



Stress-Corrosion Cracking of Copper Based Alloys

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. Stress-corrosion cracking (or, as it is alternatively known, season cracking) is failure by cracking under the combined action of corrosion and stress - either external (applied stress) or internal (residual stress).

1.2 Applicability. This test method shall be used to determine the susceptibility of formed components and semi-finished products made from copper based alloys, especially copper-zinc alloys, to stress-corrosion cracking.

This test is carried out by exposing sample components to suitable corrosive media under controlled conditions for specified time periods and subsequently examining for induced cracking.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.2 Equipment.

3.2.1 Apparatus. Test vessel made of glass and of suitable size to contain test piece and requisite volume of test medium.

A test vessel (approximately 150 mm high) must be fitted with a gas tight sealed glass lid and a suitable glass grid or frame to allow suspension of the test piece above the test medium.

Suitable magnifying aid giving magnification of 10x.

3.2.2 Test Solution. For preparing the test solution reagent grade constituents are required and distilled or deionized water shall be used.

3.2.2.1 Ammonia Solution. 25% by weight ammonia, shall be diluted with water to volume relation 1 + 1 (density at +20 °C = 0.946 g/cm³ to 0.950 g/cm³).

3.3 Test Vehicle/Test Piece. The test piece wherever possible shall be the finished part. If finished part size, shape is impracticable to test, then a suitable section shall be excised from the part for testing purposes. This section must be representative of maximum deformation encountered in forming of the part, and sectioning must be conducted in such a manner so as to minimize any relaxation of internal stress contained within the part.

In the case of testing semi-finished products, suitable sections shall be used.

For initial sample approval and arbitration purposes, at least three test pieces shall be tested. For routine quality control at least one test piece shall be tested.

3.4 Test Time.

Calendar time: 1 d to 3 d
Test time: 24 h (maximum)
Coordination time: 2 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation.

4.1.1 Test Piece Preparation. The test piece shall be cleaned by degreasing in a suitable alkaline cleaner or organic solvent and, if necessary, immersed for approximately 30 s in either sulphuric acid or nitric acid and subsequently washed in clean running water to remove any adhered oxides and prior to test shall be dried.

Surface coatings when present on test pieces shall be removed by suitable means before testing.

For testing of semi-finished products or semi-finished product parts, the test piece, wherever possible, shall be pre-stressed such that the magnitude and direction of the applied stress shall equal that occurring within the finished part. If this is impracticable, then the test piece shall be loaded such that the induced stress equals approximately 40% of the average ultimate tensile stress of the material under test.

Note where used, any test piece clamping shall be effectively sealed against influence of the test media.

4.2 Conditions.

4.2.1 Environmental Conditions. Unless otherwise specified the test shall be performed at a temperature of $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.3 Instructions.

4.3.1 Instructions. The test vessel shall be filled with test medium to a depth of approximately 30 mm. The cleaned test piece shall be suspended at a height of 50 mm above the surface of the test medium and the test vessel sealed.

The test may be suspended (in instances when the exposure time exceeds the 8 h working day) by storing the test piece overnight (16 h) in deionized water followed by re-exposure after drying.

Upon completion of the required exposure time the test piece shall be pickled in either sulphuric acid or nitric acid at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 30 s to 60 s.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results.

5.2.1 Evaluation. Test pieces shall be subsequently examined for cracks with the aid of the magnifying equipment.

Test pieces shall be free from cracks.

5.3 Test Documentation. The test documentation shall contain at least 5.3.1 thru 5.3.9.

5.3.1 All details necessary to identify the material/part.

5.3.2 The type of coating, with an identification of its surface finish.

5.3.3 Number of the test specimens of each coating or product subjected to the test.

5.3.4 Dimensions and shape of the test specimens and the nature and area of the surface tested.

5.3.5 Pretreatment of the test specimens, including any cleaning treatment applied and any protection given to edges or other special areas.