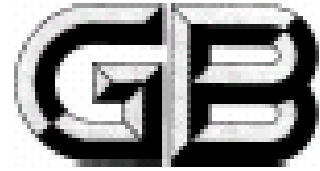


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Vaporizer/pressure regulator of LPG vehicle

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Issued by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China and the Standardisation Administration of the People's Republic of China.

Foreword

Chapters 4-8 of this standard are compulsory and the others are voluntary.

This standard and ECE R67 of *Approved Uniform Specifications for Special Devices for Motor Vehicles that Use Dynamic System LPG* are not equivalent.

This standard is proposed by the National Development and Reform Commission.

This standard is under the jurisdiction of the China National Standardisation Technical Committee for motor vehicles.

The institution responsible for drafting this standard is the China Automotive Technology and Research Centre.

The main drafters of this standard are Ma Zonghua, Gu Yanping, Feng Yi, Liu Guibin, Chen Song and Zhang Fuxing.

Vaporizer/pressure regulator of LPG vehicle

1 Scope

This standard specifies the model labelling, requirements, test method, inspection gauge, marking, packaging, transport and storage of a vaporizer/pressure regulator (for definitions see GB/T 17895) of a liquefied petroleum gas (hereinafter referred to as LPG) vehicle.

This standard applies to the operating ambient temperature of -40°C to 120°C. The nominal operating pressure at the entrance is 2.2 MPa (pressures mentioned in this standard all refer to gauge pressure) so that the vaporizer/pressure regulator of a vehicle (hereinafter referred to as “vaporizer/pressure regulator”) used in an LPG vehicle meets the GB 19159 standard.

2 Normative references

The clauses in the following documents become clauses of this standard after being referenced. In relation to dated reference documents, all subsequent amendments (excluding corrections) and revised versions do not apply to this standard; however, any parties that come to an agreement in accordance with the Standard are encouraged to study whether the latest versions of these documents are applicable. Where the references are not dated, their latest versions are applicable to the Standard.

GB/T 528 Measurement of deformation of tensile stress of vulcanised rubber or thermal-plastic rubber (GB/T 528-1998, eqv ISO 37:1994)

GB/T 1173 Cast aluminium alloys

GB/T 1220 Stainless steel bars

GB/T 4423 Wrought copper and copper alloy rod and bar (GB/T 4423-1992, neq ISO 1637:1987, Wrought copper and copper alloy rod and bar – Technical conditions of delivery)

GB 5626.1 Connecting terminal of flared type taper thread straight-through pipe

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

Rubber, vulcanised or thermoplastic – Resistance to ozone cracking – Static strain testing
GB 9969.1 Operating instructions and general principles of industrial products
GB/T 10125 Corrosion test and salt spray test under a man-made atmosphere (GB/T 10125-1997, eqv ISO 9227:1990)
GB/T 17895 Glossary of natural gas vehicles and LPG vehicles
GB 19159 LPG
GB/T 19239 Requirements for installing special devices in LPG vehicles
CB/T 3764 Thickness series and quality requirements for metal coating and chemical coating

3 Terms and definitions

The following terms and definitions are applicable to this standard:

Design pressure

The vaporizer/pressure regulator is designed for working spaces with different levels of pressure according to the practical requirements for use. The maximum working pressure for each working space is the design pressure.

4 Requirements

4.1 General requirements

4.1.1 The surface of the vaporizer/pressure regulator should have no closed angle or burr.

4.1.2 The connector lug of the vaporizer/pressure regulator that regulates the pressure of liquid phase LPG can use a connecting terminal of the cutting sleeve type or flared type. The comprehensive mechanical strength of the connecting terminal should be no lower than that required by GB 5626.1.

4.1.3 All elements of the electric appliance should have a protective device installed. Parts used for conducting electricity may not be exposed, to prevent electrical sparks.

4.1.4 The requirements for the appearance of components that carry out metal treatment of

coating and chemical coating in the vaporizer/pressure regulator should comply with the corresponding regulations in CB/T 3764.

4.1.5 The method of installation of the vaporizer/pressure regulator on the vehicle should comply with the stipulations of GB/T 19239.

4.1.6 The vaporizer/pressure regulator should perform the function of expelling impurities.

4.2 Requirements for materials

4.2.1 The materials used to make the vaporizer/pressure regulator should be compatible with LPG.

4.2.2 The housing of the vaporizer/pressure regulator should be made of compression-cast aluminium alloy as per GB/T 1173. Any other metal materials utilised should have comprehensive mechanical properties and corrosion-resistant properties, and should meet the requirements of the corresponding standard. The remaining metal parts should generally utilise stainless steel bars that comply with standard GB/T 1220 or HPb59-1. Copper alloy rods and bars should comply with standard GB/T 4423.

4.2.3 Cast iron or malleable cast iron may not be used in the bearing components of the vaporizer/pressure regulator.

4.3 Performance requirements

4.3.1 Strength of liquid static pressure

After the strength test of liquid static pressure is carried out for the vaporizer/pressure regulator according to the test method specified in 5.3, there should be no breakages or permanent deformations, etc.

4.3.2 Air-tightness

4.3.2.1 Air-tightness at normal temperatures

After the test for the vaporizer/pressure regulator is carried out according to the test method

specified in 5.4.1 no air bubbles should appear; and the leakage rate should not exceed 15×10^{-6} N.m³/h.

4.3.2.2 Air-tightness at high temperatures

If the air-tightness test at a high temperature for the vaporizer/pressure regulator is carried out according to the test method specified in 5.4.2, the display value of the pressure gauge should not fall before 1 minute; nor should the leakage rate exceed 15×10^{-6} N.m³/h.

4.3.2.3 Air-tightness at low temperatures

If the air-tightness test at a low temperature for the vaporizer/pressure regulator is carried out according to the test method specified in 5.4.3, the display value of the pressure gauge should not fall before 1 minute; nor should the leakage rate exceed 15×10^{-6} N.m³/h.

4.3.3 High temperature test

After the high temperature test is carried out according to the test method specified in 5.5, the air-tightness check at a high temperature for the vaporizer/pressure regulator should be carried out according to the test method specified in 5.4.2, which should meet the requirement for air-tightness at high temperatures in 4.3.2.2.

4.3.4 Low temperature test

After the low temperature test is carried out according to the test method specified in 5.6, an air-tightness check at a low temperature for the vaporizer/pressure regulator should be carried out, according to the test method specified in 5.4.3, which should meet the requirement for air-tightness at low temperatures in 4.3.2.3.

4.3.5 Dryness and heat resistance properties

The dryness and heat resistance test for the non-metal parts of the vaporizer/pressure regulator that come into contact with LPG is carried out according to the test method specified in 5.7. The change of tensile strength should not exceed +25% and the variable range of the rate of elongation should not exceed -30% to +10%.

4.3.6 Compatibility

After the test for compatibility of non-metal parts of the vaporizer/pressure regulator that come into contact with LPG is carried out according to the test method specified in 5.8, the rate of volume change should not exceed 20% and the drop in quality should not exceed 5%.

4.3.7 Resistance to ozone

After the test for the resistance to ozone of the non-metal parts of the vaporizer/pressure regulator that come into contact with LPG is carried out according to the test method specified in 5.9, there should not be any cracks.

4.3.8 Corrosion resistance

4.3.8.1 After the salt spray test for the vaporizer/pressure regulator according to the test method specified in 5.10.1 is completed, the air-tightness test should be carried out at the normal temperature, according to the test method specified in 5.4.1, which should meet the air-tightness requirements in 4.3.2.

4.3.8.2 After the test for the brass bearing parts with a zinc content of more than 15% is carried out according to the test method specified in 5.10.2, there should be no cracks on any of the parts, even when magnified 25 times.

4.3.9 Vibration resistance

No connections should be loose after the vibration test for the vaporizer/pressure regulator is carried out according to the test method specified in 5.11. This should meet the requirement for air-tightness in 4.3.2 if the air-tightness test at a normal temperature is carried out according to the test method specified in 5.4.1.

4.3.10 Rated flow

Rated flow Q , measured by the vaporizer/pressure regulator according to the test method specified in 5.12, should be no lower than the rated value provided by the manufacturer.

4.3.11 Durability

After the durability test of the vaporizer/pressure regulator according to the test method specified in 5.12, equivalent to 50,000 uses, the following requirements should be met:

- a) Air-tightness tests carried out at a normal temperature according to the test method specified in 5.4.1 should meet the requirements of 4.3.2.1;
- b) The rated flow Q that is measured according to the test method specified in 5.12 should meet the requirements of 4.3.10.

4.3.12 Temperature cycle test

After the temperature cycle test is carried out on the vaporizer/pressure regulator according to the test method specified in 5.13, the air-tightness requirement in 4.3.2 should be met.

5 Test methods

5.1 General specifications

5.1.1 Test conditions

Unless otherwise specified, tests should be carried out under the following conditions:

- a) The test environment temperature should be 15-35°C (unless otherwise specified, the test should be carried out at an ambient temperature of $20\pm 5^\circ\text{C}$).
- b) The test medium should be clean, dry air or nitrogen gas.

5.1.2 Requirements for test instruments

- a) Pressure instrument: accuracy should be no lower than 1.5 grade, the range of measurement 1.5-3 times the measured value.
- b) Flow instrument: accuracy should be no lower than 1.5 grade, the range of

measurement 1.5-3 times the measured value.

- c) Temperature instrument: accuracy should be $\pm 0.5^{\circ}\text{C}$, the minimum distinguishing rate no more than twice the accuracy (i.e. 1°C).

5.2 Visual inspection

The metal coating and chemical coating of the vaporizer/pressure regulator undergoes a visual inspection.

5.3 Strength test of liquid static pressure

The components of the vaporizer/pressure regulator should be checked when filling the cavity of the vaporizer/pressure regulator with water, closing the exit, and filling the entrance with a hydraulic pressure of 6.75Mpa. This pressure should be maintained for no less than 1 minute.

5.4 Air-tightness test

5.4.1 Air-tightness check at normal temperatures

The test for air-tightness at normal temperatures may be carried out by means of observing air bubbles or measuring leakage rates.

5.4.1.1 Methods for observing air bubbles

To seal the outlet of the sample, connect the inlet to an air supply pipe, set all air passage control devices to normal operating conditions, adjust the inlet pressure to twice the normal operating pressure, and immerse the sample in water 100-300 mm deep. Observe for at least 1 minute and then check whether there is an air bubble.

5.4.1.2 Methods for measuring leakage rates

To block the outlet of the sample, set the input air pressure to twice the normal operating pressure of the inlet, and measure the leakage rate with the leakage rate tester. The measurement time should be no less than 1 minute.

5.4.2 Air-tightness test at high temperatures

To seal the outlet of the sample, connect the inlet to an air pressure source via a positive direction stop valve, and install a pressure meter between the sample and the positive direction stop valve. The pressure range of the positive direction stop valve and pressure meter should be no lower than 1.5 times and no higher than twice the test pressure. Put the sample into a high temperature cabinet then when the temperature of the high temperature cabinet indicator reaches 120°C, fill the sample with a test air pressure of twice the normal operating pressure and close the positive direction stop valve. Observe the display value of the pressure gauge for at least 1 minute to see whether it falls, or measure the leakage rate with the leakage rate tester.

5.4.3 Air-tightness test at low temperatures

Seal the outlet of the sample, connect the inlet to an air pressure source via a positive direction stop valve and install a pressure meter between the sample and the positive direction stop valve. The pressure range of the positive direction stop valve and pressure meter should be no lower than 1.5 times and no higher than twice the test pressure. Put the sample into a low temperature cabinet then when the temperature of the low temperature cabinet indicator reaches -40°C, fill the sample with a test air pressure of twice the normal operating pressure, and close the positive direction stop valve. Observe the display value of the pressure gauge for at least 1 minute to see whether it falls, or measure the leakage rate with the leakage rate tester.

5.5 High temperature test

Block the outlet of the sample and put it in a high temperature cabinet, adjust the temperature to 120°C and maintain an air pressure of twice the normal operating pressure for 8 hours. An air tightness check at a high temperature may then be carried out.

5.6 Low temperature test

Block the outlet of the sample and put it in a low temperature cabinet, adjust the temperature to -40°C and maintain an air pressure of twice the normal operating pressure for 8 hours. An

air-tightness check at a low temperature may then be carried out.

5.7 Test for dryness and heat resistance properties

When non-metal parts of the vaporizer/pressure regulator that come into contact with LPG are exposed to temperatures of $120\pm 2^{\circ}\text{C}$ for 168 hours, they change their tensile strength. Any elongation may be checked, according to the method specified in GB/T 528.

5.8 Compatibility test

Immerse the non-metal parts of the vaporizer/pressure regulator that come into contact with LPG in pentane or hexane at $23\pm 2^{\circ}\text{C}$ for 72 hours. Any volume change may then be checked.

5.9 Test for resistance to ozone

Stretch the non-metal parts of the vaporizer/pressure regulator that come into 20% contact with LPG according to the stipulations of GB/T 7762, and then put them in an ozone room with an ozone concentration of 50 ± 5 pphm and at a temperature of $40\pm 2^{\circ}\text{C}$ for 120 hours. The surface of the sample may be checked when magnified to twice its size.

5.10 Test for corrosion resistance

5.10.1 When the connecting hole of the vaporizer/pressure regulator is sealed, a 144-hour salt spray test may be carried out, according to the neutral salt spray test method specified in GB10125.

5.10.2 To eliminate surface oil stains from brass parts and to maintain maximum operating stress conditions (produced by machinery assembly and the air pressure of rated operating pressure), put the parts into a closed container with 0.6 l ammonia water with a specific weight of 0.94 at a temperature of $35\pm 2^{\circ}\text{C}$ and with a volume of 30 l. Parts may be 40 mm above the surface of the ammonia water for 240 hours.

5.11 Test for vibration resistance

- a) Fix sample firmly onto vibration test stand.

- b) Set vibration frequency at 17Hz and amplitude at 1.5 mm;
- c) Vibrate for two hours in three directions, all vertical;
- d) Check air-tightness according to the method specified in 5.4.1.

5.12 Measurement of rated flow

A flow meter may be installed in the air inlet or in all air outlets of the vaporizer/pressure regulator. Test the input gas at normal operating pressure at the inlet of the vaporizer/pressure regulator, make a final stage diaphragm in a completely open state, repeatedly adjust the measured vaporizer/pressure regulator to the pressure of the first level chamber, and allow the outlet of the vaporizer/pressure regulator to achieve maximum flow. At this point you can read the maximum value of the flow quantity from the flow meter.

5.13 Serviceability test

An operating cycle serviceability test should be carried out on the vaporizer/pressure regulator after every 50,000 uses. In each operating cycle the air supply should be switched on. When the inlet pressure reaches the normal operating pressure, the outlet may be opened to form a stable output flow. Switch off the air supply when the inlet pressure falls below 1.1MPa, and then the outlet may be closed. The cycle frequency should be no higher than 10 times per minute.

5.14 Temperature cycle test

Keep the sample at a test pressure of 2.2Mpa and carry out the temperature cycle test within -40°C to 120°C for 96 hours. The cycle period is 120 minutes.

6 Inspection rules

6.1 For inspection items see table 1.

6.2 Delivery inspection

Before leaving the factory, a test should be carried out on the products one by one according to the items specified in table 1.

Table 1 Inspection items

No.	Inspection items	Inspection method	Judgment basis	Delivery inspection	Model inspection
1	Visual inspection	5.2	4.1	√	√
2	Strength of liquid static pressure	5.3	4.3.1		√
3	Air-tightness	5.4	4.3.2	√	√
4	High temperature test	5.5	4.3.3		√
5	Low temperature test	5.6	4.3.4		
6	Dryness and heat resistance properties	5.7	4.3.5		√
7	Compatibility	5.8	4.3.6		√
8	Resistance to ozone	5.9	4.3.7		√
9	Corrosion resistance	5.10	4.3.8		√
10	Vibration resistance	5.11	4.3.9		√
11	Rated flow	5.12	4.3.10		√
12	Durability	5.13	4.3.11		√
13	Temperature cycle test	5.14	4.3.12		√
Remarks: an air-tightness test at normal temperatures may only be carried out as an air-tightness test in the delivery inspection.					

6.3 Model inspection

6.3.1 If one of the following conditions applies, then a model inspection should be carried out for the vaporizer/pressure regulator, according to the items specified in table 1. A review of the product design should also be carried out for the newly designed products according to the requirements of 4.1 and 4.2.

- 1) When there is a new design or design parameters, technology or materials have undergone significant alterations.
- 2) When production is resumed after a cessation of production of more than six months.
- 3) When continuous production has been ongoing for one year.

6.4 Once samples have undergone an inspection or test, and if the results of the inspection may affect the service performance or service life of the sample, then the sample may not leave the factory as an acceptable product.

7 Marking, packaging, transport and storage

7.1 Marking

There should be permanent markings on the housing of the vaporizer/pressure regulator and the markings should be clear. The markings should include the following information:

- a) Name of manufacturer or trademark;
- b) Product model;
- c) “LPG” marking;
- d) Normal operating pressure;
- e) Manufacturing batch number and date.

7.2 Packaging

7.2.1 The packaging of the products should ensure that no damage occurs during transport.

7.2.2 The product’s packing box should contain an approved certificate for the product, operating instructions, and the necessary packing list. The following information should be marked on the packing box:

- a) Name of manufacturer;
- b) Model and number of products;
- c) Quantity and gross weight;
- d) Date of manufacture;

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

f) Precautions for transport.

7.3 Transportation and storage

7.3.1 When the products are being transported, they should be loaded and handled gently, avoiding pressure from any heavy weights or collisions. Particular care must be taken to protect against rain and chemical leaks.

7.3.2 The products should be stored in a ventilated, dry and clean room.

8 Manufacture documents

The manufacture documents include an approved certificate for the product, a packing list, and operating instructions.

8.1 The following information should be listed in the approved certificate for the product:

a) Name of manufacturer and trademark;

b) Product model and number;

c) Seal of inspection department and date of inspection.

8.2 Packing list

A packing list should be included when there are accessories (such as joint connections, special tools, etc) in the packing box in addition to the vaporizer/pressure regulator.

8.3 Operating instructions for production

Operating instructions should be compiled according to GB 9969.1 and pay particular

attention to the following:

- a) Structural shape and description of the function of the vaporizer/pressure regulator.
- b) Ways to identify faults and methods of eliminating these in the operating process.