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ISO 15500-9

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

Part 9: Pressure regulator

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

Partie 9: Régulateur de pression

Reference number
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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 3.

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 part of ISO 15500 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15500-9 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 25, *Road vehicles using natural gas*.

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*

— *Part 17: Flexible fuel line*

— *Part 18: Filter*

— *Part 19: Fittings*

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

Part 9: Pressure regulator

1 Scope

This part of ISO 15500 specifies tests and requirements for the pressure regulator, a compressed natural gas fuel system component intended for use on the types of motor vehicles defined in ISO 3833.

This part of ISO 15500 is applicable to vehicles using natural gas in accordance with ISO 15403 (mono-fuel, bi-fuel or dual-fuel applications). 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.

NOTE 1 It is recognized that miscellaneous components not specifically covered herein can be examined to meet the criteria of this part of ISO 15500 and tested according to the appropriate functional tests.

NOTE 2 All references to pressure in this part of ISO 15500 are to be considered gauge pressures unless otherwise specified.

NOTE 3 This part of ISO 15500 is based upon a service pressure for natural gas as a 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.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 15500. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 15500 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

ISO 3833, *Road vehicles — Types — Terms and definitions*.

ISO 15403, *Natural gas — Designation of the quality of natural gas for use as a compressed fuel for vehicles*.

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

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

3 Terms and definitions

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

3.1
lock-up pressure
stabilized outlet pressure of the regulator at 0 (zero) flow

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 service pressure or pressure and temperature range.

The following additional markings are recommended:

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

e) the type of fuel;

f) electrical ratings (if applicable);

g) the symbol of the certification agency;

h) the type approval number;

i) the serial number or date code;

j) reference to this part of ISO 15500.

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

5.1 The pressure regulator shall comply with the applicable provisions of ISO 15500-1 and ISO 15500-2, and with the tests specified in clause 6 of this part of ISO 15500.

5.2 A pressure relief valve shall be of a type that resets after relieving; it is intended that downstream components be protected from exposure to cylinder pressure.

5.3 A pressure relief valve may be integral to the pressure regulator, or not.

5.4 The pressure regulator shall have a factory-set maximum outlet pressure. The maximum outlet pressure rating and the inlet pressure rating shall be marked on the regulator.

6 Tests

6.1 Applicability

The tests required to be carried out are indicated in Table 1.

Table 1 — Tests applicable

Test	Applicable	Test procedure as required by ISO 15500-2	Specific test requirements of this part of ISO 15500
Hydrostatic strength	X	X	X (see 6.2)
Leakage	X	X	X (see 6.3)
Excess torque resistance	X	X	
Bending moment	X	X	
Continued operation	X	X	X (see 6.4)
Corrosion resistance	X	X	
Oxygen ageing	X	X	
Electrical overvoltages	X	X	
Non-metallic synthetic immersion	X	X	
Vibration resistance	X	X[a]	
Brass material compatibility	X	X	
Insulation resistance	X		X (see 6.5)
Minimum opening voltage	X		X (see 6.6)
Pressure impulse	X		X (see 6.7)
Water jacket freezing	X		X (see 6.8)

[a] The vibration resistance test in ISO 15500-2 is not applicable if the pressure regulator is engine-mounted.

6.2 Hydrostatic strength

6.2.1 Test the pressure regulator according to the procedure for testing hydrostatic strength specified in ISO 15500-2.

6.2.2 Test the inlet of the first stage of the pressure regulator using a pressure of at least 100 MPa (1 000 bar).

6.2.3 Test the inlet or inlets of the downstream stage or stages at four times the working pressure.

6.2.4 Test the outlet chamber, port and all outlet fittings at four times the working pressure, or 0,4 MPa (4 bar), whichever is the greater.

6.3 Leakage

Test the pressure regulator at the temperatures and pressures given in Table 2.

Table 2 — Test temperatures and pressures

Temperature °C	**Percentage**	**Inlet test pressure** MPa [bar]	
		First test	Second test
– 40	1	15 [150]	0,5 [5]
20	1	0,5 [5]	30 [300]
120	1	0,5 [5]	
– 40	2, 3, ...	0,75 × working pressure	1
20	2, 3, ...	1	1,5 × working pressure
120	2, 3, ...	1	1,5 × working pressure

6.4 Continued operation

The regulator shall be able to withstand 50 000 cycles without any failure when tested according to the following procedure. Where the stages of pressure regulation are separate, the service pressure in a) to f) is considered to be the working pressure of the upstream stage.

a) Recycle the regulator for 95 % of the total number of cycles at room temperature and at the service pressure. Each cycle shall consist of flow until stable outlet pressure has been obtained, after which the gas flow shall be shut off by a downstream valve within 1 s, until the downstream lock-up pressure has stabilized. Stabilized outlet pressures are defined as set pressure ± 15 % for at least 5 s. The regulator shall comply with 6.3 at room temperature at intervals of 20 %, 40 %, 60 %, 80 % and 100 % of room temperature cycles.

b) Cycle the inlet pressure of the regulator for 1 % of the total number of cycles at room temperature from 100 % to 50 % of the service pressure. The duration of each cycle shall be no less than 10 s. The regulator shall comply with 6.3 at room temperature at the completion of this test.

c) Repeat the cycling procedure of a) at 120 °C at the service pressure for 1 % of the total number of cycles.

d) Repeat the cycling procedure of b) at 120 °C at the service pressure for 1 % of the total number of cycles. The regulator shall comply with 6.3 at 120 °C at the completion of this test.

e) Repeat the cycling procedure of a) at – 40 °C and 50 % of service pressure for 1 % of the total number of cycles.

f) Repeat the cycling procedure of b) at – 40 °C and 50 % of service pressure for 1 % of the total number of cycles. The regulator shall comply with 6.3 at – 40 °C at the completion of this test.

g) At the completion of the cycles, the lock-up pressure downstream of the regulator shall not exceed the lock-up pressure.

6.5 Insulation resistance

This test is designed to check for a potential failure of the insulation between the two-pin coil assembly and the pressure regulator casing.

Apply 1 000 V d.c. between one of the connector pins and the housing of the pressure regulator for at least 2 s. The minimum allowable resistance shall be 240 kΩ.

6.6 Minimum Opening Voltage

The minimum opening voltage at room temperature shall be $\leqslant$ 6 V for a 12 V system and $\leqslant$ 16 V for a 24 V system.

6.7 Pressure impulse

a) Subject the pressure regulator with its first stage valve rendered fully open to a sudden application of its service pressure at its inlet. The pressure regulator shall retain or release the pressure without any permanent deformation.

b) Record the lock-up pressure of the regulator.

6.8 Water Jacket Freezing

a) Fill the regulator or water jacket, which normally contains an antifreeze solution, with water to normal capacity and expose it at – 40 °C for 24 h. Attach 1 m sections of coolant hose to the coolant inlet and outlet of the regulator or water jacket.

b) Following the freezing conditioning, conduct an external leakage test at room temperature according to 6.3.

A separate sample may be used for this test.