
**Road vehicles — Compressed gaseous
hydrogen (CGH₂) and hydrogen/
natural gas blends fuel system
components —**

**Part 14:
Flexible fuel line**

*Véhicules routiers — Composants des circuits d'alimentation pour
hydrogène gazeux comprimé (CGH₂) et mélanges de gaz naturel et
hydrogène —*

Partie 14: Tuyauterie flexible pour combustible



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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).

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).

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

For an explanation on 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 the following URL: 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 12619 series can be found on the ISO website.

Road vehicles — Compressed gaseous hydrogen (CGH₂) and hydrogen/natural gas blends fuel system components —

Part 14: Flexible fuel line

1 Scope

This document specifies tests and requirements for the flexible fuel line, a compressed gaseous hydrogen (CGH₂) and hydrogen/natural gas blend fuel system component intended for use on the types of motor vehicles defined in ISO 3833.

It is applicable to vehicles using CGH₂ in accordance with ISO 14687-1 or ISO 14687-2 and hydrogen/natural gas blend using natural gas in accordance with ISO 15403-1 and ISO/TR 15403-2. It is not applicable to the following:

- a) liquefied hydrogen (LH₂) fuel system components;
- b) fuel containers;
- c) stationary gas engines;
- d) container mounting hardware;
- e) electronic fuel management;
- f) refuelling receptacles;
- g) fuel cell vehicles.

NOTE 1 It is recognized that miscellaneous components not specifically covered herein can be examined to meet the criteria of this document and tested according to the appropriate functional tests.

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

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 12619-1, *Road vehicles — Compressed gaseous hydrogen (CGH₂) and hydrogen/natural gas blend fuel system components — Part 1: General requirements and definitions*

ISO 12619-2, *Road vehicles — Compressed gaseous hydrogen (CGH₂) and hydrogen/natural gas blend fuel system components — Part 2: Performance and general test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12619-1 apply.

ISO 12619-14:2017(E)

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

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

4 Marking

Marking of the component shall provide sufficient information to allow the following to be traced:

- a) the manufacturer's or agent's name, trademark or symbol;
- b) the model designation (part number);
- c) the temperature range.

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, i.e. ISO 12619-14:2017.

NOTE This information can be provided by a suitable identification code on at least one part of the component when it consists of more than one part.

5 Construction and assembly

The flexible fuel line shall comply with the applicable provisions of ISO 12619-1 and ISO 12619-2 and with the tests specified in [Clause 6](#). Tolerances should follow the specifications of ISO 12619-2.

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 12619-2	Specific test requirements of this document
Hydrostatic strength	X	X	X (see 6.2)
Leakage	X	X	—
Excess torque resistance	x ^a	X	—
Bending moment	—	—	—
Continued operation	X	X	X (see 6.3)
Corrosion resistance	X	X	—
Oxygen ageing	X	X	—
Ozone ageing	X	X	—
Heat ageing	X	X	—
Automotive fluids	X	X	—
Electrical over-voltages	—	—	—
Non-metallic material immersion	X	X	—
Vibration resistance	—	—	—
Brass material compatibility	X	X	—
Bending	X	—	X (see 6.4)
Pull-off	X	—	X (see 6.5)
Electrical conductivity	X	—	X (see 6.6)
Permeability	X	—	X (see 6.7)

^a Applicable to the fittings.

6.2 Hydrostatic strength

Test the flexible fuel line according to the procedure for testing hydrostatic strength specified in ISO 12619-2. The test pressure shall be four times the specified working pressure.

NOTE The higher hydrostatic test pressure for the flexible fuel line compared with the other components in the other parts of ISO 12619 is due to the necessary provisions to cope for eventual damage or abrasions under normal operation.

6.3 Continued operation

Test high pressure flexible fuel lines in accordance with the procedure for testing continued operation given in ISO 12619-2 for a total of 20 000 cycles and low pressure flexible lines for a total of 100 000 cycles.

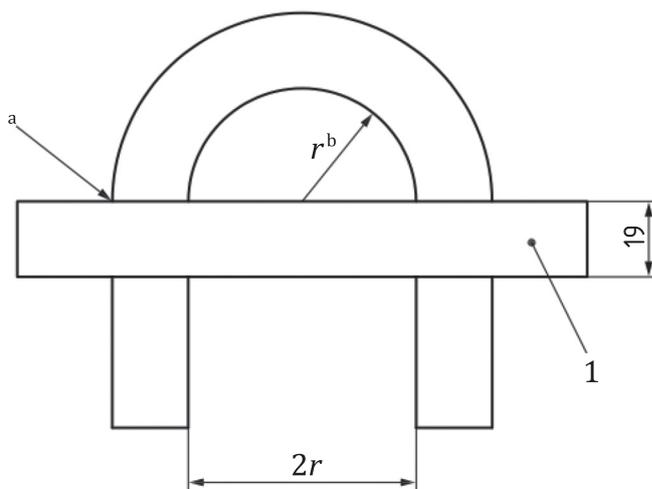
Following cycling testing, perform the leak test as specified in ISO 12619-2, then the hydrostatic test in accordance with 6.2.

6.4 Bending

Test the flexible fuel line using a suitable length of flexible fuel line with no end fittings according to the following procedure and acceptance criteria.

- Carefully bend the flexible fuel line and place it in a fixture as shown in [Figure 1](#).
- After the flexible fuel line has been left in this position for 5 min, insert into one end of the flexible fuel line a steel ball having a diameter equal to half of the nominal inside diameter of the flexible fuel line.

The fuel line shall not kink and the ball shall pass freely from one end of the flexible fuel line to the other.

**Key**

- 1 board
- a Hole size as necessary to fit flexible fuel line outside diameter.
- b $r = 10$ times the nominal flexible fuel line inside diameter, or the flexible fuel line manufacturer's specified minimum bend radius, whichever is less.

Figure 1 — Bending test**6.5 Pull-off**

Test the flexible fuel line, attached to its fitting or fittings 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 flexible fuel line axis at a maximum rate of 250 N/min until the flexible fuel line separates from its fitting.

The force (F), in newtons, required to pull apart the fuel line from its fitting shall be equal to or in excess of that calculated in [Formula \(1\)](#):

$$F = (\pi \times d^2 \times P) / 10 \quad (1)$$

where

d is the inside diameter, in millimetres;

P is the specified working pressure, in bar.

6.6 Electrical conductivity

Conduct the test with the flexible fuel line depressurized and at the specified working pressure. Check the flexible fuel line resistance using an applied potential of up to DC 500 V and measure the current.

Electrical resistance between couplings at each end of the flexible fuel line shall be $<1 \text{ M}\Omega/\text{m}$, in order to dissipate static electricity.

6.7 Permeability

Fill a suitable length of flexible fuel line with hydrogen or hydrogen/natural gas blend to service or working pressure. Place it in an enclosed sealed chamber at ambient temperature and monitor it for permeation for 14 days.

The hourly permeation rate shall be less than 20 cm³/m. Section the flexible fuel line and inspect the internal surfaces for any evidence of cracking or deterioration.

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