GB

NATIONAL STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

ICS 77.060

CCS H 25

GB/T 41653-2022

Corrosion of Metals and Alloys - Anodic Test for Evaluation of Intergranular Corrosion Susceptibility of Heat-treatable Aluminum Alloys

金属和合金的腐蚀 热处理铝合金晶间

腐蚀敏感性阳极试验方法

(ISO 15329:2006, MOD)

Issued on: July 11, 2022 **Implemented on: February 1, 2023**

Issued by: State Administration for Market Regulation;

Standardization Administration of the People's Republic of China.

Table of Contents

Corrosion of Metals and Alloys - Anodic Test for Evaluation of Intergranular Corrosion Susceptibility of Heat-treatable Aluminum Alloys

1 Scope

This document specifies the electrochemical test method for determining the intergranular corrosion susceptibility of heat-treatable aluminum alloys (2XXX, 6XXX, 7XXX and 8XXX) in various aged conditions and without a protective coating.

This document is applicable to castings, forgings, strips, plates, extruded profiles and semi-finished or finished products of cast and forged heat-treatable aluminum alloys. This document can be applied to the comparative evaluation of different grades of alloys, thicknesses and other factors related to chemical composition. It can also be used to examine the thermal process quality of test materials. The test results are conducive to the determination of the intergranular corrosion resistance and thermal process quality of test materials.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the normative references in this text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 6682-2008 Water for Analytical Laboratory Use - Specification and Test Methods (ISO 3696:1987, MOD)

NOTE: there is no technical difference between the content quoted in GB/T 6682-2008 and the content quoted in ISO 3696:1987.

GB/T 7998-2005 Test Method for Intergranular Corrosion of Aluminum Alloy

GB/T 10123 Corrosion of Metals and Alloys - Vocabulary (GB/T 10123-2022, ISO 8044:2020, IDT)

3 Terms and Definitions

The terms and definitions defined in GB/T 10123 are applicable to this document.

4 Principle

4.1 This test method is based on the following principle: if aluminum alloys are susceptible to intergranular corrosion, the susceptibility is manifested in the rupture of the surface oxide film when it is anodic polarized in a solution containing chloride ions.

4.2 The intergranular corrosion susceptibility of solution-heat-treatable aluminum alloys depends on the alloy composition, manufacturing method, solution heat treatment, quench treatment and artificial precipitation hardening (ageing) treatment.

4.3 In the naturally aged condition, the intergranular corrosion susceptibility of solution-heat-treatable aluminum alloys mainly depends on the cooling rate in the critical temperature range during quenching.

4.4 Regardless of the type of pitting initiation and extended zones (intergranular or transgranular), depassivation (destruction of the passive state of the metal) occurs at the pitting initiation potential (E_{pi}). At a potential slightly positive than the initiation potential of pitting corrosion, the development of intergranular corrosion frequently occurs.

4.5 Historically, the acceleration methods for intergranular corrosion testing have tended towards arbitrary, possibly extreme conditions, including either externally applied current (galvanostatic) or externally applied potential (potentiostatic). This type of tests can be improved by selecting electrochemical effects, considering the following factors associated with the anodic properties of the material:

a) The relative cathodic phase of the material;

b) The chemical composition of the test medium.

4.6 The test method begins with the anodic polarization of the specimen, so as to determine the subsequent externally applied potential. As with other accelerated tests, the test results must be correlated with the service properties of the material being tested.

4.7 Metallographic examination is required to determine localized corrosion patterns.

4.8 The principle involves anodic polarization of the specimen in aqueous solution of sodium chloride (NaCl) to a potential (E_{ic}) that exhibits intergranular corrosion susceptibility and exposure at this potential (see Figure 1).

5.2.2 Specimens with surface defects (metallurgical or mechanical) should not be used for testing.

5.2.3 Not less than three parallel specimens of the same shape, dimension and surface condition should be used for the test.

6 Surface Preparation

6.1 Before the test, the specimen should be mechanically ground. Use a soft brush and an organic solvent (hydrocarbon solvent with a boiling point of 60 °C ~ 120 °C) to degrease it, or perform ultrasonic cleaning in a container full of solvent. After cleaning, the specimen should be rinsed with fresh solvent, dried and stored in a desiccator for 1 h before testing.

6.2 In accordance with GB/T 7998-2005, perform the pre-treatment.

7 Test Procedures

7.1 Naturally aged alloys are tested 24 h after quenching. Artificially aged alloys can be tested in accordance with this method at any time.

7.2 Before the test, use distilled water or deionized water with a conductivity of not greater than 10 μS/cm (in accordance with GB/T 6682-2008) to prepare the solution. Use analytically pure chemicals to prepare the solution.

7.3 The ratio of the solution volume to the specimen area should not be lower than 50 mL/cm^2. For each test, a newly prepared solution should be used.

7.4 The specimens placed in the solution shall avoid mutual contact with each other, and with the wall of the test container. The liquid level of the solution should not be lower than 20 mm from the upper edge of the specimen. The immersion height of all specimens should be the same. Specimens of different alloy systems are not allowed to be tested in the same solution.

7.5 The test is carried out in a glass container, or a container made of inert materials.

7.6 In accordance with the following steps, carry out the test.

a) In an electrolytic cell (including test material, auxiliary electrode and reference electrode) whose temperature is constant between 18 °C ~ 25 °C, carry out the test. The test solution is NaCl solution with a mass fraction of 0.1%. Use a potentiostat to polarize the test electrode to E_{ic} potential at a constant scan rate.

b) The mechanically polished surface of the test electrode (specimen) is not less than 1 cm^2; the surface roughness $R\alpha \leq 1$ μm.

c) The auxiliary electrode is a platinum electrode, and the reference electrode can be a calomel electrode of Ag/AgCl electrode.

This is an excerpt of the PDF (Some pages are marked off intentionally)

------ The End ------