

INTERNATIONAL STANDARD



196

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Wrought copper and copper alloys — Detection of residual stress — Mercury(I) nitrate test

Cuivre et alliages de cuivre corroyés — Détection des contraintes résiduelles — Essai au nitrate de mercure(I)

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FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 196 was developed by Technical Committee ISO/TC 26, *Copper and copper alloys*.

It was submitted directly to the ISO Council, in accordance with clause 6.13.1 of the Directives for the technical work of ISO. It cancels and replaces ISO Recommendation R 196-1961, and has been approved by the member bodies of the following countries :

Australia	India	Poland
Belgium	Ireland	Romania
Brazil	Israel	Spain
Canada	Italy	Sweden
Chile	Japan	Switzerland
Denmark	Mexico	Turkey
Finland	Netherlands	United Kingdom
France	New Zealand	U.S.A.
Germany	Norway	U.S.S.R.
Greece	Portugal	Yugoslavia

No member body expressed disapproval of the document.

Wrought copper and copper alloys – Detection of residual stress – Mercury(I) nitrate test

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies an accelerated test, using mercury(I) nitrate, for the purpose of detecting the presence of residual (internal) stresses in wrought copper and copper alloy products that might bring about failure of the material in service or storage through stress corrosion cracking.

While this method has also been used for testing assemblies and partial assemblies, it is not intended for that purpose, and some modification may be required for such use.

2 DEFINITIONS

2.1 stress corrosion cracking: Spontaneous failure of metals by cracking under combined action of corrosion and stress, residual or applied.

2.2 applied stress: Stress that is set up and exists in a body during application of an external load.

2.3 residual stress: Stress that remains within a body as the result of plastic deformation.

3 TEST SOLUTION

The test solution is an aqueous solution containing 10 g of mercury(I) nitrate and 10 ml of nitric acid per litre of solution.

This solution shall be prepared by the following procedure.

WARNING – Mercury(I) nitrate crystals should be handled with caution because of their highly toxic effects.

Dissolve 11,4 g of mercury(I) nitrate dihydrate ($\text{HgNO}_3 \cdot 2\text{H}_2\text{O}$) or 10,7 g of mercury(I) nitrate monohydrate ($\text{HgNO}_3 \cdot \text{H}_2\text{O}$) in approximately 40 ml of distilled water acidified with 10 ml of nitric acid (ρ_{20} 1,40 to 1,42 g/ml). After the crystals are completely dissolved, dilute the solution with distilled water to 1 000 ml.

NOTE – If heating is used for preparing the mercury(I) nitrate solution, care should be exercised to prevent loss of nitric acid.

4 TEST PIECE

4.1 The length of the test piece shall be at least 150 mm

for products of diameter less than or equal to 75 mm. For products of diameter greater than 75 mm, the length shall be subject to agreement.

4.2 Test pieces for the mercury(I) nitrate test shall not be marked for identification by stamping.

5 PROCEDURE

5.1 First degrease the test piece. Then totally immerse it in an aqueous solution of sulphuric acid [15 % (V/V)] or in a mixture containing 60 parts by volume of distilled water and 40 parts by volume of concentrated nitric acid for a period not exceeding 30 s, to remove all traces of carbonaceous matter and oxide films. Remove the test piece from the pickling solution and wash it immediately in running water. Then drain the test piece free of excess water and totally immerse it in the test solution (clause 3). Use at least 1,5 ml of test solution per square centimetre of exposed surface of the test piece.

5.2 After 30 min, remove the test piece from the test solution and wash it in running water. Wipe off any excess mercury from the surface of the test piece. Examine the test piece at once, unless otherwise specified in the material specification. The material specification may permit a lapse of time before examination, which may vary with the alloy being tested. In cases of doubt regarding the presence of cracks, volatilize (with caution) the mercury on the surface of the test piece by the application of heat on a hot-plate or in an oven. Then examine the specimen for cracks under suitable magnifying equipment at a magnification of 10 to 18 X.

WARNING – Mercury is a definite health hazard and therefore equipment for the detection and removal of mercury vapour produced in volatilization is recommended. The use of rubber gloves is advisable.

5.3 A solution the concentration of which is not in accord with that specified in clause 3 must not be used.

6 TEST REQUIREMENTS

The interpretation of the visual appearance of the test pieces after testing is a matter for the material specification.