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Methods for the plane bending fatigue of copper alloy elastic strips

铜合金弹性带材平面弯曲疲劳试验方法

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Foreword

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1 Scope

China's national methods for plane bending fatigue testing of copper alloy elastic strip. The

strip in question is the material of electrical contacts, connectors, springs and relay blades, and plane bending is how it is actually loaded: a contact is deflected as a mating part is inserted, and the deflection repeats every time the connector is used or every time a relay operates. Fatigue life under that loading is what determines how many cycles a connector is rated for, which for an automotive or an industrial connector is a specification number the customer relies on. Testing it as plane bending rather than as axial fatigue matters because the stress distribution through the thickness is what governs - the surface is at maximum stress and the neutral axis at none, so the surface condition and any decarburised or worked layer dominate the result in a way that an axial test would not reveal.

This document describes the principle, test conditions, testing machine, specimens, test procedures, result expression and test report of the plane bending fatigue test method for copper alloy elastic strip. This document is applicable to the determination of plane bending fatigue properties of copper alloy elastic strips with a thickness of

0.1 mm~

1.0 mm at 10°C~35°C.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

GB/T 16825.1, Verification of static uniaxial testing machines -- Part 1: Tension/compression testing machines -- Verification and calibration of the force-measuring system

3 Terms and definitions

There are no terms or definitions that require definition in this document.

4 Method principle

The prepared specimen is mounted on a fixed cantilever constant deflection fatigue testing machine (hereinafter referred to as the "testing machine"). A load is applied to it. The specimen is bent repeatedly at a certain frequency until the specimen fails or reaches a specified number of cycles. The principle diagram is shown in Figure 1. h - Thickness of the specimen at the load-bearing point, in millimeters (mm). The calculation result is rounded to two decimal places.

8.1.2 Uniform cross-sectional specimens The maximum bending stress S of the uniform cross-section specimen is calculated according to formula (2): Where, P - Applied load, in Newton (N); L - Distance from the force application point to the force receiving point, in

millimeters (mm); b - Width of the specimen at the force receiving point, in millimeters (mm); h - Thickness of the specimen at the force receiving point, in millimeters (mm). The calculation result is rounded to two decimal places.

8.2 Static calibration of loads If the testing machine is equipped with a load sensor, the load (P) can be recorded directly. No static calibration is required. If such a device is not available, static calibration of the load can be performed according to the following steps: Paste a strain gauge on the axis of the center position of the specimen working area. Perform static calibration step by step. The calibration method is as follows: Paste a strain gauge on the specimen working area and connect it to the strain indicator. Fix one end of the specimen. Then add weights step by step vertically at the force application point as the load (P). After the data stabilizes, record the strain value shown by the strain indicator until the stress on the specimen is equal to or slightly greater than the required test stress. Reinstall the specimen in the same clamping position. Measure 2 ~3 times.

8.3 Specimen installation When installing the specimen, the alignment check shall be completed first. The center line of the fixture shall coincide with the force axis of the testing machine, so that the specimen and the upper and lower fixtures of the testing machine remain coaxial. Ensure that the force is evenly distributed over the entire cross section of the specimen. Try to reduce the stress other than the specified bending stress on the specimen. The clamping force of the specimen shall be as small as possible to reduce the probability of the specimen breaking in the jaws. Use an adjustable torque wrench to fix the specimen on the fixture (the recommended torque value is 3 N·m).

8.4 Test frequency The test frequency is generally in the range of

5 Hz~200 Hz. The recommended test frequency is

5 Hz~100 Hz. The tests of the same batch of specimens shall be carried out at the same frequency. The stress cycle frequency shall not cause overheating of the specimens or resonance of the testing machine. At high frequencies, the specimens will generate a lot of heat, which will affect the test results of fatigue life and fatigue strength. If the specimens are hot, it is recommended to reduce the test frequency. If the specimen temperature exceeds 35°C, it shall be noted in the report.

8.5 Application of loads

8.5.1 The load shall be applied smoothly and accurately. Overloading is not allowed.

8.5.2 If the testing machine is equipped with a load sensing device, the load can be adjusted to the required value through the control system. If the testing machine is not equipped with a load sensing device, the load can be adjusted to the required value through the load adjustment device.

8.6 Determination of S-N curve Usually at least 5 stress levels are taken. The number of

specimens at each stress level shall be gradually increased as the stress level decreases. The conditional fatigue limit obtained by the lifting and lowering method is used as the lowest stress level point on the S-N curve. The number of specimens at each stress level is not less than 3. If necessary, it shall be determined by negotiation between the two parties. With stress S as the ordinate and fatigue life N as the abscissa, the S-N curve is drawn using the best fitting method.

8.7 Termination of tests The test is terminated when the specimen fails or reaches the specified number of cycles. If other conditions cause the test to be interrupted during the test, the number of cycles and the rest time at the time of interruption must be noted in the test report.

9 Result presentation

9.1 By tables The table shall include specimen identification, test sequence, test shape and size, test frequency, test stress, fatigue life or number of cycles at the end of the test, and failure criteria.