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

GB/T 39152-2020

**Test method for the bending stress relaxation of copper and
copper alloys**

铜及铜合金弯曲应力松弛试验方法

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1 Scope

China's national test method for the bending stress relaxation of copper and copper alloys. It specifies the terms and definitions, the principle of the method, and the instruments and apparatus. Stress relaxation is the loss of force in a component held at constant deflection, and for a copper alloy spring it is the property that determines service life. An electrical connector works by a strip of alloy pressed against a mating pin: the contact force is what keeps the resistance low, and that force comes from the elastic deflection of the strip. Over time, at temperature, the alloy creeps slightly and the force decays - and when it falls far enough the contact resistance rises, the joint heats, and the connection becomes intermittent. Nothing about it looks wrong. Since a connector under a car bonnet may sit at over a hundred degrees C for fifteen years, this measurement is how alloys for that duty are selected, and it is why the expensive copper alloys exist.

This Standard specifies the method principles, instruments and apparatuses, samples, test conditions, determination of various parameters before the test, test procedures, test data processing, and test reports for the test method of the bending stress relaxation for copper and copper alloy materials. This Standard applies to the determination of the bending stress relaxation properties for copper and copper alloy plates and strips whose thickness is

0.1 mm ~

1.0 mm under constant strain conditions.

2 Normative references

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

GB/T 8170, Rules of rounding off for numerical values & expression and judgment of limiting values

GB/T 10623-2008, Metallic material - Mechanical testing - Vocabulary

GB/T 22315, Metallic materials - Determination of modulus of elasticity and poisson's ratio

GB/T 26303.3, Measuring methods for dimensions and shapes of wrought copper and copper alloys - Part 3: Sheets and strips

GB/T 34505, Copper and copper alloy materials - Tensile testing at room temperature

3 Terms and definitions

Terms and definitions determined by GB/T 10623-2008 and the following ones are applicable to this document.

3.1 Bending stress The normal stress that is generated by the sample in the single-ended bending state.

3.2 Initial stress At the beginning of the stress relaxation test, the maximum bending stress that is generated by the sample at the moment of the specified bending deformation.

Note: Rewrite GB/T 10623-2008, definition 3.27.

3.3 Initial deformation The artificially set elastic bending deformation that is generated by the sample at room temperature.

3.4 Initial reference height Give initial deformation at room temperature; after unloading, the height of the load point of the sample to the reference surface.

3.5 Relaxed stress The reduced bending stress on the sample at any time in the stress relaxation test.

Note: Rewrite GB/T 10623-2008, definition 3.29.

3.6 Permanent deformation The plastic bending deformation that is caused by stress relaxation.

3.7 Stress relaxation ratio The percentage of relaxed stress and initial stress, which is expressed as the ratio of permanent deformation and initial deformation.

4 Principle of the method

Copper and copper alloys maintain a certain bending deformation under the action of long-term stress and a certain temperature. With the extension of time, their internal elastic strain will gradually transform into plastic strain, which will cause stress relaxation, which is an important form of failure of metal components. Heat the sample to a specified temperature; maintain a constant bending deformation at this temperature; remove the sample load after the specified time; measure the permanent deformation of the sample. The initial deformation (ϵ_0) shall not be greater than 1/2 of the length of the bending section (l_s). The initial deformation is recommended to be 4 mm; other negotiated values can also be used. Only when the initial deformation is the same, the stress relaxation ratio can be compared with each other.

8.5 Measurement of the initial reference height Clamp the sample on the fixture; give the initial deformation at the specified position of the free end of the sample; unload it after standing at room temperature for 30 s ~ 35 s; measure the height from the load point of the free end of the sample to the reference surface, which is the initial reference height (H_i).

9 Test procedure

9.1 The test temperature is 125° C or 150 °C; the time is 24 h, 48 h, 96 h, 192 h. After negotiation, the temperature and time can also be other values. The time accuracy shall be within 3%.

9.2 Use a fixture to fix the sample; place it in the heating equipment. When the temperature reaches 95% of the specified temperature, start timing.

9.3 After reaching the specified test time, remove the fixture from the heating equipment and place it at room temperature. After the sample is cooled to room temperature, remove the sample load; measure the distance from the sample load point to the reference surface, which is the height after stress relaxation (H_t).