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Pressure regulator of CNG vehicles

汽车用压缩天然气减压调节器

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Foreword

This Standard was proposed by and shall be under the jurisdiction of the National Technical Committee for Standardization of Automobiles.

Drafting organizations of this Standard: Chongqing Automobile Research Institute, and Chongqing Dinghui Automobile Fuel Gas System Co., Ltd.

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Pressure regulator of CNG vehicles

1 Scope

This Standard specifies the model label, requirements, test methods, inspection rules, marks, packaging, transportation and storage of the pressure regulator of compressed natural gas (hereinafter referred to as CNG) vehicles.

This Standard applies to the pressure regulators of CNG vehicles (hereinafter referred to as pressure regulators) whose nominal operating pressure is not more than 20MPa (the pressure described in this Standard refers to gage pressure), whose operating ambient temperature is within the range of -40°C ~ 120°C, and whose working medium meets the requirements specified in the GB 18047.

2 Normative references

The provisions in the following documents become the provisions of this Standard through reference in this Standard. For dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard. However, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest versions apply to this Standard.

GB/T 528 Rubber, vulcanized or thermoplastic – Determination of tensile stress-strain properties (GB/T 528-1998, eqv ISO 37:1994)

GB/T 3765 24° cone connectors – Specification

GB/T 7762 Rubber, vulcanized or thermoplastic – Resistance to ozone cracking – Static strain test (GB/T 7762-2003, ISO 1431-1:1989 Rubber, vulcanized or thermoplastic – Resistance to ozone cracking – Part 1: Static and dynamic strain testing, MOD)

GB 9969.1 General principles for preparation of instructions for use of industrial products

GB/T 10125 Corrosion tests in artificial atmospheres – Salt spray tests (GB/T

10125-1997, eqv ISO 9227:1990)

GB/T 17895 Natural gas vehicle and liquefied petroleum gas vehicle – Vocabulary

GB 18047 Compressed natural gas as vehicle fuel

GB/T 19240 Mounting requirements of special equipment for compressed natural gas vehicles

CB/T 3764 Thickness series and quality requirements for metallic and chemical coatings

QC/T 245 Technical specifications for isolated plant of compressed-natural-gas (CNG) automobile

3 Terms and definitions

The terms and definitions established in the GB/T 17895 and the following ones apply to this Standard.

3.1 First grade designed pressure P_1

It refers to the maximum operating pressure of the first grade chamber of the pressure regulator.

3.2 Rated flow Q

It refers to the maximum flow obtained by the pressure regulator when the ambient temperature is 20°C, the intake pressure of the pressure regulator is rated operating pressure, and the first grade pressure of the working chamber is P_1.

3.3 Safety valve open pressure P_2

It refers to the pressure when the pressure relief valve is initially open. The pressure value P_2 equals to $1.3P_1$.

3.4 Safety valve emission pressure P_{RV}

It refers to the upper pressure limit when the pressure relief valve is totally open. The pressure value P_{RV} equals to $2P_1$.

The rated flow *Q* of the pressure regulator measured according to the test methods specified in the Article 5.6 shall not be less than the calibration value of the manufacturer.

4.2.5 Durability

After being conducted with the durability test according to the provisions specified in the Article 5.7, the pressure regulators shall meet the requirements specified in the Articles 4.2.3 and 4.2.4.

4.2.6 Corrosion resistance

After being conducted with the salt spray test according to the test methods specified in the Article 5.8.1, the pressure regulators shall meet the requirements specified in the Article 4.2.3.1.

USE a 25× magnifier to check the brass pressure-bearing components whose zinc content is greater than 15% after conducting the test according to the test methods specified in the Article 5.8.2. There shall be no cracks on the components.

4.2.7 Ozone resistance

After being conducted with the ozone resistance test according to the test methods specified in the Article 5.9, the non-metallic parts and components of pressure regulators in contact with the natural gas shall have no cracks.

4.2.8 Compatibility

After the non-metallic parts and components of pressure regulators are conducted with the compatibility test according to the test methods specified in the Article 5.10, the volumetric change rate shall not be greater than 20%, and the mass decrease rate shall not be greater than 5%.

4.2.9 Vibration resistance

After being conducted with 6-hour vibration test according to the test methods specified in the Article 5.11, the pressure regulators shall meet the requirements specified in the Article 4.2.3.1.

4.2.10 Dry heat resistance

5.3 Hydrostatic strength test

REMOVE the pressure relief valve first. SEAL this location afterwards. BLOCK the outlet of the pressure regulator. APPLY 40MPa pressure at the inlet. KEEP this pressure for no less than 1min. CHECK the pressure regulator afterwards. The components conducted with this test shall not be used any longer.

5.4 Performance test for the pressure relief valve

The test for the pressure relief valve of the pressure regulator can be conducted separately or on the pressure regulator. The inlet diameter of the gas source shall not be less than that of the pressure regulator. When the test is conducted on the pressure regulator, various levels of pressure relief mechanisms shall be removed from the pressure regulator, and the outlet of the pressure regulator shall be blocked as well. Furthermore, the specified test pressure shall be applied at the inlet afterwards.

a) SET the inlet pressure of the pressure relief valve as 95% of P_2.

b) SET the inlet pressure of the pressure relief valve as 105% of P_2.

c) USE the input pressure at the inlet of the pressure relief valve P_{RV} to totally open the pressure relief valve. CUT off the gas source to close the pressure relief valve and to complete one cycle. Each cycle shall last for 3s. REPEAT the above procedures 100 times.

d) ADJUST the gas supply pressure to P_{RV}. MEASURE the emission flow Q_{RV} of the pressure relief valve.

5.5 Gas leakage test

5.5.1 Gas tightness at room temperature

The gas leakage test shall be conducted according to the Articles 5.5.1.1 and 5.5.1.2.

5.5.1.1 Bubble observation method

a) CONNECT the sample inlet with the gas supply pipeline.

b) BLOCK the sample outlet.

c) IMMERSE the samples 100mm to 300mm below the surface of the water.

contact with the natural gas for 20% according to the provisions specified in the GB/T 7762. PLACE the non-metallic parts and components in the ozone chamber with the ozone concentration of $50 \times 10^{-8} \pm 5 \times 10^{-8}$ at 40 ± 2 °C for 120h. USE a 2× magnifier to check the surfaces of test pieces.

5.10 Compatibility test

IMMERSE the non-metallic parts of pressure regulators in contact with the natural gas in the N-pentane or N-hexane at 23°C ± 2°C for 72h. PLACE the non-metallic parts and components in the air at 40°C for 48h. CHECK the volume change rate and mass change rate afterwards.

5.11 Vibration resistance test

a) FIX the test samples on the vibration test stand in a reliable way;

b) Respectively SET the frequency and amplitude as 17Hz and 1.5mm;

c) Respectively CONDUCT 2-hour vibration along three mutually perpendicular directions;

d) CHECK the gas tightness of test samples according to the methods specified in the Article 5.5.

5.12 Dry heat resistance test

EXPOSE the non-metallic test parts and components of pressure regulators in contact with the natural gas in the air at 120°C ± 2°C for 168h. CHECK the variation in tensile strength and elongation according to the methods specified in the GB/T 528.

5.13 Temperature cycling test

CONDUCT the temperature cycling test to the pressure regulators under the maximum operating pressure (the input gas pressure is 20MPa during the test). The temperature varies from the minimum operating temperature (-40°C) to the maximum operating temperature (120°C), and then varies from the maximum operating temperature (120°C) to the minimum operating temperature (-40°C) for alternating cycle. Each cycle shall last for 120min. CONDUCT the gas leakage test after 96-hour temperature cycling test.

b) Product model and serial number;

c) Quantity and gross weight;

d) Date of production;

e) Appearance dimensions (length × width × height);

f) Handling precautions.

7.3 Transportation and storage

7.3.1 HANDLE with care during the product loading and transportation. PREVENT heavy load and collisions. TAKE strict precautions against rain and chemical corrosion.

7.3.2 The products shall be stored in a well-ventilated, dry and clean room.

8 Exit-factory documents

The exit-factory documents include the product conformity certificate, packing list, and product instructions for use.

8.1 The following contents shall be indicated on the product conformity certificate:

a) Manufacturer’s name and trademark;

b) Product model and serial number;

c) Signature of the inspection authority, and inspection date.

8.2 Packing list

When there are accessories (such as connectors, special tools, etc.) besides pressure regulators in the packaging boxes, the packing lists shall also be provided.

8.3 Product instructions for use

The instructions for use shall be written according to the GB 9969.1. The following contents shall be explained particularly:

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