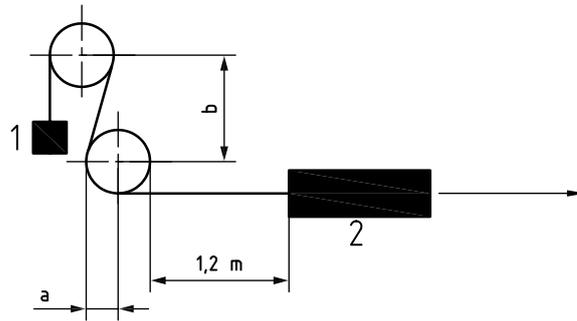
The mechanism shall be so adjusted that the hose travels a total distance of 1,2 m in both directions.

## 6.7.2 Bending test for synthetic hoses

**6.7.2.1** This test shall be performed on uncoupled flexible hoses.

**6.7.2.2** An empty hose, at a length of approximately 3,5 m shall be able to withstand 3 000 times the hereafter prescribed alternating-bending test without breaking. After the test the hose shall be capable

of withstanding hydrostatic test pressure of  $2,25 \times$  working pressure applied during 10 min, without any leakage.



**Key**

- 1 mass
- 2 propulsion mechanism
- a 102 mm.
- b 241 mm.

**Figure 2 — Example of a bending test machine for synthetic hoses**

**6.7.2.3** The testing machine (see [Figure 2](#)) shall consist of a steel frame, provided with two wooden wheels, with a rim width of approximately 130 mm.

The circumference of the wheels shall be grooved for the guidance of the hose. The radius of the wheels, measured to the bottom of the groove, shall be 102 mm.

The longitudinal median planes of both wheels shall be in the same vertical plane. The distance between the wheel centres shall be vertical 241 mm and horizontal 102 mm.

Each wheel shall be able to rotate freely round the pivot centre.

A propulsion mechanism pulls the hose over the wheels at a speed of four complete motions per minute.

**6.7.2.4** The hose shall be S-shape like and installed over the wheels (see [Figure 2](#)).

The end that runs over the upper wheel shall be furnished with a sufficient mass as to achieve a complete snuggling of the hose against the wheels. The part that runs over the lower wheel is attached to the propulsion mechanism.

The mechanism shall be so adjusted that the hose travels a total distance of 1,2 m in both directions.

**6.8 Impulse test**

**6.8.1** This test shall be performed on an assembly of hose and couplings.

**6.8.2** The hose assembly shall be subjected to an impulse test in compliance with ISO 1436.

**6.8.3** The test shall be completed with circulating oil having a temperature of 93 °C and a minimum pressure of WP.

**6.8.4** The hose shall be subjected to 150 000 impulses.

**6.8.5** After the impulse test, the hose shall withstand a test pressure of  $2,25$  WP applied during 10 min, without any leakage.