

Road vehicles — Compressed Gaseous Hydrogen (CGH₂) and Hydrogen Blends fuel system components — Part 3: Pressure regulator

Véhicules routiers — Composants ... — Partie 3: ...

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Foreword

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ISO XXX-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 25, *Road vehicles using gaseous fuels*.

ISO XXX consists of the following parts, under the general title *Road vehicles — Compressed Gaseous Hydrogen (CGH₂) and Hydrogen Blends fuel system components*:

- *Part 1: General requirements and definitions*
- *Part 2: Performance and general test methods*
- *Part 3: Pressure regulator*

Road vehicles — Compressed Gaseous Hydrogen (CGH₂) and Hydrogen Blends fuel system components — Part 3: Pressure regulator

1 Scope

This Standard specifies tests and requirements for the pressure regulator, a compressed gaseous hydrogen fuel system component intended for use on the types of motor vehicles defined in ISO 3833.

It is applicable to vehicles using hydrogen in accordance with ISO 14687 (mono-fuel, bi-fuel or dual-fuel applications). It is not applicable to the following:

- a) liquefied hydrogen (LH₂) 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 Standard and tested according to the appropriate functional tests.

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

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this Standard 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.

ISO 3833:1977, *Road vehicles - Types - Terms and definitions*

ISO XXXXX-1, *Road vehicles - Compressed Gaseous Hydrogen (CGH₂) and Hydrogen Blends fuel system components - Part 1: General requirements and definitions*

ISO XXXXX-2, *Road vehicles - Compressed Gaseous Hydrogen (CGH₂) and Hydrogen Blends fuel system components - Part 2: Performance and general test methods*

ISO 14687:1999, *Hydrogen fuel - Product specification*

3 Terms and definitions

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

3.1

lock-up pressure

stabilized outlet pressure of the regulator at 0 (zero) flow

4 Marking and labelling

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 Standard

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 Qualifications for construction and assembly

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

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.

¹⁾ Presently at DIS stage

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6 Tests

6.1 Applicability

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

Test	Applicable	Test procedure as required in ISO XXXXX-2	Specific test required in this Standard
Hydrostatic strength	X	X	§ 6.2
Leakage	X	X	§ 6.3
Excess torque resistance	X	X	-
Bending moment	X	X	-
Continued operation	X	X	§ 6.4
Corrosion resistance	X	X	-
Oxygen ageing	X	X	-
Electrical over-voltages	X	X	-
Non-metallic synthetic immersion	X	X	-
Vibration resistance	X	X ^a	-
Brass material compatibility	X	X	-
Insulation resistance	X	-	§ 6.5
Minimum opening voltage	X	-	§ 6.6
Pressure impulse	X	-	§ 6.7
Water jacket freezing	X	-	§ 6.8

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

Table 1

6.2 Hydrostatic strength

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

6.2.2 Test the inlet of the first stage of the pressure regulator using a pressure of at least four times the service pressure.

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.

Temperature °C	Stage	Inlet Test Pressure Mpa [bar]	
		First test	Second test
-40	1	75% service pressure	2.5% service pressure
20	1	2.5% service pressure	150% service pressure
120	1	2.5% service pressure	150% service pressure
-40	2, 3, 4...	75% working pressure	2.5% working pressure
20	2, 3, 4...	2.5% working pressure	150% working pressure
120	2, 3, 4...	2.5% working pressure	150% working pressure

Table 2 – Test temperatures and pressures

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.

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ISO/TC197 N 391_Form 04_Annex 3 (Draft) = Reintroduction of****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 k Ω .

6.6 Minimum opening voltage

The minimum opening voltage at room temperature shall be ≤ 6 V for a 12 V system and ≤ 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.