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ईंधन प्रणाली के घटक - दाब रेगुलेटर
(प्रथम संशोधन)

Draft Indian Standard

**ROAD VEHICLES — COMPRESSED NATURAL GAS (CNG) / BIO- COMPRESSED
NATURAL GAS (BIO- CNG) FUEL SYSTEM COMPONENTS — PRESSURE
REGULATOR**
(*First Revision*)

ICS: 43.060.40

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Last date for receipt of
is 26/02/2023

Automotive Vehicles Running on Non-Conventional Energy Sources Sectional Committee,
TED 26

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Vehicles Running on Non-conventional Energy Sources Sectional Committee had been approved by the Transport Engineering Division Council.

In the formulation of this standard considerable assistance has been derived from the following standards issued by the Automotive Research Association of India and the International Organization for standardization respectively:

AIS 024(Rev.1) (Part A):- Safety and Procedural Requirements for Type Approval of Gaseous Fuelled Vehicles - Part A (Automotive Application).

AIS 024(Rev.1) (Part B):- Safety and Procedural Requirements for Type Approval of Gaseous Fuel Agricultural Tractors - Part B (Agricultural Tractors Application).

AIS 024(Rev.1) (Part C):- Safety and Procedural Requirements for Type Approval of Gaseous Fuel Vehicles - Part C (CEV's Application).

AIS 028(Rev.1) (Part A):-Code of Practice for Use of Gaseous Fuels in Internal Combustion Engine Vehicles - Part A (Automotive Application)

AIS 028(Rev.1) (Part B):-Code of Practice for Use of Gaseous Fuels in Internal Combustion Engine Agricultural Tractors - Part B (Agricultural Tractors Application)

AIS 028(Rev.1) (Part C):-Code of Practice for Use of Gaseous Fuels in Internal Combustion Engine Construction Equipment Vehicles (CEV's) - Part C (CEV's Application).

ISO 15500-9:2001 — Road vehicles — Compressed natural gas (CNG) fuel system components — Part 9: Pressure regulator

This standard deviates from ISO 15500-9:2001 with respect to following:

- a) The hydrostatic strength test pressure is changed from 100 MPa to four times the working pressure
- b) Considering Indian climate conditions, the low temperature test of pressure regulator is changed to -20°C instead of -40°C
- c) Testing at room temperature shall be done at 27±5°C instead of 20°C

This standard is one of the series of Indian Standards published on CNG/Bio-CNG onboard fuel system components. Other standards in the series are:

| <i>IS No.</i> | <i>Title</i> |
|---------------|--------------|
|---------------|--------------|

- 15710: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components – General requirements & definition.
- 15711: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components –Performance and general test methods
- 15712: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components – Automatic valve
- 15714: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components – Gas Air mixer
- 15715: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) / Liquefied Petroleum Gas (LPG) Fuel system components – CNG/Bio-CNG/LPG Conduit (Ventilation Hose/Pipe)
- 15716: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components –CNG / Bio-CNG high pressure fuel line (rigid) with end connections (having pressure exceeding 2.15 MPa)
- 15717: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) / Liquefied Petroleum Gas (LPG) Fuel system components – Petrol valve (Automatic/Manual)
- 15718: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components – CNG/Bio-CNG high Pressure fuel line(flexible hose)with end connections (having pressure exceeding 2.15 MPa)
- 15719: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG)/ Liquefied Petroleum Gas (LPG) fuel system components – Electrical Wiring kit
- 15720: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) /Liquefied Petroleum Gas (LPG) fuel system component – Compartments sub- Compartments
- 15721: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) / Bio-Compressed natural gas (Bio-CNG)/ Liquefied Petroleum Gas (LPG) fuel system components – Fire retardant material for seat, upholstery, roof and side lining
- 15722: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) / Bio-Compressed natural gas (Bio-CNG) fuel system components - CNG /Bio-CNG flexible fuel line with or without end connections(having pressure not exceeding 2.15 MPa)

15723: XXXX¹⁾ Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) /Liquefied Petroleum Gas (LPG) fuel system components – Current Limiting devices

Note — Standards Marked with superscript '1)' are under the process of Revision. The year of publication of these standards will be updated at the time of printing of this draft standard.

The composition of the Committee responsible for the formulation of this standard is given at Annex A (Will be added later).

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of test or analysis, shall be rounded off in accordance with IS 2:2022 'Rules for rounding off numerical values (*Second Revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Draft Indian Standard

**ROAD VEHICLES — COMPRESSED NATURAL GAS (CNG) / BIO- COMPRESSED
NATURAL GAS (BIO- CNG) FUEL SYSTEM COMPONENTS — PRESSURE
REGULATOR**

1 SCOPE

1.1 This standard specifies definitions, test methods and requirements of pressure regulator of CNG /Bio-CNG onboard fuel system component intended for use on motor vehicles defined in IS 14272.

1.1.1 This standard is applicable to CNG /Bio-CNG fuel system components intended to use on vehicles using compressed natural gas / Bio- compressed natural gas in accordance with IS 15320 Part 1 (mono-fuel or bi-fuel applications or dual fuel applications).

1.1.2 This standard 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;
- g) CNG / Bio- CNG fuel systems components for the propulsion of marine craft, and
- h) Hydrogen Natural Gas Blend (HCNG) Fuel system components.

1.1.3 This standard is based upon a service pressure for compressed natural gas / Bio-compressed natural gas as a fuel at 20 MPa (200 Bar) settled at 15°C. Other service pressures could 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. All references to pressure are to be considered gauge pressures unless otherwise specified.

2 REFERENCES

The following standards contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

| <i>IS No.</i> | <i>Title</i> |
|---------------|---|
| IS 14272:2011 | Automotive Vehicles – Types – Terminology |

| | |
|---|--|
| IS 15320 (Part 1) :2012/ ISO 15403-1 : 2006 | Natural gas - Natural gas for use as a compressed fuel for vehicles: Part 1 designation of the quality (First Revision) |
| 15710: XXXX ²⁾ | Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components – General requirements & definition. |
| 15711: XXXX ²⁾ | Road vehicles - Compressed natural gas (CNG) /Bio-Compressed natural gas (Bio-CNG) fuel system components – Performance and general test methods |

Note — Standards Marked with superscript '2)' are under the process of Revision. The year of publication of these standards will be updated at the time of printing of this draft standard.

3 DEFINITIONS

For the purpose of this standard the following definition in addition to those given in IS 15710 shall apply.

3.1 Lock-up Pressure — Stabilized outlet pressure of the regulator at zero flow.

4 CONSTRUCTION AND ASSEMBLY

4.1 The pressure regulator shall comply with the applicable provisions of IS 15710 and IS 15711, and with the tests specified in 5.

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

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

4.4 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.

5 TESTS

5.1 Applicability

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

Table 1 Test Applicable
(Clause 5.1)

| SI No. (1) | Tests (2) | Applicable Tests on the component (3) | Tests for which Procedure is given in IS 15711 (4) | Specific Tests/Test Conditions required for This Standard (5) |
|---------------|----------------------------------|--|---|--|
| i) | Hydrostatic strength | X | X | X (see 5.2) |
| ii) | Leakage | X | X | X (see 5.3) |
| iii) | Excess torque resistance | X | X | ---- |
| iv) | Bending moment | X | X | ---- |
| v) | Continued operation | X | X | X (see 5.4) |
| vi) | Corrosion resistance | X | X | ---- |
| vii) | Oxygen ageing | X | X | ---- |
| viii) | Electrical over-voltages | X | X | ---- |
| ix) | Non-metallic synthetic immersion | X | X | ---- |
| x) | Vibration resistance | X | X ¹ | ---- |
| xi) | Brass material compatibility | X | X | ---- |
| xii) | Insulation resistance | X | ---- | X (see 5.5) |
| xiii) | Minimum opening voltage | X | ---- | X (see 5.6) |
| xiv) | Pressure impulse | X | ---- | X (see 5.7) |
| xv) | Water jacket freezing | X | ---- | X (see 5.8) |

NOTES —

1 Superscript '1' indicates that the vibration resistance test in IS 15711 is not applicable if the pressure regulator is engine mounted.

2 The tests electrical over voltages, insulation resistance, and minimum opening voltage are applicable only, if the regulator has integrated solenoid valve.

5.2 Hydrostatic Strength

5.2.1 Test the pressure regulator according to the procedure for testing hydrostatic strength specified in IS 15711.

5.2.2 Test the inlet of the first stage of the pressure regulator using a pressure of four times the working pressure.

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

5.2.4 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.

5.3 Leakage

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

Table 2 Test Temperatures and Pressures
 (Clause 5.3)

| SI No. (1) | Temperature (°C) (2) | Stage (3) | Test Pressure Factor | |
|---------------|----------------------------|---|----------------------|--------------------|
| | | | First Test (4) | Second Test (5) |
| 1 | -40 or -20 | Inlet to 1 | 0.75 | 0.025 |
| 2 | 20 | | 0.025 | 1.5 |
| 3 | 120 | | 0.05 | |
| 4 | -40 or -20 | Chambers downstream of Inlet to 1 | 0.75 | 0.025 |
| 5 | 20 | | 0.025 | 1.5 |
| 6 | 120 | | 0.05 | |

NOTE — Test Pressure = Test Pressure Factor * Working Pressure

5.4 Continued Operation

The regulator shall be able to withstand 50000 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 percent 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 \pm 15 percent for at least 5 s. The regulator shall comply with 5.3 at room temperature at intervals of 20 percent, 40 percent, 60 percent, 80 percent and 100 percent of room temperature cycles.
- b) Cycle the inlet pressure of the regulator for 1 percent of the total number of cycles at room temperature from 100 percent to 50 percent of the service pressure. The duration of each cycle shall be not less than 10s. The regulator shall comply with 5.3 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 percent of the total number of cycles.
- d) Repeat the cycling procedure of (b) at 120°C at the service pressure for 1 percent of the total number of cycles. The regulator shall comply with 5.3 at 120°C at the completion of this test.
- e) Repeat the cycling procedure of (a) at -20°C and 50 percent of service pressure for 1 percent of the total number of cycles.
- f) Repeat the cycling procedure of (b) at -20°C and 50 percent of service pressure for 1 percent of the total number of cycles. The regulator shall comply with 5.3 at -20°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.

5.5 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 1000 V dc between one of the connector pins and the housing of the pressure regulator for at least 2s. The minimum allowable resistance shall be 240 k Ω .

5.6 Minimum Opening Voltage

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

5.7 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.

5.8 Water Jacket Freezing

- a) Fill the regulator or water jacket, which normally contains an anti-freeze solution, with water to normal capacity and expose it at -20°C for 24 h. Attach 1m 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 **5.3**.

A separate sample maybe used for this test.

6 MARKING

6.1 Each Pressure regulator shall be legibly and indelibly marked with the following:

- a) Manufacturer's name, trade-mark or symbol;
- b) Part No. or unique identification mark;
- c) Working pressure and temperature range or service pressure; and
- d) Date of manufacture or batch number.

6.2 BIS Certification Marking

Each pressure regulator may also be marked with the BIS Standard Mark.

6.2.1 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

7 TECHNICAL INFORMATION TO BE SUBMITTED BY THE COMPONENT MANUFACTURER

Technical information to be submitted by the component manufacturer for component type test

(type approval) shall contain at least following information:

- a) Name of the manufacturer,
- b) Manufacturing plant address,
- c) Part number,
- d) Type No. /Model No.,
- e) Number of pressure reduction stages in the regulator,
- f) Working pressure of each stage,
- g) Rated voltage of the solenoid coil (if any),
- h) Operating temperatures, and
- j) Drawings with relevant dimensions and material.

8 NUMBER OF SAMPLES FOR TESTING

Minimum 7 numbers of the CNG/Bio-CNG pressure regulator assemblies shall be submitted to the test agency for complete type testing along with minimum 10 numbers each of the non-metallic parts used in the CNG/Bio-CNG pressure regulator assembly. Each non-metallic part shall be submitted separately in the packets mentioning detail like part name, part numbers and quantity.

9 TYPE TEST (TYPE APPROVAL)

For type approval CNG/Bio-CNG pressure regulator shall meet the requirements as specified in this standard.

For type approval automatic valve (Solenoid valve) shall meet the requirements as specified in this standard.

10 ACCEPTANCE TEST (CONFORMITY OF PRODUCTION)

For the purpose of acceptance test, CNG/Bio-CNG pressure regulators manufactured shall conform to following test requirements as specified in relevant clauses of this standard (*see* Table 1)

- a) Hydrostatic strength test,
- b) Leakage test,
- c) Corrosion resistance test,
- d) Non-metallic synthetic immersion test,
- e) Oxygen ageing,
- f) Brass material compatibility, and
- g) Over voltage test.

11 CHANGES IN TECHNICAL SPECIFICATIONS OF A TYPE APPROVED COMPONENT AND EXTENSION OF APPROVAL

Any modification in technical specification of already type approved component shall require re-type test/extension of approval at the discretion of certification authority, based on the justification provided by the component manufacturer and reviewed by the certification authority, which has granted type approval.

ANNEX A
(Foreword)

COMMITTEE COMPOSITION

Automotive Vehicles Running on Non-conventional Energy Sources Sectional Committee, TED 26

Will be Added Later.