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Corrosion of metals and alloys —etermination of dezincification resistance of copper alloys with zinc

Corrosion des métaux et alliages — Détermination de la résistance à la dézincification des alliages de cuivre avec le zinc

[Revision of first edition (ISO 6509:1981)]

ICS 77.060

ISO/CEN PARALLEL PROCESSING

This draft has been developed within the International Organization for Standardization (ISO), and processed under the **ISO-lead** mode of collaboration as defined in the Vienna Agreement.

This draft is hereby submitted to the ISO member bodies and to the CEN member bodies for a parallel five-month enquiry.

Should this draft be accepted, a final draft, established on the basis of comments received, will be submitted to a parallel two-month approval vote in ISO and formal vote in CEN.

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6509 was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*, Subcommittee SC , .

This second edition cancels and replaces the first edition (ISO 6509:1981), which has been technically revised.

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Corrosion of metals and alloys — Determination of dezincification resistance of copper alloys with zinc

1 Scope

This International Standard specifies a method for the determination of the dezincification resistance of copper alloys with zinc exposed to fresh, saline waters or drinking water, and calculation of dezincification depth after the test . The method is intended for copper alloys with a mass fraction of zinc more than 15%.

NOTE The method may be used outside its scope for control or research purposes.

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.

ISO 8044 *Corrosion of metals and alloys – Basic terms and definitions*

3 Terms and definitions

For the purposes of this document the terms and definitions are as given in ISO 8044.

4 Principle

Exposure of test specimens to copper (II) chloride solution followed by microscopic examination.

5 Reagents and materials

Use only reagents of recognized analytical grade.

5.1 Copper (II) chloride, mass fraction 1 % solution, freshly prepared.

Dissolve 12,7 g of copper(II) chloride dihydrate ($CuCl_2.2H_20$) in deionized water (5.2) and make up the volume to 1 000 ml.

5.2 Water, deionized with a conductivity not higher than 20 µS/cm at 25 °C ± 2 °C.

5.3 Non-conducting mounting material, such as phenolic resin for embedding the test specimens.

5.4 Appropriate solvent for cleaning the test specimens.

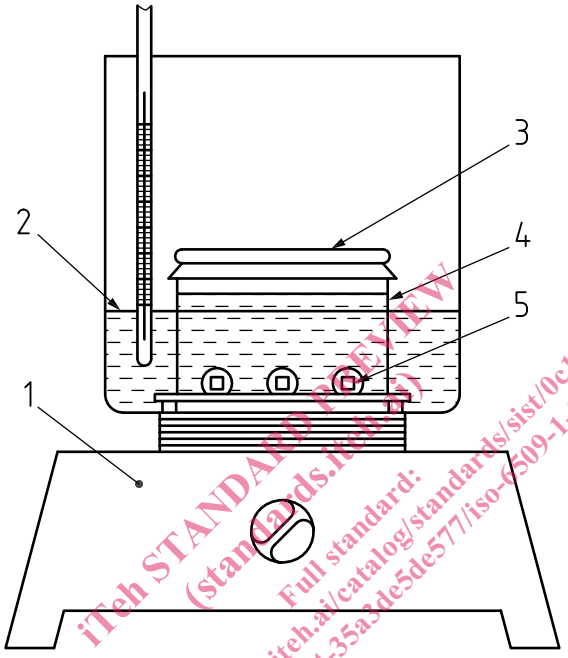
6 Apparatus

(see Figure 1)

6.1 Beaker, of glass, covered with suitable plastic foil, for example polyethylene, secured with elastic thread or another method of sealing using non-metallic material.

6.2 Thermostatically controlled method of maintaining the test temperature at 75 °C ± 5 °C.

6.3 Optical microscope, provided with a scale for measurement.



Key
1 Heating device
2 Water or oil bath
3 Plastic foil secured with elastic thread
4 Beaker containing the copper (II) chloride solution
5 Embedded test specimen

Figure 1 — Example of test apparatus

7 Test specimens

(see Figure 2)

7.1 Unless specified in other product standards, the following method for specimen preparation shall be adopted.

7.2 The test specimens shall be taken, for example by sawing and grinding with light pressure in such a way that the properties of the materials are unaffected.

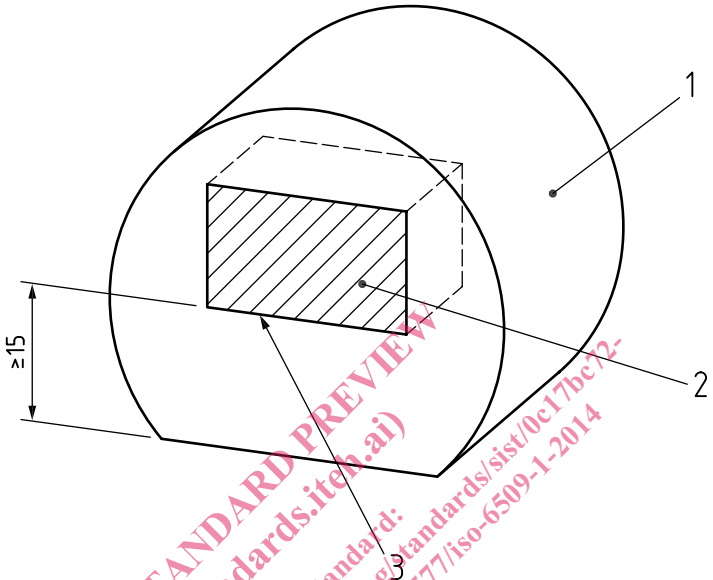
7.3 Not less than two test specimens shall be taken from each copper alloy sample supplied for testing. For forgings and castings, at least one test specimen shall be taken from the area with the thinnest section and at least one from the area with the thickest section.

7.4 In the case of materials with a specific extrusion or rolling direction, for example plates or bars, two specimens shall be taken. One of the specimens shall be taken from the end and the other specimen from

another section of the extruded product. In each specimen surfaces both parallel and perpendicular to the extrusion or rolling direction shall be tested. In addition, in the case of rods, all test specimens, transverse or longitudinal, shall be cut in such a way as to include points midway between the axis and the periphery.

7.5 The area of each test specimen to be exposed shall be approximately 100 mm^2. If the size of the component or the cross-section of the rod to be tested is too small to provide test areas of this size, the largest possible test area shall be taken..

Dimensions are in mm



Key
1 Phenolic resin or equivalent material
2 Ground test surface
3 Test specimen

Figure 2 — Embedded test specimen with one test surface

8 Preparation of test specimens

8.1 The test specimens shall be embedded in the phenolic resin or equivalent material (5.3). The test surfaces to be exposed shall be ground using wet abrasive paper, finishing with 500 grade or finer. (See Figure 2.)

8.2 Prior to testing, the test specimens shall be cleaned to remove any surface contamination. The efficacy of the solvent chosen shall be demonstrated (for example according to ASTM F21 - 65(2007) Standard Test Method for Hydrophobic Surface Films by the Atomizer Test).

9 Procedure

9.1 Positioning of test specimens for test

The test specimens shall be placed in the beaker (6.1) containing the copper (II) chloride solution (5.1) so that the test surfaces are vertical and at least 15 mm above the bottom of the beaker. The plastic foil shall then be placed over the beaker and secured (see Figure 1).

NOTE 250 (+50/ - 10) ml of the copper (II) chloride solution are required per 100 mm^2 of exposed surface of the test pieces.

9.2 Operating conditions

9.2.1 The beaker containing the test specimens shall be placed in the thermostatically controlled environment (6.2), the temperature of which shall be maintained at 75 °C ± 5 °C during the entire exposure period.

9.2.2 Different alloys shall not be tested simultaneously in the same beaker.

9.3 Duration of test

The test specimens shall be exposed continuously for 24 h ± 0,5 h. At the end of this period, they shall be removed from the beaker, washed in water (5.2), rinsed in the ethanol (5.4) and allowed to dry.

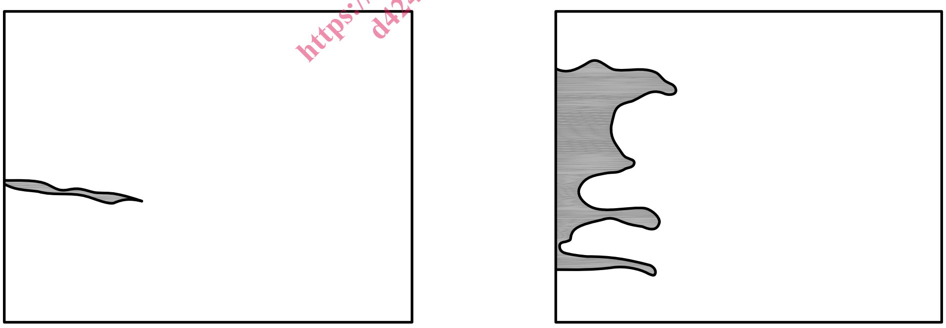
9.4 Preparation of sections for microscopic examination

Microscopic examination of the test specimens shall be carried out as soon as possible after exposure. If the test specimens are stored before microscopic examination, they shall be kept in a desiccator. Each test specimen shall be sectioned at right angles to the exposed test surface. The section shall be ground and polished for microscope examination. The total length of the section through the exposed surface shall be not less than 5 mm. If the dimensions of the test specimen make this impossible, the section shall be taken to provide the maximum possible total length.

9.5 Microscopic examination

9.5.1 The micro-section prepared from each test area shall be examined using an optical microscope provided with a scale for measurement of the dezincification depth (6.3) and the maximum as well as the average depth of dezincification shall be recorded. The appropriate magnification shall be used to provide the greatest accuracy of measurement.

9.5.2 For some purposes, assessment of the characteristics of dezincification distribution, for example whether the depth of the dezincified zone varies greatly (localized dezincification) or is an extended area (layer dezincification) and whether the attack is limited to a single phase in the alloy, measurements of both the average and the maximum depth of dezincification shall be executed. In the case of a few localised dezincification attacks, only the measurement of the maximum depth of attack is required. The importance of measurement of both maximum and average dezincification depth is demonstrated in Figure 3.



Localised dezincification   Layer dezincification

Figure 3 — Cross-sections through two copper alloy specimens with different dezincification resistance

NOTE The dezincification attack has propagated from the left side of both copper alloy specimens. Dark areas represent attacks in most probably the β-phase. Figure 3 demonstrates the importance of measurement of both maximum and average dezincification depth. If only the maximum depth were measured the two specimens would have been judged equally resistant to dezincification.

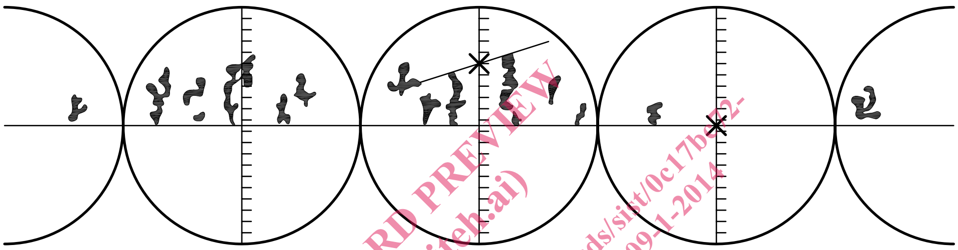
9.5.3 The examined section shall have the maximum possible length. If there is evidence of edge effects, for example a greater depth of dezincification along the line of the interface between the mounting material and

the specime, the maximum depth of dezincification shall be measured at a sufficient distance from the interface to render such edge effects negligible.

9.5.4 Using the measuring scale incorporated in the microscope, measure and record the dezincification depth, i.e. the point of intersection of the scale and the dezincification front (see Figure 4 a), for each contiguous field. If the scale lies between two dezincified areas within the visual field, the dezincification depth shall be recorded as the point of intersection of the scale and an imaginary line joining the extremities of the two dezincification fronts adjacent to the scale (see Figure 4 b). If there is no evidence of dezincification in the field examined, or only one dezincified area which does not intersect the scale, then record the dezincification depth of that field as zero (see Figure 4 c).

NOTE To ensure the best accuracy of measurement, measure the largest number of contiguous fields at the greatest possible magnification.

9.5.5 After measurement of all the contiguous fields along the entire length of the section for evaluation, calculate and report the mean dezincification depth as the sum of the measured depth for every field, divided by the number of contiguous fields examined.



a) b) c)

Figure 4 — Illustration of three consecutive microscope visual fields along a cross section of a tested specimen of copper alloy

NOTE The dezincification attacks (dark areas) have started at the central horizontal line. Measurement for calculation of average dezincification depth are made at the crossing of the black lines in the above figure 4.

10 Assessment criteria

Water composition has a marked effect on initiation and propagation of dezincification. Thus, the likelihood of dezincification will depend on the local source of the water, flow rate and how well the system is managed. In addition, susceptibility will depend on product type. Accordingly, while it is relevant to establish criteria as a basis for assessment of susceptibility it is not possible to convert these to universal acceptance criteria applicable to all water types.

11 Test report

Unless otherwise specified, the test report shall contain the following information for each material or product being tested:

— the type of product, material and manufacturer;

— the number of test specimens, and the total area of exposed test surfaces in square millimetres;

— the length of section examined;

— the magnification employed for microscopic examination;