

ICS 27.070
CCS K82



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 20042.7-2024

**Proton exchange membrane fuel cells - Part 7: Test methods for
carbon paper characteristics**

质子交换膜燃料电池 第7部分：炭纸特性测试方法

Issued on: December 31, 2024

Implemented on: July 1, 2025

**Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC**

Table of Contents

1	Scope
2	Normative references
3	Terms and definitions
4	Symbols
5	Sample and test preparation
5.1	Sample preparation
5.2	Test preparation
6	Test instruments and apparatus
7	Thickness uniformity test
7.1	Test method
7.2	Data processing
8	Resistance test
8.1	In-plane resistivity test
8.1.1	Test method
8.2	Through-plane resistivity test
8.2.1	Test method
8.3	Area specific resistance test
8.3.1	Test method
9	Mechanical strength test
9.1	Tensile strength test
9.1.1	Test method
9.1.2	Data processing
9.2	Compression property test
10	Gas permeability test...
11	Porosity test...
12	Bulk density test...
13	Surface density test...
14	Roughness test...
15	Through-plane thermal conductivity test...
16	Bending stiffness test...
17	Static contact angle test...
18	Durability test (acid oxidation method)...

43 References...

1 Scope

GB/T 20042.7-2024 specifies the test methods for the carbon paper used as the gas diffusion layer in a proton exchange membrane fuel cell. The carbon paper has to do several contradictory things at once: conduct electrons and heat, let reactant gas through to the catalyst, get liquid water out of the way, and hold its structure under compression for thousands of hours. Which is why it is characterised on a long list of properties, and why until now those properties were measured differently by every supplier. This document fixes the methods: the measurement of thickness and areal weight, the through-plane and in-plane electrical resistivity, the compressive behaviour and the thickness under load, the gas permeability, the thermal conductivity, the contact angle and the hydrophobicity after PTFE treatment, the porosity and pore size distribution, the surface morphology and the mechanical strength, together with the sample preparation and the conditions each measurement requires. For a carbon paper producer, an MEA maker or a buyer qualifying a supply in China, this is the basis of comparison.

This document defines the terms and definitions of carbon paper for proton exchange membrane fuel cells; describes the test methods for the properties of carbon paper for proton exchange membrane fuel cells, including thickness uniformity test, resistance test, mechanical strength test, air permeability test, porosity test, bulk density test, surface density test, roughness test, vertical thermal conductivity test, bending stiffness test, static contact angle test, durability test, as well as the test report. This document is applicable to the detection of carbon paper for proton exchange membrane fuel cells.

2 Normative references

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

GB/T 1040.3-2006 Plastics - Determination of tensile properties - Part

3 Terms and definitions

The terms and definitions defined in GB/T 20042.1-2017 and GB/T 28816-2020, as well as the following terms and definitions, apply to this document.

3.1 Area specific resistance Under specified pressure conditions, the ohmic resistance of carbon paper multiplied by its effective area.

Note. The unit of area specific resistance is milliohm square centimeter ($\text{m}\Omega\cdot\text{cm}^2$).

3.2 Through-plane resistivity The resistivity in the direction perpendicular to the surface of carbon paper.

Note. The unit of through-plane resistivity is milliohm centimeters ($\text{m}\Omega\cdot\text{cm}$).

3.3 In-plane resistivity The resistivity in the direction parallel to the surface of carbon paper.

Note. The unit of in-plane resistivity is milliohm centimeters ($\text{m}\Omega\cdot\text{cm}$).

3.4 Through-plane gas permeability The permeability in the direction perpendicular to the surface of carbon paper.

Note. The unit of through-plane gas permeability is milliliter millimeters per square centimeter hour Pa [$\text{mL}\cdot\text{mm}/(\text{cm}^2\cdot\text{h}\cdot\text{Pa})$].

3.5 In-plane gas permeability The permeability in the direction parallel to the surface of carbon paper.

Note. The unit of in-plane gas permeability is milliliter millimeters per square centimeter hour Pa [$\text{mL}\cdot\text{mm}/(\text{cm}^2\cdot\text{h}\cdot\text{Pa})$].

3.6 Porosity The percentage of pore volume of carbon paper to its total volume.

4 Symbols

The following symbols apply to this document.

Note. The symbols, meanings, units used in this document are shown in Table 1, including appropriate units of measurement.

5.1 Sample preparation

5.1.1 The shape, size, quantity of the sample to be tested shall be determined by negotiation between the tester and the sample sender.

5.2 Test preparation

5.2.1 For each test, testing instruments and equipment that meet the accuracy requirements shall be selected, to minimize the measurement error.

5.2.3 Each test shall be tested at least 3 times (to ensure that 3 valid values are obtained).

5.2.4 Unless otherwise specified, the temperature of the test environment is $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

6 Test instruments and apparatus

The instruments and apparatus used in the test methods given in this document and their accuracy requirements are as follows:

7.1 Test method

7.1.1 The zero point of the thickness gauge shall be calibrated before each measurement; the zero point shall be rechecked after each set of specimen measurements.

7.2 Data processing

7.2.1 The thickness uniformity of the sample is expressed by the average thickness, thickness standard deviation, thickness dispersion coefficient.

7.2.2 The average thickness is calculated according to formula (1).

7.2.3 Thickness standard deviation is calculated according to formula (2).

7.2.4 Thickness dispersion coefficient is calculated according to formula (3).

8.1.1 Test method

8.1.1.1 Use a length measuring instrument to measure the length and width of the sample.

8.1.2 Data processing Calculate the in-plane resistivity according to formula (4).

8.2.1 Test method

8.2.2 Data processing Calculate the through resistivity according to formula (5).

9.1.1 Test method

9.1.1.1 Measure the average thickness of the sample according to the method in Chapter 7.

9.1.1.4 Perform a tensile strength test on a mechanical properties testing machine. The tensile rate shall be maintained at 10 mm/min.

9.1.1.5 After the specimen breaks, read the corresponding load value. If the specimen breaks somewhere within ± 5 mm of the marking line, the result shall be discarded.

9.2 Compression property test

9.2.1 Cut the test material with the same cross-sectional size as the flat plate fixture of the testing machine, as the sample.

9.2.2 Place the sample between two smooth flat plate fixtures. During the test, pressure is applied to the outside of the two clamps; a clamp displacement value and the sample thickness dpi are recorded for each

0.05 MPa increase in pressure. When the specified pressure is reached, the test is stopped.