



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

GB/T 7998-2023

**Method for evaluating the susceptibility to intergranular
corrosion of aluminum alloys**

铝合金晶间腐蚀敏感性评价方法

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1 Scope

GB/T 7998-2023 gives the method for evaluating the intergranular corrosion susceptibility of aluminium alloys. Intergranular attack is the dangerous form of aluminium corrosion because it is nearly invisible: the surface can look sound while the grain boundaries have been eaten away and the part has lost most of its strength, and in the high strength 2000 and 7000 series it is decided by the heat treatment rather than by the composition, so it is a process control question and not a material selection one. The method accelerates the attack in a defined solution by cathodic depolarisation and then measures the depth of penetration or the mass loss. The standard sets the principle, the test conditions, the reagents, the instruments and materials, the specimens, the test procedure, the processing and expression of the results, and the test report. It took effect on 1 December 2023.

This document describes the evaluation method of intergranular corrosion sensitivity of aluminum alloy products. This document is applicable to the determination of intergranular corrosion sensitivity of 2xxx series, 5xxx series, 6xxx series, 7xxx series aluminum alloy products.

2 Normative references

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

GB/T 3246.1 Inspection method for structure of wrought aluminum and aluminum alloy products - Part

3 Terms and definitions

The following terms and definitions apply to this document.

3.1 Intergranular corrosion Corrosion that develops along the grain boundary of a metal or alloy or its adjacent area.

4 Principle

According to the principle of cathode depolarization, the aluminum alloy specimen is placed in a specific test solution for a certain period of time, to accelerate the corrosion of the alloy grain boundary or near the grain boundary; the corrosion depth or mass loss is measured to evaluate the intergranular corrosion sensitivity of the aluminum alloy.

5 Test conditions

The test environment temperature shall not be higher than the test temperature; ventilation facilities shall be configured.

6 Reagents

Warning - The inorganic acids used in the analysis are corrosive to the human body. The test personnel shall wear personal protective equipment to reduce the danger caused by direct contact.

6.1 Nitric acid ($\rho =$

6.2 Nitric acid (1 + 4).

6.3 Sodium hydroxide solution A. 100 g/L.

6.4 Sodium hydroxide solution B. 50 g/L.

6.5 Sodium chloride-hydrogen peroxide solution. Dissolve 57 g of sodium chloride in a small amount of water; stir evenly; dilute to 990 mL with water. During the test, first heat the test solution to the test temperature; add 10 mL of hydrogen peroxide (mass fraction 30%).

6.6 Sodium chloride-hydrochloric acid solution. Dissolve 30 g of sodium chloride in a small amount of water; stir evenly; dilute to 990 mL with water; add 10 mL of hydrochloric acid ($\rho =$

1.19 g/mL); stir evenly.

6.7 Etching agent. Mix hydrofluoric acid ($\rho =$

1.15 g/mL), hydrochloric acid ($\rho =$

1.19 g/mL), nitric acid ($\rho =$

1.40 g/mL), water in a volume of (2 + 3 + 5 + 190); mix evenly.

7 Instruments and materials

7.1 Conduction constant temperature device. The temperature control accuracy shall comply with the provisions of Table 1.

7.2 Test liquid container (with lid). Beaker or other container with lid.

7.3 Specimen holder. Made of glass, plastic or other inert materials.

7.4 Sandpaper. Particle size is 35 μm .

7.5 Optical (metallographic) microscope. In accordance with JJG (Education Committee) 012, it shall be equipped with an eyepiece micrometer

0.1 mm scale plate (or integrated with the eyepiece); the magnification should be 100X ~ 500X.

7.6 Metallographic grinding and polishing machine.

7.7 Ultrasonic cleaning machine. Working frequency 30 kHz ~ 60 kHz.

7.10 Micrometer. The graduation value shall not be greater than

0.01 mm; the maximum allowable deviation is $\pm 4.0 \mu\text{m}$.

8 Specimens

8.1 The samples shall be cut from the products and retain the original surface. The number of samples shall comply with the requirements of the relevant product standards or the agreement between the supplier and the buyer.

8.2 The specimens shall be cut from the samples; at least one surface of the cut specimens shall be the original surface of the product. The original surface shall be clean and shall not have defects such as bumps and scratches that affect the test results. The length direction of the specimen is the main deformation direction of the product.

8.3 The specimen shall not be cut at the flange or rib of the product, or the weld of the seamed extruded material.

8.4 The type, shape, size, quantity of the specimen shall comply with the requirements of Table 2.

8.6 Corrosion depth method specimens can be directly marked; the marking shall be carried out on the non-test surface. Mass loss method specimens should be marked with hanging tags.

8.7 If there are a large number of specimens, through-holes with a diameter not greater than 4 mm may be drilled on the surface of the specimens shown in Figures 5 ~ 7 for ease of cleaning.

9 Test procedure

9.1 Pretreatment of specimens Before pretreatment of the mass loss method specimen, use a fine file or sandpaper (7.4) to grind all edges to remove burrs, scratches and other defects that may affect the test results; then measure the length, width, thickness of the specimen, accurate to

0.02 mm.

9.2 Calculation and weighing The total surface area (S) of the mass loss method specimen shall be calculated; the additional surface of the hole wall of the perforated specimen shall be ignored. Then it shall be placed on an electronic balance and weighed (m_1), accurate to

0.1 mg.

9.4.2 Mass loss method

9.4.2.1 Take out the mass loss method specimen; rinse it with water to remove the acid.

9.4.2.2 Immerse the specimen (see Figure 18) or hang it (see Figure 19) in an ultrasonic cleaning machine for 1 min ~ 2 min; rinse with water; air dry or blow dry with clean compressed air.

10 Result processing and result expression

10.1 Corrosion depth method The test results are divided into two types. no intergranular corrosion (see Figures 20 and 21) and intergranular corrosion (see Figures 22 and 23). Intergranular corrosion shall be graded according to the maximum corrosion depth D as specified in Table 8.