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Metallic coatings — Test methods for electrodeposited silver and silver alloy coatings — Part 1 : Determination of coating thickness

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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.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 4522/1 was prepared by Technical Committee ISO/TC 107, *Metallic and other non-organic coatings*.

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Metallic coatings — Test methods for electrodeposited silver and silver alloy coatings — Part 1 : Determination of coating thickness

0 Introduction

The methods given in this part of ISO 4522 are considered to have an adequate accuracy when properly used with test specimens suitable for the particular method. If a referee method is required, it shall be agreed between the parties concerned and shall be selected from the methods given in clauses 3 to 9 for local thickness and 10 and 11 for average thickness. The method chosen shall be one which is expected to yield the most reliable results considering such factors as coating thickness, shape of component, size of component, coating material, basis material, etc. Those methods requiring a value for the density of the electrodeposited coating can only be used if the true density of the silver or silver alloy is known.

Other test methods may be used if it can be demonstrated that they have a measurement uncertainty of less than 10 %, or that they are as good as or better than the methods given in this part of ISO 4522 for the particular application.

1 Scope and field of application

This part of ISO 4522 specifies methods for the determination of the thickness of electrodeposited silver and silver alloy coatings for engineering, and decorative and protective purposes.

2 References

ISO 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method.*

ISO 2177, *Metallic coatings — Measurement of coating thickness — Coulometric method by anodic dissolution.*¹⁾

ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method.*

ISO 3497, *Metallic coatings — Measurement of coating thickness — X-ray spectrometric methods.*

ISO 3543, *Metallic and non-metallic coatings — Measurement of thickness — Beta backscatter method.*

ISO 3868, *Metallic and other non-organic coatings — Measurement of coating thickness — Fizeau multiple-beam interferometry method.*

ISO 4518, *Metallic coatings — Measurement of coating thickness — Profilometric method.*

3 Microscopical method

Use the method specified in ISO 1463, paying particular attention to the requirements for overplating and its limitations when measuring thin coatings.

4 Coulometric method

Use the method specified in ISO 2177.

NOTE — Certain addition agents may affect the accuracy of coulometric results.

5 Beta backscatter method

Use the method specified in ISO 3543.

6 Magnetic method

Use the method specified in ISO 2178.

7 X-ray spectrometric method

Use the method specified in ISO 3497.

1) At present at the stage of draft. (Revision of ISO 2177-1972.)

8 Interferometric method

Use the method specified in ISO 3868.

9 Profilometric method

Use the method specified in ISO 4518.

10 Gravimetric method

10.1 Principle

Chemical or electrochemical dissolution of the silver or silver alloy coating (without attacking the substrate) and determination of the mass of the coating. Calculation of the average thickness of the coating from its mass, area and density.

10.2 Stripping solution

Use a solution capable of stripping, either chemically or electrochemically, the silver or silver alloy without attacking the substrate.

NOTE — Silver can be stripped electrolytically from nickel and steel substrates in a solution containing per litre, 90 g of sodium cyanide and 15 g of sodium hydroxide. Carry out the dissolution at room temperature using steel cathodes, maintaining the voltage between 2 and 6 V.

Silver can be stripped from copper or copper alloy substrates by immersion at 65 °C in a solution composed of 19 parts by volume of concentrated sulfuric acid ($\rho = 1,84$ g/ml) and 1 part by volume of concentrated nitric acid ($\rho = 1,42$ g/ml). The parts to be stripped should be thoroughly dry, and water should be kept out of the solution.

Silver can be stripped electrolytically from tin alloys in 30 g/l sodium cyanide solution. Carry out the dissolution at room temperature, using steel cathodes, and maintain the voltage at 4 V.

10.3 Procedure

Thoroughly degrease a sample of known area, rinse and dry, if necessary. Weigh the sample.

Using the stripping solution (10.2) appropriate to the basis metal, completely remove the silver or silver alloy coating. Thoroughly rinse in running water. Dry and reweigh the sample.

10.4 Expression of results

The average coating thickness, d , in micrometres, is given by the equation

$$d = \frac{10 m}{A \rho}$$

where

m is the loss in mass, in milligrams, of the sample;

A is the surface area, in square centimetres, of the coating;

ρ is the density, in grams per cubic centimetre, of the coating (unless the true value is known, a value of 10,6 g/cm³ shall be used).

11 Chemical analysis

11.1 Procedure

Dissolve the silver or silver alloy coating from a sample of known area in a suitable reagent (10.2) and determine the mass of silver in the solution by a suitable analytical method.

11.2 Expression of results

The average coating thickness, d , in micrometres, is given by the equation

$$d = \frac{10^3 m}{A \rho w_{Ag}}$$

where

m is the mass, in milligrams, of the silver;

A is the surface area, in square centimetres, of the coating;

ρ is the density, in grams per cubic centimetre, of the coating;

w_{Ag} is the silver content expressed as a percentage by mass, of the coating.

12 Direct measurement with a micrometer

Coatings thicker than 50 μ m can, if appropriate, be measured directly with a micrometer by measuring the part before and after electroplating.

NOTE — The method is not necessarily valid if two layers of the coating are to be measured and both are included between the platens of the micrometer.

13 Test report

The test report shall include at least the following information :

- a reference to this part of ISO 4522, including an identification of the specific method used;
- the result(s) of the test(s) carried out and the form in which these are expressed;
- any unusual features noticed during the determination;
- any operation not included in this part of ISO 4522 or in the International Standards to which reference is made;
- any other relevant information requested by the purchaser.