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**Compressed hydrogen surface vehicle refueling connection
devices**

压缩氢气车辆加注连接装置

(ISO 17268:2006, NEQ)

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Compressed hydrogen surface vehicle refueling connection devices

1 Scope

This document specifies the definitions, design requirements, safety requirements, test methods and inspection rules for compressed hydrogen surface vehicle refueling connection devices. The compressed hydrogen surface vehicle refueling connection devices described in this Standard consists of two parts: receptacle and its protective cap (installed on the vehicle), and nozzle.

This Standard is applicable to compressed hydrogen surface vehicle refueling connection devices where the working medium is compressed hydrogen, the working pressure is 25 MPa and 35 MPa, and the ambient temperature is 15°C.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 24548-2009, *Fuel cell electric vehicles - Terminology*

GB/T 24549-2009, *Fuel cell electric vehicles - Safety requirements*

ISO 188, *Rubber vulcanized - Accelerated ageing or heat resistance tests*

ISO 1817, *Rubber, vulcanized - Determination of the effect of liquids*

ISO 9227, *Corrosion tests in artificial environments - Salt spray tests*

ISO 14687-2, *Hydrogenfuel - Product specification*

ISO 15501-2, *Road vehicles - Compressed natural gas (CNG) fuel systems - Part 2: Test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 24548-2009 as well as the followings apply.

nozzle and transfer fuel.

NOTE: This may also be called fuel import.

3.12 working pressure

The pressure when the system is operating when the gas temperature is 15°C.

NOTE: This determines the density of the gas when the hydrogen storage bottle is full.

4 General requirements

4.1 The nozzle and the receptacle of the compressed hydrogen surface vehicle designed in accordance with this Standard shall meet safety, durability and maintainability requirements.

4.2 The nozzle and the receptacle of the compressed hydrogen surface vehicle shall have good matching and be manufactured according to engineering application requirements.

4.3 The design of the nozzle and the receptacle of the compressed hydrogen surface vehicle shall:

- a) Reduce the possibility of mis-installation;
- b) Resist displacement, twisting, bending or other damage;
- c) Its installation shall maintain operational integrity under normal conditions of operation and use.

4.4 The materials used for the nozzle and the receptacle of the compressed hydrogen surface vehicle shall be compatible with compressed hydrogen within the design pressure and temperature range (see 3.4, 5.9 and 7.7). The materials of all pressurized and wetted components shall be compatible with deionized water. The compatibility of non-metallic materials shall be tested by the component manufacturer or an independent third party. There shall be a test report in compliance with ISO 1817. The nozzle, receptacle and protective cap shall be made of non-fireable materials and have relevant test reports.

4.5 Tools shall not be used when connecting and disconnecting the connector of the compressed hydrogen surface vehicle.

4.6 The receptacle of the compressed hydrogen surface vehicle shall be installed on the vehicle in accordance with the requirements of GB/T 24549-2009.

4.7 The protective cap shall prevent foreign contaminants from entering the receptacle, but it shall not withstand pressure. There shall be appropriate frictional resistance to

prevent inadvertent shedding. The cap cover shall be attached to the receptacle or vehicle.

5 Nozzle

5.1 Nozzles shall comply with the dimensional requirements of Chapter 6. The design of the nozzle shall ensure that it can only be used in connection with the receptacle of a higher working pressure level. Avoid connecting to receptacles with lower operating pressure levels.

5.2 The nozzle shall be one of the three types described below:

- a) Type A: This type of nozzle is suitable for devices where the filling hose is under high pressure after the hydrogenation machine is shut down. Gas filling can only be performed when the nozzle is correctly connected to the receptacle. This type of nozzle is equipped with one or more integrated valves, which can be closed to first stop gas filling and then safely vent the gas in the nozzle head before unloading the nozzle. The operating mechanism shall ensure that the drain line is open before the drain action is taken. Before removing the nozzle, the gas between the nozzle stop valve and the air receptacle needle valve has been safely discharged (see 10.2.4~10.2.7).
- b) Type B: This type of nozzle is suitable for devices where the filling hose is under high pressure after the hydrogenation machine is shut down. An independent three-way valve is installed directly or indirectly before the receptacle of this type of nozzle. This valve allows you to safely evacuate the remaining gas in the nozzle head before removing it. Gas filling can only be performed when the nozzle is correctly connected to the receptacle. Deflate the nozzle before removing it (see 10.2.4~10.2.7). The external three-way valve shall have markings indicating the open, closed and bleed positions.
- c) Type C: This type of nozzle is suitable for devices where the filling hose is depressurized (less than or equal to 0.5 MPa) after the hydrogenation machine is shut down (see 10.2.4~10.2.7). Gas filling can only be performed when the nozzle is correctly connected to the receptacle. By receiving the correct connection signal from the nozzle, the gas dispenser can control related functions.

In addition, according to the maintenance methods specified by the manufacturer, the cycle life of the nozzle shall reach 100,000 times. The three-way valve used to activate the Type B nozzle shall have the same cycle life as the nozzle.

5.3 The deflation and decompression process of the connection between all types of nozzles and the receptacle shall be carried out before unloading the nozzle. The vented gas shall be directed to a safe location through the exhaust pipe.

5.4 The connection between the nozzle and the gas dispenser hose shall not rely solely

receptacle shall be able to prevent the entry of fluid and foreign matter.

7.6 The receptacle shall be able to be securely mounted on the vehicle and comply with the abnormal load test requirements of 10.7.

7.7 The working temperature range of the receptacle is -40°C~60°C.

8 Instructions

The manufacturer of the receptacle and nozzle shall provide concise and easy-to-understand instructions, which shall at least contain the followings:

- a) Correct on-site assembly (special tools required to connect the receptacle to the pipe shall be clearly stated in the instructions);
- b) Installation;
- c) Maintenance;
- d) Parts replacement (including expected service life);
- e) User safe operation;
- f) applicability;
- g) Transport, storage and handling.

9 Marks

9.1 The marks on the receptacle and nozzle shall be clear and easy to understand. Permanently marked nameplate shall be mechanically attached to the part.

9.2 The nozzle and air receptacle shall have the following information:

- a) Name, trademark or logo of the manufacturer or distributor;
- b) Model mark;
- c) Applicable working pressure (25 MPa or 35 MPa);
- d) Nozzle type A, B or C (only for nozzles);
- e) A mark that can track the receptacle information. The nozzle shall have an independent serial number.

9.3 All components shall be marked in compliance with this standard. The mark can be printed on the packaging or on the notification sheet inside the equipment shipping

package.

10 Design verification test procedures

10.1 Overall requirements

10.1.1 Unless otherwise specified, the nozzle and air receptacle shall comply with the requirements of all clauses in this standard:

- a) The test shall be carried out at $20^{\circ}\text{C}\pm 5^{\circ}\text{C}$;
- b) All pressure tests shall use leak test gas;
- c) All leak tests shall use leak test gas;
- d) Before all testing begins, the test fluid and equipment shall be in equilibrium in the test environment.

10.1.2 The test fixture shall be used for testing of the nozzle, see Figure 5, Figure 6, Figure 9 and Figure 10. Each nozzle shall be tested with a new receptacle. Any failure of the nozzle or receptacle during testing indicates a failed nozzle design.

10.1.3 The receptacle shall be tested using a nozzle manufactured by another manufacturer and certified by this Standard. Any failure of the receptacle or nozzle during testing indicates a failure in the receptacle design.

10.2 Human-machine interface

10.2.1 The appearance of the nozzle and air receptacle shall intuitively indicate their correct use.

10.2.2 Hydrogen can only be added after the nozzle and receptacle are correctly connected and locked.

10.2.3 All types of nozzles shall stop filling with hydrogen when the connection is disconnected. There shall be no hazardous situation when disconnecting the nozzle. During the test, the internal pressure of Type C nozzle is 0.5 MPa.

10.2.4 When the internal pressure is less than or equal to 0.5 MPa, the disassembly force of Type A and B nozzles and the wear test device (Figure 7 or Figure 8) shall be less than 22.2 N, and the disassembly torque shall be less than 7 N·m. When removing the nozzle, apply force and torque in the direction of unloading the nozzle. Torque shall be able to be applied to the separation device or three-way valve.

10.2.5 For devices that are not pressurized, the axial force required to connect or disconnect from the wear test device (Figure 7 or Figure 8) shall be less than or equal to 90 N.

hydrogen leakage rate is less than 20 cm³/h at 20°C and 101325 kPa.

Other test procedures of equal accuracy and repeatability may be used.

10.4.2 The leakage rate of the unconnected nozzle shall be less than 20 cm³/h at 20°C and 101325 kPa. The leakage rate of the connector at 20°C and 101325 kPa shall be less than 20 cm³/h.

The test shall be carried out at 0.5 MPa and 1.5 times the working pressure.

Example of test method - Pour the pressurized leak test gas into the connector or the inlet of the unconnected nozzle, and then proceed according to the general test procedure in 10.4.1.

10.4.3 The receptacle shall be bubble-free within 3 min of each leak test. The test shall be carried out at 0.5 MPa and 1.25 times the working pressure.

Example of test method - When the one-way valve of the receptacle is in a closed state, introduce pressurized leakage test gas from the outlet of the receptacle. The tests are conducted under two pressure states of 0.5 MPa and 43.75 MPa, respectively. The duration of each measuring point shall not be less than 3 min. Check for air tightness with leak detection fluid. If no continuous bubbles are generated within 1 min, the test ends.

10.5 Valve operating handle

If the nozzle is equipped with a valve operating handle, the farthest point from the rotation axis shall be able to withstand a pressure of 200 N without causing damage to the operating handle or the bayonet.

Example of test method - Tests requiring torque or force in the opening or closing direction shall be carried out in two situations:

- a) The nozzle and the air receptacle are correctly connected;
- b) The nozzle is intentionally improperly attached to the receptacle.

10.6 Vibration resistance of receptacle

After completing the vibration test according to the following test methods, the receptacle and protective cap shall not be damaged, and shall comply with the receptacle leakage test (10.4 and 10.10) and the hydrostatic strength test (10.12).

Test method - Fix the receptacle and protective cap on the test instrument. Vibrate at various integer frequencies between 5 Hz ~ 60 Hz for 8 min. The amplitude is at least 1.5 mm between 5 Hz ~ 20 Hz. The amplitude is at least 1.2 mm between 20 Hz ~ 40 Hz. The amplitude is at least 1 mm between 40 Hz ~ 60 Hz. The test shall be carried out once in the axial direction and once in the radial direction. If the receptacle is not

radially symmetrical, it shall be vibrated in two directions perpendicular to each other.

10.7 Abnormal load

10.7.1 The connecting parts of the nozzle and the air receptacle shall be able to withstand the following abnormal loads during operation:

- a) Stretching along the longitudinal axis of the nozzle and air receptacle;
- b) Torque of nozzle end fittings.

After the hydrogenation receptacle and hydrogenation nozzle are connected, a pressure of 670 N can be applied in any direction without distortion, damage or leakage.

After completing these tests, the receptacle shall meet the requirements of 10.4, 10.10 and 10.12. The test device diagram is shown in Figure 4.

10.7.2 Testing under non-pressure conditions - The receptacle test device and nozzle shall not be pressurized during abnormal load testing.

Test method - Regardless of the design pressure rating of the nozzle, the "loose fit" test setup shown in Figures 5 and 6 shall be used for this test. The test apparatus shall be equipped as a cantilever connected to a supporting element. For testing purposes, support elements shall be able to withstand the specified load without displacement or deflection. The nozzle shall be properly connected to the test device.

The applied load and the equipment's resistance to damage shall meet the requirements in 10.7.1. After completion of the test, the receptacle shall comply with the requirements of 10.4, 10.10 and 10.12.

10.7.3 Test under pressurized conditions - The receptacle test equipment and nozzle shall be pressurized to the design pressure during abnormal load testing.

Test method - Regardless of the design pressure rating of the nozzle, the "loose fit" test setup shown in Figures 5 and 6 shall be used for this test. The test equipment shall be equipped as a cantilever connected to a supporting element. For testing purposes, support elements shall be able to withstand the specified load without displacement or deflection. The nozzle shall be properly connected to the test equipment.

The applied loads and the resistance of the equipment to damage shall be as specified in 10.7.1. After completion of the test, the receptacle shall comply with the requirements of 10.4, 10.10 and 10.12.

specified test temperature. Block the outlet of the device with a plug. Then apply test pressure at the inlet of the device.

10.10.2 Leakage - When tested according to the following test provisions, the filling connector shall meet the leakage requirements in 10.4.1.

Test method - Fill the nozzle, air receptacle and its connecting parts with 35 MPa compressed air or nitrogen, respectively. Place it in an incubator. The temperature gradually rises from room temperature to $60^{\circ}\text{C}\pm 2^{\circ}\text{C}$. Keep warm for 8 h. Remove and cool to room temperature in the air. Then put it into the low temperature box. Gradually cool down to $-40^{\circ}\text{C}\pm 2^{\circ}\text{C}$ and keep warm for 8 h. Take it out. After rising to room temperature, perform the room temperature leakage test according to 10.4.

10.10.3 Operation - Equipment shall connect and disconnect normally when tested under the following conditions:

- a) At -40°C , when pressurized to the maximum working pressure, the nozzle and air receptacle are connected and disconnected 10 times.
- b) At 60°C , when pressurized to the maximum working pressure, the nozzle and air receptacle are connected and disconnected 10 times.

10.11 Life and maintainability

10.11.1 Cycle life

10.11.1.1 Nozzle

The nozzle shall be able to withstand 100,000 cycles. During the following tests, all equipment shall be maintained according to the manufacturer's instructions. If maintenance is performed below the number of cycles specified by the manufacturer, it shall be deemed not to comply with this Standard.

- a) Test methods for Type A and Type B nozzles

Keep leak test gas flowing into the nozzle at the design pressure. An operating loop shall be:

- 1) Correctly connect the nozzle to the test equipment;
- 2) Operate the valve. First pressurize and then deflate;
- 3) Remove the nozzle. When disassembled, the test equipment shall be rotated randomly or in an angular incremental pattern relative to the nozzle.

- b) Type C nozzle test method

An operating cycle shall be:

10.11.1.3 Connector

The connector between the nozzle and the air receptacle shall be able to withstand the highest air flow conditions.

Connect the nozzle or receptacle test device to the equipment. The outlet of the receptacle is connected to the atmosphere. The inlet of the nozzle shall be connected to the gas supply system of the leak test gas.

Each nozzle and air receptacle shall be recycled 30 times. Each cycle shall begin at operating pressure (equivalent to the highest airflow condition). One cycle is 2 s. At the end of each cycle, the air source pressure cannot be lower than 80% of the working pressure. The air supply system must not limit flow during the test.

After the test is completed, the nozzle or air receptacle shall meet the requirements in 10.4.

10.11.2 Oxygen resistance aging test

Sealing materials shall have anti-oxidative aging properties. The synthetic rubber filling the connector shall show no cracks or visible damage in accordance with the test methods specified below.

Test method - Samples of synthetic rubber shall be exposed to $70^{\circ}\text{C} \pm 1^{\circ}\text{C}$, 2 MPa for 96 h. The test shall be carried out in accordance with ISO 188.

10.11.3 Non-metallic material immersion test

When tested in accordance with the following method, the non-metallic material portion of the filling connector that is in direct contact with hydrogen must not experience excessive volume changes or mass losses.

Test method - Non-metallic parts in contact with hydrogen shall be soaked in n-pentane or n-hexane at $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for 72 h, and then placed at room temperature for 48 h. Measure its volume change rate and mass change rate. In addition, the expansion of the sample cannot exceed 25%, the shrinkage cannot exceed 10%, and the mass loss cannot exceed 10%.

10.11.4 Resistor

Under pressure or non-pressure conditions, the resistance of the receptacle and the nozzle connection shall not be greater than 1000 Ω . Resistance testing shall be performed before and after the life cycle test (see 10.11.1).

The hydrostatic strength test is the final test. The sample shall not be used for any other testing after this test.

The unconnected nozzle and receptacle and the connected nozzle and receptacle must not leak when performing the following tests.

Test method - Unconnected or connected equipment outlets shall be plugged. The valve seat or internal module shall be placed in the open position. The water pressure is 52.5 MPa. The duration shall not be less than 1 min.

10.13 Materials

The manufacturer shall list the sealing material and be able to demonstrate that it meets the oxygen aging resistance and non-metallic material immersion test requirements of 10.11.2 and 10.11.3.

10.14 Corrosion resistance

After the nozzle and receptacle undergo the following tests, there shall be no corrosion or loss of protective coating and show good safety.

Test method - New samples shall be used. The protective cap shall be in place. The vent holes in the protective cap shall not be blocked. The connection to the system can be plugged.

The nozzle and air receptacle shall be supported horizontally. The nozzle shall be exposed to salt spray for 96 h in accordance with ISO 9227. The receptacle shall be exposed to salt spray for 1000 h in accordance with ISO 9227.

During the test, the temperature in the experimental box shall be maintained at 33°C~36°C. The salt spray solution shall contain 5% sodium chloride and 95% distilled water (by mass).

Continuously flow 0.5 MPa air into the inlet of the nozzle. Within 8 h of starting the test, the nozzle shall be opened (release air into the environment) once an hour.

After 1000 h of testing, immediately check the receptacle area protected by the dust cover. There shall be no water vapor entering.

Then, clean the nozzle and air receptacle. Carefully remove the salt layer. Then conduct room temperature leakage test (see 10.4) and resistance test (10.11.4) on the nozzle and receptacle.

10.15 Transformation

Field connected/assembled components shall be able to withstand 1.5 times the installation torque without deformation, damage or leakage.

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