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**Test method for adaptability to operating conditions of
membrane electrode assembly used in PEM fuel cells**

质子交换膜燃料电池膜电极工况适应性测试方法

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1 Scope

This guiding technical document specifies the terms and definitions, the boundary conditions, the test environment conditions, the test preparation, the test for the adaptability of the membrane electrode assembly of a proton exchange membrane fuel cell to operating conditions, and the test report, for the method of testing the membrane electrode assembly (MEA) of a proton exchange membrane fuel cell (PEMFC) under typical vehicle operating conditions. This guiding technical document applies to membrane electrode assemblies meeting the performance requirements put forward by the party being tested; testing is carried out on a single cell of 5 cm x 5 cm active area and is used to evaluate the adaptability of the membrane electrode assembly (MEA) to the typical operating conditions of a fuel cell, but does not consider the correspondence between the accelerated test life and the actual life.

This guiding technical document specifies the terms and definitions, boundary conditions, test environmental conditions, test preparation of the test method for typical car operating conditions of proton exchange membrane fuel cell (PEMFC) membrane electrode (MEA), test experiment and test report on adaptability of membrane electrode of proton exchange membrane fuel cell. This guiding technical document is applicable to the membrane electrode that meets the performance requirements of the tested party. Use a single cell with an active area of 5cmx5cm for testing. It is used to evaluate the adaptability of membrane electrode (MEA) to typical fuel cell operating conditions. However, the

relationship between accelerated test life and actual life is not considered.

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 3095-1996, Ambient air quality standard

GB/T 20042.1, Proton exchange membrane fuel cell - Terminology

GB/T 20042.5-2009, Proton exchange membrane fuel cell - Part 5: Test method for membrane electrode assembly

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

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 20042.1, GB/T 24548-2009 as well as the followings apply.

3.1 operating condition the performance that combines each typical condition of the fuel cell into a cycle spectrum according to the proportion of impact on fuel cell performance, so as to test the fuel cell NOTE: In the test, each typical condition can be expressed by power and current, or voltage. It is recommended to express in voltage in this guiding technical document.

4 Boundary conditions

4.1 Boundary conditions of sample This guiding technical document does not consider the influence of the following factors: - Fuel cell performance; - Durability of bipolar plates; - Performance of flow field plate.

4.2 Test boundary conditions This guiding technical document does not consider the influence of the following factors: - Impurity gas; - Low temperature start (less than 0°C); - Control perturbation; - Vibration in work environment; - Emergencies.

5 Test environment conditions

The test environmental conditions of this guiding technical document are: - Altitude: < 1000m; - Temperature: 15°C~30°C; - Test gas: - Fuel: Hydrogen without CO, SO₂, HS and other impurities generated by area is 5cmx5cm; the surrounding area outside the effective area of the sample is sealed.

c) The test sample shall be free of oil, wrinkles, defects and breakage.

d) The number of samples is 5, so as to meet the requirements of 3 effective tests.

6.3 Other requirements See Annex A for other requirements of test preparation.

7 Adaptability test of membrane electrode for proton

exchange membrane fuel cell

7.1 General rules The adaptability test of membrane electrode for proton exchange membrane fuel cell of this guiding technical document includes the adaptability test of single operating condition and combined cycle condition.

7.2 Setting of test condition According to the requirements of submitting party, determine the test items of operating condition adaptability. It may, according to the requirements of submitting party, set power, current or voltage as test condition. This guiding technical document recommends that in the operating condition adaptability test, the operation state of the fuel cell is controlled by voltage. In the test, the submitting party provides the operation condition of each operating condition or output parameters and polarization curve of each operating condition of the test sample. The testing party, according to the requirements of the submitting party and the data provided, formulates the testing plan.

7.3 Fuel cell assembly Assemble the sample to be tested, the flow field plate, current collector and end plate of the corresponding specifications into a single cell. The assembly shall meet the following conditions:

a) The contact resistance between the gas diffusion layer and the bipolar plate is the smallest. NOTE: The contact resistance test of the flow field plate and the gas diffusion

7.5.1 Install the single cell on the fuel cell test platform.

7.5.2 Use reactive gas as activation medium. According to the requirements of the membrane electrode (MEA) submitter, control the operation condition. The activation conditions are proposed by the submitting party, including humidification degree, excess coefficient of gas, cell temperature, back pressure maintenance constant value, current density of fuel cell operation and fuel cell operating time. Activate the single cell. When the cell voltage stabilizes at the same value under the same current density, the cell activation is completed.

7.6 Test of open circuit condition

7.6.1 Use the activated single cell to determine the polarization curve, the electrochemical active area of the catalyst and the hydrogen permeability. Refer to GB/T 20042.5-2009 for test method.

7.6.2 Keep the single cell in the open circuit state for 80h then test. The test conditions are proposed by the submitting party, including humidification degree, gas excess coefficient,

cell temperature, and back pressure maintenance constant value.

7.6.3 Determine the polarization curve of the single cell, the electrochemical active area of the catalyst and the hydrogen permeability every 8h. Calculate the voltage drop when the current density is 600mA/cm², the decrease in electrochemical active area of the catalyst and the increase in hydrogen permeability in the polarization curve test results after each cycle.

7.6.4 Calculate the voltage decay rate, electrochemical active area loss rate and hydrogen permeation increase rate per hour at 600mA/cm².

7.7 Test of idle condition

7.7.1 Use the activated single cell to determine the polarization curve, the electrochemical active area of the catalyst and the hydrogen permeability.

7.7.2 Keep the single cell in the idle condition for 80h then test. The loading conditions, according to the requirements of the submitting party, can be set as power, current or voltage. The test conditions are proposed by the submitting party, including humidification degree, gas excess factor, cell temperature, back pressure maintenance constant value, loading rate.

7.7.3 Determine the polarization curve of the single cell, the electrochemical active area of the catalyst and the hydrogen permeability every 8h. Calculate the voltage drop when the current density is 600mA/cm², the decrease in electrochemical active area of the catalyst and the increase in hydrogen permeability in the polarization curve test results after each cycle.

7.10.1 Use the activated single cell to determine the polarization curve, the electrochemical active area of the catalyst and the hydrogen permeability.

7.10.2 Cycle the single cell between the idle condition and the overload condition. Keep each condition for 2min. The loading conditions, according to the requirements of the submitting party, can be set as power, current or voltage. The test conditions are proposed by the submitting party, including humidification degree, gas excess factor, cell temperature, back pressure maintenance constant value, loading rate.

7.10.3 Respectively cycle 0 times, 120 times, 240 times, 360 times, 480 times, 600 times, 720 times, 840 times, 960 times, 1080 times and 1200 times in the idle-overloading cycle condition. Determine the polarization curve of the single cell, the electrochemical active area of the catalyst and the hydrogen permeability. Calculate the voltage drop when the current density is 600mA/cm², the decrease in electrochemical active area of the catalyst and the increase in hydrogen permeability in the polarization curve test results after each cycle.

7.10.4 Calculate the voltage decay rate, electrochemical active area loss rate and hydrogen