

ICS 25.220.50

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

GB/T 9989.3-2025

Replacing GB/T 9989.3-2015

Vitreous and porcelain enamels - Determination of resistance to chemical corrosion - Part 3: Determination of resistance to chemical corrosion by alkaline liquids using a hexagonal vessel or a tetragonal glass bottle

搪瓷耐化学侵蚀的测定 第3部分：用六角形容器或四边玻璃容器进行耐碱性溶液化学侵蚀的测定

(English Translation)

Issued on: August 29, 2025

Implemented on: March 1, 2026

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

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents". Drafting.

This document is Part 3 of GB/T 9989, "Determination of Chemical Resistance of Enamel". GB/T 9989 has already published the following parts.

---Part 1: Determination of acid resistance at room temperature;

---Part 2: Determination of resistance to chemical corrosion from boiling acids, boiling neutral liquids, alkaline liquids and their vapors;

---Part 3: Determination of resistance to chemical attack by alkaline solutions using hexagonal or quadrangular glass containers;

---Part 4: Determination of resistance to alkaline solution corrosion using cylindrical containers;

---Part 5: Determination of resistance to chemical attack in closed systems.

This document replaces GB/T 9989.3-2015 "Determination of Chemical Resistance of Enamelware - Part 3: Alkali Solution Resistance Using Hexagonal Containers".

The main technical changes in "Determination of Erosion" compared to GB/T 9989.3-2015, apart from structural adjustments and editorial modifications, are as follows.

- a) The temperature requirement in the range has been removed (see Chapter 1);
- b) Acetic acid solution reagent was added (see 5.8);
- c) The number of sealing rings has been changed (see 6.1.6, 5.1.6 in the 2015 version);
- d) The experimental apparatus "quadrilateral glass container" and its experimental procedures have been added (see 6.2, 8.3).

This document is modified to adopt ISO 28706-3:2017 "Enamelled porcelain - Determination of resistance to chemical attack - Part 3: Chemical attack using hexagonal or quadrangular glass containers".

Determination of the resistance of glass containers to chemical corrosion by alkaline solutions.

The technical differences between this document and ISO 28706-3:2017, and the reasons therefor, are as follows.

- a) The scope of application has been changed to suit my country's technological conditions (see Chapter 1);
- b) ISO 3696 (see 5.1) has been replaced with the normatively referenced GB/T 6682 to adapt to my country's technical conditions and increase operability. Actual nature;
- c) ISO 48 (see 6.1.1, 6.2.1) has been replaced with the normatively referenced GB/T 6031 to adapt to my country's technical conditions and to add [further details needed]. Operability;
- d) The number of sealing rings was changed (see 6.1.6) to adapt to my country's technical conditions and increase operability;
- e) ISO 3585 (see 6.2.1, 6.2.5, 6.2.6) has been replaced with the normatively referenced GB/T 34843 to adapt to my country's technical requirements. Add components to increase operability;
- f) ISO 4799 has been replaced with the normatively referenced GB/T 28212 (see 6.2.5) to adapt to my country's technical conditions and increase operability. Actual nature;
- g) ISO 28764 (see Chapter 7) has been replaced with the normatively referenced GB/T 38166 to adapt to my country's technical conditions and add [further details needed]. Operability;
- h) The oven temperature was changed to $120^{\circ}\text{C}\pm 5^{\circ}\text{C}$ (see 8.3), consistent with the oven temperature conditions in 8.2, increasing operational uniformity and operability. Comparison of sexes. The following editorial changes have been made to this document.

---The national standard cited in the introduction replaces the international standard GB/T 9989.1-2015, replacing ISO 28706-1:2008.

GB/T 9989.2-2025 replaces ISO 28706-2:2017; GB/T 9989.5-2015 replaces ISO 28706-5:2010.

---Notes 1 and 2 in Chapter 1 of ISO 28706-3:2017 have been deleted (see Chapter 1);

---The note in Chapter 4 of ISO 28706-3:2017 has been removed (see Chapter 4);

---The phrase "such as distilled water or water of equivalent purity" has been removed from section 5.1 of ISO 28706-3:2017 regarding test water;

---Notes in sections 10.2 and 11.2 of ISO 28706-3:2017 have been removed.

Introduction

GB/T 9989 aims to describe the test methods for the chemical resistance of enamel, and is proposed to consist of five parts.

---Part 1: Determination of Acid Resistance at Room Temperature. The purpose is to evaluate the chemical resistance of enamel in an acidic environment at room temperature. It can provide testing methods.

---Part 2: Determination of resistance to chemical corrosion by boiling acids, boiling neutral liquids, alkaline liquids and their vapors. The purpose is to evaluate the resistance of enamel.

This study investigates the corrosion resistance of ceramics under high temperatures and in the presence of liquids and vapors with different chemical properties, and provides testing methods.

---Part 3: Determination of resistance to chemical attack by alkaline solutions using hexagonal or square glass containers. The purpose is to... The chemical resistance of enamel in alkaline solution environments in containers of specific shapes is evaluated and a test method is provided.

---Part 4: Determination of resistance to alkaline solutions using cylindrical containers. The purpose is to utilize cylindrical containers to determine resistance to alkaline solutions.

The liquid erosion test method is mainly applicable to chemical enamel.

---Part 5: Determination of chemical resistance in enclosed systems. The purpose is to assess the performance of enamel used in chemical processing. The evaluation provides testing methods.

The erosion of enamel and porcelain enamel by aqueous solutions is a hydrolytic process. The main component of the enamel layer is silicon dioxide, which is a three-dimensional silicon dioxide.

The acid-silicone network structure, after hydrolysis, forms silicate or silicate acid that dissolves into the etching medium. Other components (mainly metal oxides) also... It will hydrolyze, forming corresponding metal hydroxide ions or hydroxides. All the products of corrosion will dissolve to some extent into the corrosive medium.

The entire erosion process results in a loss of weight per unit area of the material.

The amount of erosion on enamel surfaces is related to the erosion time; some aqueous solutions show a linear relationship, while others show a logarithmic relationship.

Only when the erosion of an aqueous solution exhibits a linear relationship can the rate of weight loss per unit area $[g/(m^2 \cdot h)]$ be accurately calculated using scientific methods. and erosion rate (mm/a).

The key factors influencing the corrosion of enamel surfaces by aqueous solutions are the quality of the enamel, temperature, and pH. The limited solubility of silica also... It plays a certain role in inhibiting corrosion. The following lists the corrosion of different types of enamel under different corrosion conditions.

a) At 80°C, alkaline solutions (such as 0.1 mol/L sodium hydroxide, see Chapter 9 of ISO 28706-4:2016) affect the silicate composition of enamel.

Network erosion is quite significant; silicates and most other hydrolyzed components dissolve in the alkaline solution, and the amount of erosion increases proportionally with the test time.

Linear relationship. Therefore, the experimental results can be expressed as the rate of weight loss per unit area (weight loss per unit area and per unit time) and the erosion rate. It is expressed as a rate (mm/a).

b) At room temperature, weak acid solutions (such as citric acid, see Chapter 9 of GB/T 9989.1-2015) or strong acid solutions (such as sulfuric acid, see Chapter 9 of GB/T 9989.1-2015)

GB/T 9989.1-2015, Chapter 10, shows minimal erosion of the silicate network in enamel, but other surface components exhibit a certain degree of precipitation.

The test revealed that high-acid-resistant enamel showed no significant changes on its surface. However, enamel with poor acid resistance showed... The surface will show signs of erosion or become rough.

c) In boiling acidic solutions (see GB/T 9989.2-2025), the silicate network of the enamel layer was eroded, and silica and Other enamel components will dissolve in the solution; however, silica has low solubility in acidic solutions, and the dissolved silica... It quickly reaches saturation in the etching solution, and etched deposits only appear on the enamel surface. Acid etching will be inhibited, and the etching rate will significantly decrease. The decline is evident.