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Third edition
2021-12

Road vehicles — Compressed natural gas (CNG) fuel system components —

Part 17: Flexible fuel line

Véhicules routiers — Composants des systèmes de combustible gaz naturel comprimé (GNC) —

Partie 17: Tuyauterie flexible pour combustible

Reference number
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Contents

Page

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 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.

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

This third edition cancels and replaces the second edition (ISO 15500-17:2012), which has been technically revised. It also incorporates the Amendment ISO 15500-17:2012/Amd 1:2016.

The main changes are as follows:

— serial number or data code changed from recommended to mandatory in Clause 4 "Marking";

— addition of requirements in Clause 5 "Construction and assembly";

— addition of the following tests:

  — automotive fluids,

  — verification of hose cover perforations,

  — vibration resistance.

A list of all parts in the ISO 15500 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.

Introduction

For the purposes of this document, all fuel system components in contact with natural gas have been considered suitable for natural gas as defined in ISO 15403-1. However, 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.

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

This document is based on a service pressure for natural gas used as fuel of 20 MPa [200 bar[1)]] settled at 15 °C. Other service pressures can be accommodated by adjusting the pressure by the appropriate factor (ratio). For example, a 25 MPa (250 bar) service pressure system will require pressures to be multiplied by 1,25.

1) 1 bar = 0,1 MPa = 10^5 Pa 1 MPa = 1 N/mm^2.

Road vehicles — Compressed natural gas (CNG) fuel system components —

Part 17: Flexible fuel line

1 Scope

This document specifies tests and requirements for the flexible fuel line, a compressed natural gas (CNG) fuel system component in accordance with SAE J517 (100R8 hose) or JIS B 8362 intended for use on the types of motor vehicles defined in ISO 3833.

This document is applicable to vehicles (mono-fuel, bi-fuel or dual-fuel applications) using natural gas in accordance with ISO 15403-1. It is not applicable to the following:

a) liquefied natural gas (LNG) fuel system components located upstream of, and including, the vaporizer;

b) fuel containers;

c) stationary gas engines;

d) container-mounting hardware;

e) electronic fuel management;

f) refuelling receptacles.

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 15500-1, *Road vehicles — Compressed natural gas (CNG) fuel system components — Part 1: General requirements and definitions*

ISO 15500-2:2016, *Road vehicles — Compressed natural gas (CNG) fuel system components — Part 2: Performance and general test methods*

ISO 15500-19, *Road vehicles — Compressed natural gas (CNG) fuel system components — Part 19: Fittings*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15500-1 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 https://www.electropedia.org/

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 working pressure or pressure and temperature range;

d) the serial number or date code.

The following additional markings are recommended:

— the direction of flow (when necessary for correct installation);

— the type of fuel;

— electrical ratings;

— the symbol of the certification agency;

— the type approval number;

— a reference to this document.

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 15500-1 and ISO 15500-2, and with the tests specified in Clause 6. Tolerances should follow the specifications of ISO 15500-2.

5.1 The nominal hose diameter shall refer to the finished internal diameter ±0,65 mm for sizes up to and including 20 mm and ±1,25 mm for sizes over 20 mm. A tapered plug gauge having a taper of 30 mm/m marked to indicate variation of 0,5 mm in diameter or other equivalent means may be used for measuring inside diameter.

5.2 If an outer hose cover is used, it shall be constructed to minimize or prevent fluid penetration into the inner plies, braids, or tube. The inner plies, braids, or tube shall be resistant to the effects of common automotive fluids, as determined by the method of test in 6.8 .

5.3 Hose assemblies shall have end fittings that comply with ISO 15500-19 and that are permanently attached. Fittings or threaded end connectors shall be faced or otherwise finished externally to provide a standard wrench flat grip.

5.4 In addition to the instruction in ISO 15500-1:2015, Clause 6, the following shall be included as a minimum:

a) the hose or hose assembly shall not be kinked, twisted or torqued;

b) contact with foreign objects or substances shall be avoided;

c) the manufacturers specified minimum hose bend radius shall be noted and not be exceeded;

d) the manufacturer shall provide appropriate installation instructions with cautionary notes for leak testing;

e) the manufacturer shall provide installation instructions that state that the hose assembly shall be of adequate length for the intended use. Hose assemblies shall not be joined together to achieve the required length; and

f) the hose assembly shall be inspected prior to installation in accordance with the manufacturer's instructions. The manufacturer's instructions shall address such items as:

   i) soft spots, bulges or blisters in the hose;

   ii) excessive abrasion exposing the hose reinforcement;

   iii) cuts or cracks in the hose that expose or damage the reinforcement; and

   iv) evidence of fitting movement or slippage with respect to the hose.

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 15500-2	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 (see 6.8)
Electrical over-voltages			
Non-metallic material immersion	X	X	
Vibration resistance	X	X	X (see 6.10)
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 15500-2. The test pressure shall be four times the specified working pressure.

NOTE The higher hydrostatic test pressure for the flexible fuel line compared to the other components in the other parts of the ISO 15500 series 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 15500-2, 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 15500-2, then the hydrostatic test in accordance with 6.2.

6.4 Bending

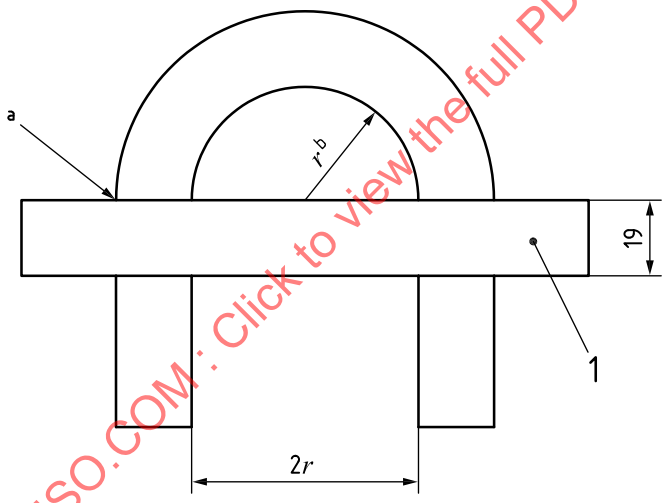
Test the flexible fuel line using a suitable length of flexible fuel line with no end fittings according to the following procedure and acceptance criteria.

a) Carefully bend the flexible fuel line and place it in a fixture as shown in Figure 1.

b) 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.

Dimension in millimetres



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 as:

$$F = \left(\pi \cdot d^2 \cdot P\right) \div 10$$

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 measuring the current.

Electrical resistance between couplings at each end of the flexible fuel line shall be <1 MΩ/m, in order to dissipate static electricity.

6.7 Permeability

Fill a suitable length of flexible fuel line with CNG to service or working pressure, place it in an enclosed sealed chamber at ambient temperature and monitor it for permeation for 14 d.

The hourly permeation rate shall be less than 20 cm^3/m. Section the flexible fuel line and inspect the internal surfaces for any evidence of cracking or deterioration.

6.8 Automotive fluid

The test shall be conducted at room temperature. The hose shall be sealed at one end. The other end shall be attached to a pressure cycling source. The hose shall be exposed to the test fluids and number of cycles as determined by the following.

During exposure, the hose shall be depressurized. Test pads of glass wool, 5 cm (2 in) wide and one layer thick [approximately 0,5 mm], shall be wrapped around one end of the hose, with each pad covering a different area of the sample material being tested. Each pad shall cover a minimum of one permeation hole. Five ml of each test fluid shall be applied to the pads, one fluid for each pad. The pads shall be removed after 30 min. The same section of hose shall be exposed to the same test fluid throughout the test. If a hose cover is used, it should be constructed to minimize or prevent fluids penetration into the inner plies, braids, or tube. The hose assembly as constructed shall be resistant to the effects of common automotive fluids, as demonstrated by the procedures in this clause.

The hose shall be exposed to the test fluids as determined by the following.

The following fluids shall be used:

a) sulfuric acid - 19 % solution by volume in water;

b) methanol/gasoline - 5 %/95 % concentrations; and

c) windshield washer fluid - 50 % volume solution of methanol.

Following fluids exposure, the following test sequence shall be conducted.

a) Samples shall be pressurized from between 10 % of service pressure and 125 %of service pressure for Class B hoses, or working pressure for Class C hoses at a rate of 4 cycles per minute, for a total of 3 000 cycles.

b) After pressure cycling, samples shall be pressurized to 125 %of service pressure for Class B hoses, or working pressure for Class C hoses, at a (30 – 60) seconds rate of rise, and held at that pressure for a minimum of 48 h.

At the completion of this test, hose assemblies shall be subjected to and shall comply with leakage and electric conductivity tests.

6.9 Verification of hose cover perforations

For testing, the hose should be submerged under water in a protective vessel that has the ability to contain any hose failure that could result from the testing.

Test sample should be assembled with the applicable fittings (see Figure 2).

a) Plug one end of the hose using an approved plug appropriate for the fittings used on the hose being tested and connect the other end to a regulated dry nitrogen tank using appropriate connectors and adapters.

b) Place the entire length of hose inside a protective vessel; submerge the assembly under water and secure the assembly from movement. This shall allow visual observation of bubbles that will emit from or cling to the surface of the hose cover along the assembly length during initial pressurization.

c) Pressurize the assembly to the working pressure of the hose while observing the hose. As the hose is initially pressurized, the hose will expand and air entrapped in the reinforcement will be forced out of the hose through the cover perforations. If bubbles do not escape from the hose during this step, note this condition and proceed with step d).

d) Allow the pressurized assembly to sit for 30 min to permit entrapped air to escape through the cover perforations.

e) Use extreme care when proceeding with this step. Do not bend, kink, or otherwise stress the hose during this procedure. Doing so can cause hose failure resulting in serious bodily injury.

f) After the pressurized assembly has reached steady state, carefully wipe off the outer surface of the hose so that development of any new bubbles can be readily seen.

g) Check the assembly every hour over a testing period of 3 h, looking for nitrogen bubbles that are attached to the surface of the hose at the location of possible perforations or emitting through the perforations of the cover. The bubbles indicate that the gas is permeating through the core tube and escaping through the perforations in the cover.

h) Carefully reduce the test pressure and remove the test assembly from the protective cabinet.

i) If the hose failed to emit bubbles as part of step c) and if after 3 h of pressurization no evidence of surface bubbles on the cover is observed, it can be concluded that cover perforation of the hose is not adequate and the sample has failed the test as set forth in this specification. Long-term pressure testing (36 h to 72 h) under these test conditions should produce large gas-filled bubbles in the hose cover as further evidence of improper hose cover perforations. Hose assemblies that fail to meet the perforation test or are subjected to long-term pressure tests shall be considered “damaged” and shall not be placed into service.

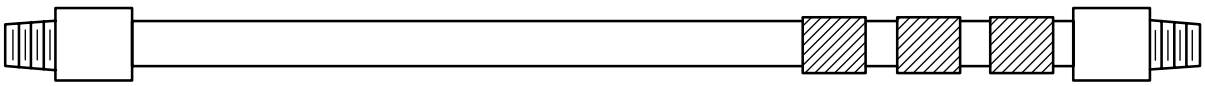


Figure 2 — Hose cover perforation