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Fuel Specification for Proton Exchange Membrane Fuel Cell Vehicles - Hydrogen

质子交换膜燃料电池汽车用燃料 氢气

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Fuel Specification for Proton Exchange Membrane Fuel Cell Vehicles - Hydrogen

1 Scope

This Standard specifies the terms, definitions, hydrogen purity, requirements of impurity content in hydrogen, and analytical and test methods of fuel hydrogen for proton exchange membrane fuel cell (PEMFC) vehicles.

This Standard is applicable to quality requirements of fuel hydrogen for perfluoro sulfonic acid proton exchange membrane fuel cell vehicles.

NOTE: molecular formula of hydrogen: H_2. Relative molecular mass: 2.01588 (in accordance with 2007 Standard Atomic Weights).

2 Normative References

The following documents are indispensable to the application of this Standard. In terms of references with a specified date, only versions with a specified date are applicable to this Standard. The latest version (including all the modifications) of references without a specified date is applicable to this Standard.

GB/T 3634.1-2006 Hydrogen - Part 1: Industrial Hydrogen

GB/T 3634.2-2011 Hydrogen - Part 2: Pure Hydrogen, High Pure Hydrogen and Ultrapure Hydrogen

GB/T 3723 Sampling of Chemical Products for Industrial Use - Safety in Sampling

GB/T 5832.2-2016 Gas Analysis - Determination of Moisture - Part 2: Dew Point Method

GB/T 6285-2016 Determination of Trace Oxygen in Gases - Electrochemical Method

GB/T 6680 General Rules for Sampling Liquid Chemical Products

GB/T 6681 General Rules for Sampling Gaseous Chemical Products

GB/T 8984-2008 Determination of Carbon Monoxide, Carbon Dioxide and Hydrocarbon in Gases - Gas Chromatographic Method

GB/T 14669-1993 Air Quality - Determination of Ammonia - Ion Selective Electrode Method

Ψ_{11}---ammonia content (volume fraction), 10^{-6};

Ψ_{12}---total halide content (volume fraction), 10^{-6}.

5.3 Determination of Water Content

Determination of water content shall comply with the method stipulated in Chapter 6 in GB/T 5832.2-2016. It is allowable to adopt other equivalent methods. When there is a disagreement of the determination result, the method stipulated in GB/T 5832.2-2016 shall be deemed as the arbitration method.

5.4 Determination of Total Hydrocarbon Content

Determination of hydrocarbon (total hydrocarbon, counted by CH_4) content shall be conducted in accordance with the method stipulated in Chapter 7 in GB/T 8984-2008. It is allowable to adopt other equivalent methods. When there is a disagreement of the determination result, the method stipulated in GB/T 8984-2008 shall be deemed as the arbitration method.

5.5 Determination of Oxygen Content

Determination of oxygen content shall be conducted in accordance with the method stipulated in Chapter 6 in GB/T 6285-2016. It is allowable to adopt other equivalent methods. When there is a disagreement of the determination result, the method stipulated in GB/T 6285-2016 shall be deemed as the arbitration method.

5.6 Determination of Helium Content

Determination of helium content shall be conducted in accordance with the method stipulated in Chapter 6 in GB/T 27894.3-2011. It is allowable to adopt other equivalent methods. When there is a disagreement of the determination result, the method stipulated in GB/T 27894.3-2011 shall be deemed as the arbitration method.

5.7 Determination of Total Nitrogen and Argon Content

Determination of total nitrogen and argon content shall be conducted in accordance with the method stipulated in Chapter 5 in GB/T 3634.2-2011. It is allowable to adopt other equivalent methods. When there is a disagreement of the determination result, the method stipulated in GB/T 3634.2-2011 shall be deemed as the arbitration method.

5.8 Determination of Carbon Dioxide Content

Determination of carbon dioxide content shall be conducted in accordance with the method stipulated in Chapter 7 in GB/T 8984-2008. It is allowable to adopt other equivalent methods. When there is a disagreement of the determination result, the method stipulated in GB/T 8984-2008 shall be deemed as the arbitration method.

5.9 Determination of Carbon Monoxide Content

Appendix A

(Normative)

Determination Method of Total Halide Content in Hydrogen

A.1 Scope

This Appendix specifies the absorption and ion chromatography of determining total halide content in hydrogen. This method is applicable to the determination of hydrogen chloride, chlorine gas and other halides in hydrogen. The determination result shall be counted by total halide content. This Method takes HCl test as an example; the detection limit is 10 x 10^{-9} mol/mol.

A.2 Method Summary

Take a certain volume of sample gas, let it pass through deionized water at a certain flow rate. Chloride in the sample gas is absorbed by water. Chloride ion content in the absorbent is quantitatively determined through ion chromatography. Then, in accordance with the total volume of gas that passes through deionized water, convert chloride content in the gas.

A.3 Reagents and Materials

A.3.1 Deionized water: comply with the stipulation of Grade-1 water in GB/T 6682.

A.3.2 Chloride ion standard stock solution: accurately weigh-take 0.1649 g of sodium chloride standard substance (dry it at 105 °C for 2 h), dissolve it in water, then, dilute to 1,000 mL volumetric flask, concentration: 0.1 g/L.

A.3.3 Chloride standard solution: from chloride ion standard stock solution, transfer 1.00 mL, 2.50 mL, 5.00 mL, 7.50 mL and 10.00 mL, then, respectively use blank water to dilute to 100 mL volumetric flask. Thus, obtain chloride standard solution at the concentration of 1.00 mg/L, 2.50 mg/L, 5.00 mg/L, 7.50 mg/L and 10.0 mg/L.

A.3.4 Leaching stock solution: weigh-take 16.96 g of sodium carbonate (excellent grade of purity), dissolve it in blank water. Then, weigh-take 4.20 g of sodium bicarbonate (excellent grade of purity); add it to the solution, dissolve it, mix it up. Use blank water to dilute to 500 mL. Concentration: 320 mmol/L of sodium carbonate and 100 mmol/L of sodium bicarbonate.

A.3.5 Leaching working solution: transfer 20 mL of leaching stock solution; use blank water to dilute to 2,000 mL; mix it up for usage. Concentration of this leaching working solution: 3.2 mmol/L of sodium carbonate and 1.0 mmol/L of sodium bicarbonate.

A.4 Instruments and Equipment

3---needle valve;

4---PFA gas wash bottle;

5---beaker or other fixtures;

6---wet gas flow meter;

7---connecting sleeve.

Figure A.1 -- Sketch Map of Sampling Device

A.5.2 Let hydrogen, which is to be tested, flow into a deionized water-containing wash bottle at the speed of 500 mL/min for sampling. Sampling time: 200 min; sampling volume: 100 L.

A.5.3 Use deionized water to dilute the post-sampling absorbent to 100 mL; use ion chromatography for detection.

A.5.4 Select proper chromatographic conditions to thoroughly warm up ion chromatograph. Typical chromatographic condition: column temperature: 35 °C; mobile phase: 3.2 mmol/L Na_2CO_3 + 1.0 mmol/L $NaHCO_3$ leaching solution (A.3.5); injection volume: 20 μL, flow rate: 0.7 mL/min.

A.5.5 Respectively inject blank water solution, chloride standard solution (A.3.3) and sample solution; integrate them and obtain peak area. Use standard curve for calibration, then, obtain the test result.

A.5.6 Independently conduct two determinations. The relative deviation of the determined value of two parallel tests shall be not more than 10%. Take the average value as the determination result.

A.6 Result Calculation

A.6.1 The sampling volume of hydrogen shall be converted into the volume under standard state in accordance with Formula (A.1):

$$V_0 = \frac{V_H \times p_H \times 273.15}{1.01 \times 10^5 \times (273.15 + t_H)} \qquad \cdots\cdots (A.1)$$

Where:

V_0---under standard state, the sampling volume of hydrogen, which is to be tested, expressed in (L);

V_H---under test conditions, the sampling volume of hydrogen, which is to be tested, expressed in (L);

p_H---atmospheric pressure during sampling, expressed in (Pa);

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