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

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**Test method for the erosion corrosion of copper and copper
alloys in marine water**

铜及铜合金海水冲刷腐蚀试验方法

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1 Scope

China's national test method for erosion corrosion of copper and copper alloys in seawater. Erosion corrosion is the combination that destroys copper alloy seawater systems: the metal's protection depends on a thin oxide film that forms on its surface, and flowing water above a critical velocity strips that film mechanically, exposing fresh metal which oxidises and is stripped again. The result is a rate of attack far higher than either corrosion or erosion alone would give, concentrated exactly where the flow is fastest - at pipe inlets, at bends, downstream of partly closed valves and wherever entrained air bubbles collapse. It is the reason condenser tubes fail at their inlet ends and why seawater system design specifies a maximum velocity for each alloy. The test establishes that velocity: it exposes specimens to controlled flow and finds the threshold above which the attack accelerates, which is the number a designer actually needs.

This document describes the test method for erosion corrosion of marine water for copper and copper alloys, including method and principle, test conditions, reagents, instruments and equipment, specimens, test procedures, test result and test report. This document is applicable to the determination of the resistance of copper and copper alloy pipes against erosion corrosion of marine water. Other copper and copper alloy materials can also be determined with reference to this document.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document

through the normative references in the 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 Water for Analytical Laboratory Use - Specification and Test Methods

GB/T 11086 Copper and Copper Alloys - Terms and Definitions

GB/T 16545 Corrosion of Metals and Alloys - Removal of Corrosion Products from Corrosion Test Specimens JG/T 494-2016 The Washed Sea Sand for Construction and Municipal Engineering

3 Terms and Definitions

The terms and definitions defined in GB/T 11086 are applicable to this document.

4 Method and Principle

Through rotation or pressure driving, the erosion medium containing sodium chloride as the main component is used to erode the surface of the specimen. At a specified temperature, erode for a specified time. In accordance with the corrosion weight loss ratio of the specimen after the test, evaluate the product's resistance against erosion corrosion. This document adopts the following two test methods:

---Rotating disk test: under the set flow rate and temperature, through the rotation of the disk, make the specimen and the erosion medium move relative to each other, and erode the surface of the specimen;

---Pipeline erosion test: under the set flow rate and temperature, use pressure to make the erosion medium perform erosion through the specimen surface at a certain angle.

5 Test Conditions

The ambient temperature of the test is room temperature.

6 Reagents

Unless it is otherwise specified, only reagents confirmed to be chemically pure or above are used in the test, and the water used is distilled water or deionized water of Grade-3 or above specified in GB/T 6682.

6.1 Sodium chloride solution: use sodium chloride and distilled water or deionized water to prepare sodium chloride solution with a concentration (mass fraction) of 3.5%.

6.2 Sea sand: the main component is SiO₂, comply with the requirements of JG/T

494-2016, and the fineness modulus is extra fine.

7 Instruments and Equipment

7.1 Basic Requirements The material used to make the test equipment shall be corrosion-resistant and with a certain strength, so as to prevent the material from being damaged by erosion and affecting the composition of the test solution.

7.2 Test Equipment of Rotating Disk The test equipment of rotating disk is shown in Figure 1. requirements shall be not lower than the medium accuracy grade.

7.6 Vernier Caliper The vernier caliper shall be calibrated with reference to JJG 30, and the resolution shall be not lower than

0.02 mm.

8 Specimens

8.1 Take the full cross-section of the sample as the specimen. The length of the specimen for the rotating disk test is 40 mm, and the length of the specimen for the pipeline erosion test is 1,000 mm. Copper pipes with a diameter greater than 30 mm should be subject to the pipeline erosion test, and copper pipes with a diameter not greater than 30 mm should be subject to the rotating disk test.

8.2 When it is impossible to cut a specimen that complies with the requirements of 8.1, a small- sized test piece can be cut from the original sample. The size of the test piece is 60 mm 30 mm original wall thickness, and the unit of the original wall thickness is millimeters (mm).

8.3 The internal and external surfaces of the specimen shall be clean, and free of dirt, stains and other foreign matters. If there are stains, use deionized water or an appropriate organic solvent (for example, ethanol) to moisten them, then, use a clean, soft cloth or similar material to remove them. Organic solvents that will corrode the test area or generate a protective film on the test area shall not be used.

9 Test Procedures

9.1 Before the test, cut the specimen and use sandpaper to polish the edges to remove burrs.

9.2 Use a vernier caliper to measure the size and calculate the inner and outer surface area S of the specimen (keep 2 decimal places).

9.3 Use organic solvents, such as: ethanol and acetone, to clean the specimen, then, use deionized water to clean it. After blow-drying, weigh the mass m_1 , accurate to

0.1 mg.

9.4 Fix the specimen on the specimen holder or install it on the erosion pipeline.

9.5 Add 0.15% (mass fraction) sea sand to the sodium chloride solution, in accordance with Table 1, set the test parameters.

9.6 Actuate the equipment and start the test.

9.7 When reaching the specified test time, stop the test.

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