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Fuel cell electric vehicles - Onboard hydrogen system technical specifications

燃料电池电动汽车 车载氢系统技术条件

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Table of Contents

Fuel cell electric vehicles - Onboard hydrogen system technical specifications

1 Scope

This document specifies the technical requirements and test methods for on-board hydrogen systems of fuel cell electric vehicles.

This document applies to fuel cell electric vehicles, that use compressed gaseous hydrogen as fuel and have an operating pressure not exceeding 70 MPa, at an ambient temperature of 15 °C.

2 Normative references

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, for dated reference documents, only the version corresponding to the date applies to this document; for undated reference documents, the latest version (including all amendments) applies to this document.

GB/T 2423.4 Environmental testing for electric and electronic products - Part 2: Test method - Test Db: Damp heat, cyclic (12 h + 12 h cycle)

GB/T 2423.17 Environmental testing for electric and electronic products - Part 2: Test method - Test Ka: Salt mist

GB/T 2423.43 Environmental testing for electric and electronic products - Part 2: Test methods - Mounting of specimens for vibration, impact and similar dynamic tests

GB/T 2423.56 Environmental testing - Part 2: Test methods - Test Fh: Vibration, broadband random and guidance

GB/T 24548 Fuel cell electric vehicles - Terminology

GB/T 24549 Fuel cell electric vehicles - Safety requirements

3 Terms and definitions

The terms and definitions as defined in GB/T 24548 and GB/T 24549, as well as the following terms and definitions, apply to this document.

be complete. The hydrogen cylinders, valves, pipelines, pipeline joints shall not be damaged. The installation brackets shall have clear anti-loosening marks. The high-pressure pipeline shall be made of materials with proven good hydrogen compatibility. If austenitic stainless steel is selected, its nickel content should be greater than 12%.

5.1.2 The on-board hydrogen system shall be manufactured in accordance with the product drawings and other technical documents approved by the prescribed procedures. The hydrogenation port, hydrogen storage cylinder, valves and other components shall comply with relevant standards; a product certificate and batch inspection certificate shall be provided.

5.1.3 Each hydrogen storage cylinder shall be equipped with a manual stop valve, which can be used to isolate each hydrogen storage cylinder individually, during hydrogenation, dehydration or maintenance.

5.2 Safety protection requirements

5.2.1 In order to prevent the pressure downstream of the pressure regulator from abnormally increasing, the following two methods can be used:

a) Discharge hydrogen gas through safety pressure relief device;

b) Turn off the hydrogen supply upstream of the pressure regulator.

5.2.2 An over-flow protection device or other measures shall be set up to automatically shut off the hydrogen supply from the hydrogen storage cylinder, when the device that detects the pressure in the hydrogen storage cylinder or pipeline detects an abnormal decrease in pressure or an abnormal increase in flow rate. The over-flow protection valve, if use, shall be installed on or close to the main shut-off valve.

5.2.3 The main shut-off valve, hydrogen storage cylinder's one-way valve, temperature driven safety pressure relief device (TPRD) shall be installed at the end of the hydrogen storage cylinder. The operation of the main shut-off valve shall be electric. The test shall be carried out in accordance with the provisions of 7.1. It shall be ensured that it opens normally when the power is turned on and closes automatically when the power is turned off.

5.3 Installation strength requirements

5.3.1 After the hydrogen storage cylinder (group) is installed and tightened, conduct a dynamic impact test according to the provisions of 7.2.2. It shall be ensured that the hydrogen storage cylinder (group) is still fixed on the fixed seat; the fastening parts shall not be deformed, broken, loosen, etc.

5.3.2 After the hydrogen storage cylinder (group) is installed and tightened, conduct a

static thrust test according to the provisions of 7.2.3. It shall be ensured that the relative displacement of the fixed point of the hydrogen storage cylinder (group) and its holder is not greater than 13 mm.

5.4 Air tightness requirements

5.4.1 The cylinder, valve, pipeline and each connection shall be well sealed. They shall be tested according to the test method in 7.3.

5.4.2 When using a gas detector to test air tightness, the hydrogen leakage rate at each detection point in each stage shall not be greater than 0.167 mL/min or the leakage concentration shall not be greater than 300 mL/m^3. See Appendix B for the calculation of leakage rate conversion between different gases.

5.5 Environmental adaptability requirements

5.5.1 The test pressure shall be the nominal working pressure of the on-board hydrogen system.

5.5.2 Environmental adaptability test includes high and low temperature test, damp heat test, vibration test, salt spray test. After each test, the air tightness of the system under the nominal working pressure shall be checked and meet the requirements of 5.4.2. When all tests are finished, the action of the main shut-off valve shall be tested according to the provisions of 7.1 and meet the requirements of 5.2.3. The test sequence and requirements are as follows:

a) After the on-board hydrogen system is subjected to high and low temperature tests according to the method specified in 7.4.1, there shall be no cracks, deformations, loose connections, etc.;

b) After the on-board hydrogen system is subjected to the damp heat test according to the method specified in 7.4.2, there shall be no corrosion, surface peeling, loose connections, etc.;

c) After the on-board hydrogen system is subjected to the vibration test according to the method specified in 7.4.3, there shall be no cracks, deformations, loose connections, etc.;

d) After the on-board hydrogen system is subjected to the salt spray test according to the method specified in 7.4.4, there shall be no corrosion, surface peeling, loose connections, etc.

6 Test conditions

6.1 During the test, the atmospheric pressure shall be no less than 91 kPa; the temperature shall be between 5 °C and 35 °C; the relative humidity shall be less than 95%; the test site shall be kept dry.

6.2 Measure the wind speed at a height of 1.2 m above the ground at the test site. The average wind speed shall be less than 3 m/s and the gust shall be less than 5 m/s.

6.3 Unless otherwise specified, the test gas shall be clean dry hydrogen, dry helium or a mixture of 10% helium and 90% nitrogen.

7 Test methods

7.1 Test method of main shut-off valve

Connect the pipeline downstream of the main shut-off valve to the flow detection device, pressure detection device, stop valve (as shown in Figure 1). For multiple cylinder groups, each main shut-off valve shall be tested one by one. During the test, the non-test main shut-off valve is in a manual cut-off closed state.

Fill the hydrogen storage cylinder (group) with test gas to the nominal working pressure. Close the shut-off valve and energize the main shut-off valve to open according to technical requirements, until the pressure in the downstream pipeline is consistent with the pressure in the cylinder.

- Keep the main shut-off valve energized; open the shut-off valve; monitor the pressure and flow changes in the downstream pipeline, to ensure that the flow does not exceed the limit value specified by the manufacturer. If after a period of time, the downstream pressure and flow rate remain stable and within the normal range, the main shut-off valve opens normally. The test is repeated three times.

- Control the main shut-off valve to cut off power. Open the shut-off valve. Monitor the pressure and flow changes in the downstream pipeline. If after a period of time, the downstream pressure is normal pressure and the flow rate is 0, the main shut-off valve closes normally. The test is repeated three times.

- 5 g acceleration in the upward direction of the vertically fixed base.

c) For category M_3 and N_3 vehicles, they shall withstand:

- 6.6 g acceleration in the forward direction of the car;
- 5 g acceleration in either direction of the car;
- 5 g acceleration in the upward direction of the vertically fixed base.

7.2.3 Static test

The test method of static installation strength is as follows:

- Adjust the force application mechanism, so that the force application point passes through the center of gravity of any hydrogen storage cylinder. The force application directions are the forward direction of the car, either the left or right directions of the car, the upward direction of the vertically fixed base. The force application size is 8 times the mass of the hydrogen storage cylinder after it is filled;
- Apply force to the test object. When it reaches the set value, it will automatically stop applying force. Record the force and displacement data in real time. Draw the "force-displacement" relationship curve.

7.3 Test method of air tightness

7.3.1 Gas replacement

Gas sampling and analysis shall be carried out after replacement. The volume concentration of oxygen shall not exceed 0.5%.

7.3.2 Air tightness test

Test as follows.

a) Fill test gas to the set pressure through the hydrogenation port and maintain the pressure. The 35 MPa on-board hydrogen system and the 70 MPa on-board hydrogen system are pressurized, according to the steps in Table 2 and Table 3, respectively.

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