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

**Part 1:
Test method**

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

Partie 1: Méthode d'essai



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT), see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 156, *Corrosion of metals and alloys*.

This first edition of ISO 6509-1, together with ISO 6509-2, cancels and replaces ISO 6509:1981, which has been technically revised. The clause formerly concerning acceptance limits has been removed since it has been taken up in the new Part 2.

ISO 6509 consists of the following parts, under the general title *Corrosion of metals and alloys — Determination of dezincification resistance of copper alloys with zinc*:

— Part 2: Acceptance criteria¹⁾

1) In preparation.

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

Part 1: Test method

1 Scope

This part of ISO 6509 specifies a method for the determination of dezincification depth of copper alloys with zinc exposed to fresh, saline waters or drinking water. The method is intended for copper alloys with a mass fraction of zinc more than 15 %.

This part of ISO 6509 describes only the test methodology and does not set out criteria for acceptability of materials for a specific application. Acceptance criteria are described in ISO 6509-2.

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 given in ISO 8044 apply.

4 Principle

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

5 Reagents and materials

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

Dissolve 12,7 g of copper(II) chloride dihydrate ($\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$) in deionized water (5.2) and make up the volume to 1 000 ml.

5.2 Water, deionized with a conductivity not higher than $20 \mu\text{S}/\text{cm}$ at $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$.

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

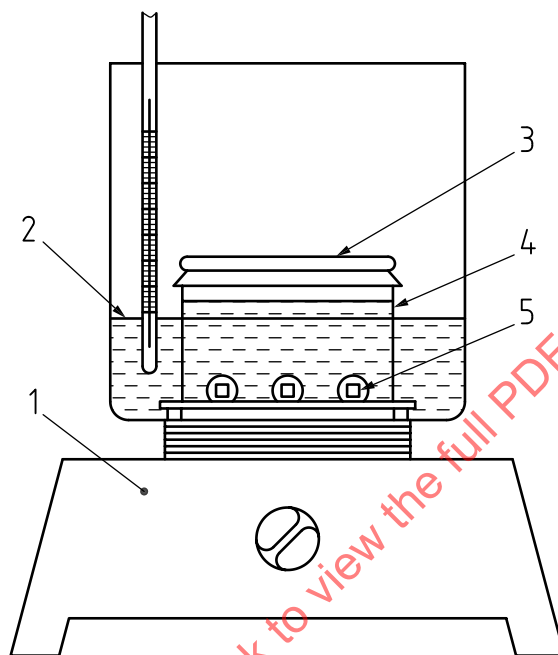
5.4 Appropriate solvent, for cleaning the test specimens.

6 Apparatus

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, capable of maintaining the test temperature at $75\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$. [Figure 1](#) provides an example of a method of heating the test solution.

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

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 with light pressure, in such a way that the properties of the materials are unaffected.

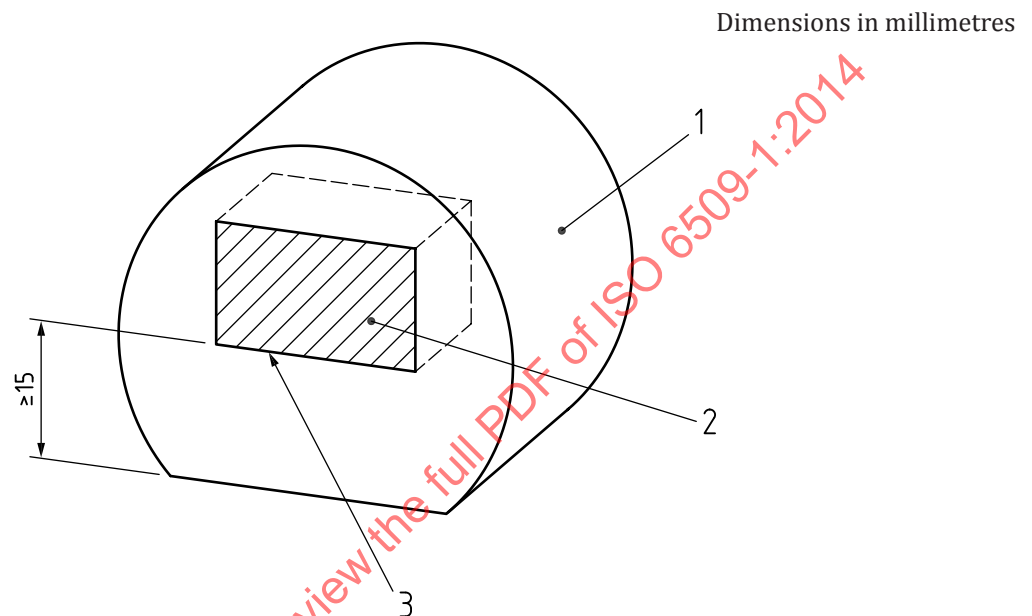
7.3 For forgings and castings, at least one test specimen shall be taken from the region with the thinnest section and at least one from the region with the thickest section.

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 mm². 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.

See [Figure 2](#).



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).

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 ml $^{+50}_{-10}$ ml of the copper (II) chloride solution are required per 100 mm² 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 ± 30 min. At the end of this period, they shall be removed from the beaker, washed in water (5.2), rinsed in an appropriate solvent (5.4) and allowed to dry.

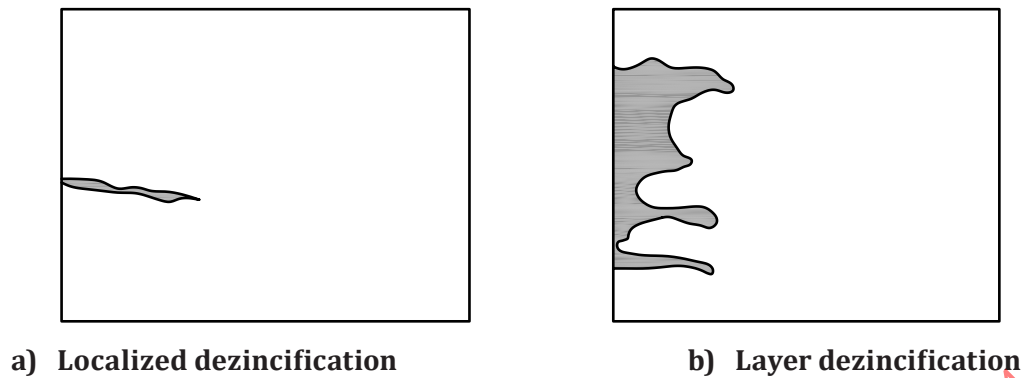
9.4 Preparation of sections for microscopic examination

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 with respect to the final, corroded, surface 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 localized 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.



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. This figure demonstrates the importance of measurement of both maximum and average dezincification depth. If only the maximum depth were measured the difference between the two specimens would not have been apparent.

Figure 3 — Cross-section through two copper alloy specimens with same maximum dezincification depth but different average dezincification depth

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 specimen, 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.

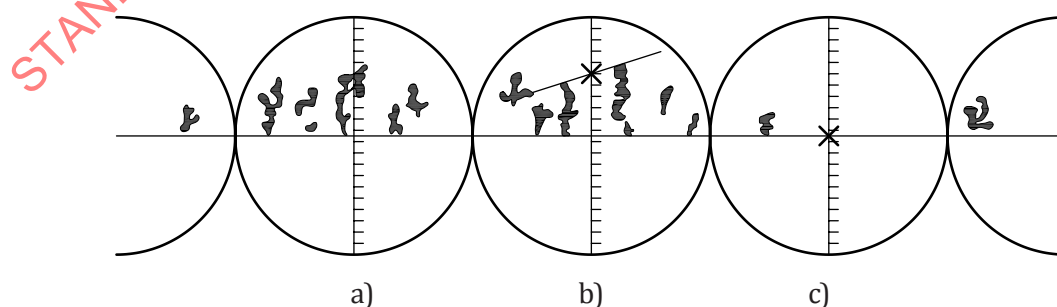


Figure 4 — Illustration of three consecutive microscope visual fields along a cross section of a tested specimen of copper alloy