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

Part 2: Performance and general test methods

Véhicules routiers — Composants des systèmes de combustible gaz naturel comprimé (GNC) — Partie 2: Performances et méthodes d'essai générales

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 15500-2 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 25, *Vehicles using gaseous fuels*.

This second edition cancels and replaces the first edition (ISO 15500-2:2001), which has been technically revised.

ISO 15500 consists of the following parts, under the general title *Road vehicles — Compressed natural gas (CNG) fuel system components*:

— *Part 1: General requirements and definitions*

— *Part 2: Performance and general test methods*

— *Part 3: Check valve*

— *Part 4: Manual valve*

— *Part 5: Manual cylinder valve*

— *Part 6: Automatic valve*

— *Part 7: Gas injector*

— *Part 8: Pressure indicator*

— *Part 9: Pressure regulator*

— *Part 10: Gas-flow adjuster*

— *Part 11: Gas-air mixer*

— *Part 12: Pressure relief valve (PRV)*

— *Part 13: Pressure relief device (PRD)*

— *Part 14: Excess flow valve*

— *Part 15: Gas-tight housing and ventilation hose*

— *Part 16: Rigid fuel line in stainless steel*

— *Part 17: Flexible fuel line*

— *Part 18: Filter*

— *Part 19: Fittings*

— *Part 20: Rigid fuel line in material other than stainless steel*

Introduction

For the purposes of this part of ISO 15500, all fuel system components in contact with natural gas have been considered suitable for natural gas as defined in ISO 15403. However, it is recognized that miscellaneous components not specifically covered herein can be examined to meet the criteria of this part of ISO 15500 and can be tested in accordance with the appropriate functional tests.

All references to pressure in this part of ISO 15500 are considered to be gauge pressures unless otherwise specified.

This part of ISO 15500 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 accomodated 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 2:
Performance and general test methods

1 Scope

This part of ISO 15500 specifies performance and general test methods for compressed natural gas (CNG) fuel system components intended for use on the types of motor vehicles defined in ISO 3833.

This part of ISO 15500 is applicable to vehicles (mono-fuel, bi-fuel or dual-fuel applications) using compressed natural gas in accordance with ISO 15403. 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 referenced documents are indispensable for the application 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 188, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*

ISO 1817, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 15500-1:2000, *Road vehicles — Compressed natural gas (CNG) fuel system components — Part 1: General requirements and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15500-1 apply.

4 General

4.1 Unless otherwise stated, the tests shall be conducted at a room temperature of 20 °C ± 5 °C.

4.2 Components shall comply with the tests specified in this part of ISO 15500 as well as the relevant parts of ISO 15500, as applicable for each component.

NOTE Because of the peculiarities of some components, the list of tests given in this part of ISO 15500 (Clauses 5 to 15) is not exhaustive. Where additional tests are required, their provisions are given in other parts of ISO 15500.

4.3 Unless otherwise specified, all tests shall be conducted using dry air or nitrogen. Tests may also be conducted with natural gas provided appropriate safety measures are taken. The dew point of the test gas at the test pressure shall be at the temperature at which there is no icing, or hydrate or liquid formation.

5 Hydrostatic strength

A component shall not show any visible evidence of rupture when subjected to the following test procedure.

Plug the outlet opening of the component and have the valve seats or internal blocks assume the open position. Apply, with a test fluid, the hydrostatic pressure specified in the applicable part of ISO 15500 to the inlet of the component for a period of at least 3 min.

The hydrostatic pressure shall then be increased at a rate of less than or equal to 1,4 MPa/s until component failure. The hydrostatic pressure at failure shall be recorded. The failure pressure of previously tested components shall be no less than 80 % of the failure pressure of the virgin component.

The samples used in this test shall not be used for any other testing.

6 Leakage

6.1 General

6.1.1 Prior to conditioning, purge the component with nitrogen, then seal it at 30 % of the working pressure using nitrogen, dry air or natural gas.

6.1.2 Conduct all tests while the device is continuously exposed to the specified test temperatures. The device shall either be bubble-free or display a leakage rate of less than 20 Ncm^3/h when subjected to the following test method.

If components are subjected to more than one working pressure, the test may be conducted in subsequent steps.

6.2 External leakage

6.2.1 Plug each device outlet into the appropriate mating connection.

6.2.2 Apply pressurized air, nitrogen or natural gas to the inlet of the test device.

6.2.3 At all test temperatures, immerse the components in a suitable test medium for 2 min $\left(^{+30}_{0}\right)$ s or use a helium vacuum test (global accumulation method) or other equivalent method.

6.2.4 If there are no bubbles for the specified time period, the sample passes the test. If bubbles are detected, measure the leakage rate using an appropriate method; the leakage rate should not be more than that specified in 6.1.2.

6.3 Internal leakage

6.3.1 The internal leakage test is applicable only to devices in the closed position. The aim of this test is to check the pressure tightness of the closed system.

6.3.2 Connect the inlet or outlet (as applicable) of the device to the appropriate mating connection, leaving the opposite connection(s) open.

6.3.3 Apply the test pressure to the inlet or outlet (as applicable) of the device using air, nitrogen or natural gas as the test fluid.

6.3.4 At all applicable test temperatures mentioned in 6.4, immerse the component in a suitable test medium for 2 min $\left(^{+30}_{0}\right)$ s or used any other equivalent method.

6.3.5 If there are no bubbles for the specified time period, the sample passes the test. If bubbles are detected, measure the leakage rate using an appropriate method; the leakage rate should not be more than that specified in 6.1.2.

6.4 Test conditions

6.4.1 The device shall be conditioned at a low temperature of –40 °C or –20 °C, as applicable, and pressurized at 75 % and 2,5 % of the working pressure.

6.4.2 The device shall be conditioned at a room temperature and pressurized at 2,5 % and 150 % of the working pressure.

6.4.3 The device shall be conditioned at a high temperature of 85 °C or 120 °C, as applicable, and pressurized at 5 % and 150 % of the working pressure.

7 Excess torque resistance

A component designed to be connected directly to threaded fittings shall be capable of withstanding, without deformation, breakage or leakage, a torque effort of 150 % of the rated installation value, when tested in accordance with 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 min, release it, then remove the component and examine it for deformation and breakage.

c) Subject the component to the leakage test specified in Clause 6.

d) Subject the component to the hydrostatic strength test specified in Clause 5

8 Bending moment

A component shall be able to operate without cracking, breaking or leaking when tested in accordance with the following procedure.

a) Assemble the connections of the component, ensuring that they are leak-tight, to one or several appropriate mating connection(s) representative of the design. After assembly, the length of the inlet tubing shall be greater than 300 mm (see Figure 1).

b) The outlet connection shall be rigidly supported at a distance of 25 mm from the component outlet, except in the following cases:

   — if the component has an integral mounting means that is independent of the inlet and outlet connections, the component shall be mounted using the integral mounting means specified by the manufacturer;

   — if the component is intended to be mounted using either the integral mounting means or the component outlet, the mounting means that produces the most severe test condition shall be used.

c) Check this assembly for leaks before subjecting it to step d).

d) With the component in the closed position, pressurize the system to 5 kPa and apply a force in accordance with Table 1, at 300 mm from the inlet, maintaining it for 15 min. Without removing the force, check the component for leakage in accordance with the test method given in Clause 6, at room temperature.

NOTE Depending on how this test is performed, it might be necessary to raise the load to compensate for buoyancy.

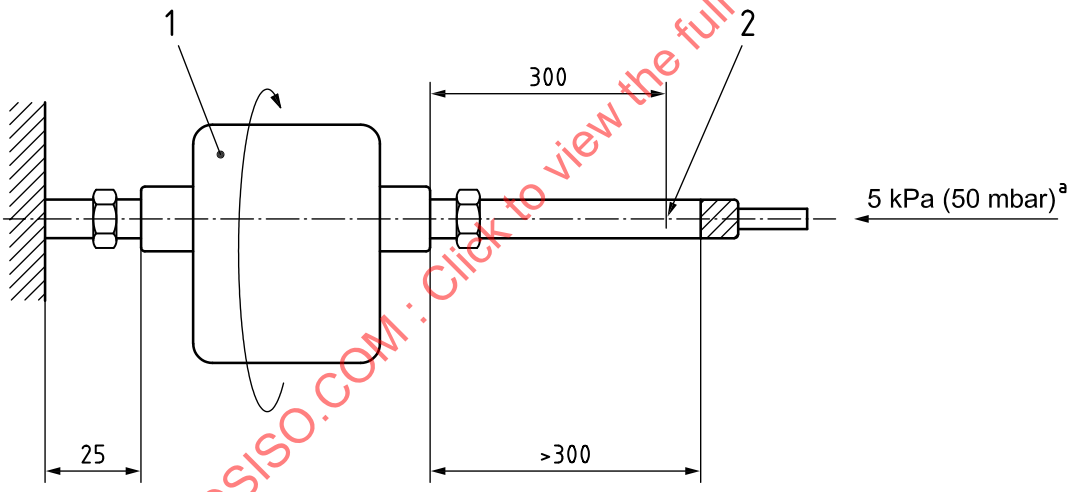
e) Perform step d) of the procedure four times, rotating the component by 90° around the horizontal axis between each test. Between tests, open and close (if applicable) the component three times with the bending moment removed.

f) At completion of the above tests, remove the component and examine it for deformation; then subject it to the leakage test specified in Clause 6 and the hydrostatic strength test specified in Clause 5.

Table 1 — Bending moment test force

Outside diameter of tubing mm	Force N
6	3,4
8	9,0
≥12	17,0

Dimensions in millimetres



Key

1 component

2 force point

a 4 × 90 ° rotation.

Figure 1 — Bending moment

9 Continued operation

9.1 General

For details on test methods pertaining to particular components, see the respective parts of ISO 15500. The method specified in this clause is general in nature and also applies to miscellaneous components.

Other components (those for which specific requirements are not specified) shall be subjected to the following continuous operation test for a total number of cycles to be determined by the testing agency. The determination of the total number of cycles shall be based on 15 000 fill cycles and/or 50 000 duty cycles.

9.2 Test methods

9.2.1 Test procedure

The component shall be installed as indicated and cycled using dry air, nitrogen or natural gas, under all the appropriate loads.

Connect the component securely, using a suitable fitting, to a pressurized source of dry air, nitrogen or natural gas, and subject it to the number of cycles specified in ISO 15500-3 or parts corresponding to specific component, as applicable. A cycle shall consist of one full operation and reset within an appropriate period as determined by the testing agency.

On completion of the cycling, the component shall be subjected to the hydrostatic strength test, as specified in Clause 5.

During the off-cycle, the downstream pressure of the test fixture shall be lowered to a maximum of 50 % of the test pressure.

Unless otherwise specified, the test pressure shall be 100 % of the working pressure.

Unless otherwise specified, the conditions of 9.2.2, 9.2.3 and 9.2.4 shall apply.

9.2.2 Room temperature cycling

Operate the component through 96 % of the total cycles at room temperature and at working pressure. On completion of the room temperature cycles, the component shall comply with the requirements of Clause 6.

This test may be interrupted, if desired, at 20 % intervals for leakage testing.

9.2.3 High-temperature cycling

Operate the component through 2 % of the total cycles at the appropriate maximum temperature specified in ISO 15500-1:2000, 4.4, and at working pressure. On completion of the high-temperature cycles, the component shall comply with the requirements of Clause 6 at the appropriate maximum temperature.

9.2.4 Low-temperature cycling

Operate the component through 2 % of the total cycles at the appropriate minimum temperature specified in ISO 15500-1:2000, 4.4, and at 100 % of the working pressure up to a maximum of 20 MPa. On completion of the low-temperature cycles, the component shall comply with the requirements of Clause 6 at the appropriate minimum temperature.

Immediately following the continued operation tests and leakage testing, perform the hydrostatic strength test in accordance with Clause 5

10 Corrosion resistance

10.1 All components shall perform safely and in compliance with Clause 6 following exposure to salt spray in accordance with the following test method. AISI series 300 austenitic stainless steels, or equivalent austenitic stainless steels, are exempt from corrosion resistance testing.

10.2 With the component supported in its normal installed position, expose it for 144 h to a salt spray (fog) test, as specified in ISO 9227. If the component is expected to operate, unprotected, in vehicle underbody service conditions, then it shall be exposed for 500 h to the salt spray (fog) test.

10.3 Maintain the temperature within the fog chamber between 33 °C and 36 °C.

10.4 The saline solution shall consist of 5 % sodium chloride and 95 % distilled water, by weight.

10.5 Immediately following the corrosion resistance test, rinse the sample and gently clean it of salt deposits; then subject it to the leakage test according to Clause 6.

10.6 Immediately following the corrosion resistance test and leakage test, subject the sample to the hydrostatic strength test according to Clause 5.

11 Oxygen ageing

No synthetic or non-metallic parts of components that provide a fuel-containing seal shall crack or show visible evidence of deterioration after oxygen ageing when tested in accordance with the following procedure.

Expose representative samples to oxygen for a minimum of 96 h at a temperature of 70 °C ± 5 °C and a pressure of at least 2 MPa (20 bar), in accordance with ISO 188.

12 Electrical overvoltages

All electrical components or devices containing electrical subcomponents shall withstand the application of 1,5 times its rated operating voltage ±5 % for periods of 3 min without creating an unsafe condition. Failure to open is not considered an unsafe condition.

13 Non-metallic material immersion

13.1 Non-metallic material used in a component shall be subjected by the test agency to the tests described in 13.2 and 13.3, except where the applicant submits a test result declaration for tests carried out on the material provided by the manufacturer.

13.2 A part made of non-metallic material in contact with natural gas shall not show excessive change in volume or weight when tested in accordance with the following procedure.

a) Prepare, measure and weigh one or more representative samples of each non-metallic material used in a component, then immerse the sample or samples at room temperature in natural gas, at a pressure equal to its working pressure, but not less than 100 kPa, for a minimum of 70 h.

b) Immediately following this period of immersion, rapidly reduce the test pressure to atmospheric pressure without causing shredding or disintegration.

No tested sample shall exhibit swelling greater than 25 % or shrinkage greater than 1 %. The weight change shall not exceed 10 %.

13.3 Non-metallic material used in a component that is likely to be exposed to ester-based or alpha-olefin-based synthetic compressor oils, including non-synthetic compressor oils, shall not show excessive change in volume or weight when tested in accordance with ISO 1817 or the following procedure.

a) Prepare, measure and weigh one or more representative samples of each non-metallic material used in a component, then immerse the sample or samples at room temperature in holders, each containing one of the test fluids, for a minimum of 70 h.

b) Following this period of immersion, remove and measure the test samples, within 1 h.

No sample shall exhibit swelling greater than 25 % or shrinkage greater than 1 %. The weight change shall not exceed 10 %.