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# International Standard



# 4521

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

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## **Metallic coatings — Electrodeposited silver and silver alloy coatings for engineering purposes**

*Revêtements métalliques — Dépôts électrolytiques d'argent et d'alliages d'argent pour applications industrielles*

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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 4521 was prepared by Technical Committee ISO/TC 107, *Metallic and other non-organic coatings*.

# Metallic coatings — Electrodeposited silver and silver alloy coatings for engineering purposes

## 0 Introduction

This International Standard specifies a range of electrodeposited silver and silver alloy coatings for electrical, electronic and other engineering purposes. Within this International Standard, engineering purposes are defined as those for which the coating has to fulfil primarily non-decorative functional tasks, while decorative purposes are defined as those for which the appearance of the finished article is of prime importance. However, protection against corrosion may be a requirement in both cases.

Electrodeposited silver and silver alloy coatings are used in many applications and are chosen for their extremely good electrical conductivity. However, in many conditions of service, sulfide films are liable to form on the coatings, consequently increasing the contact resistance of the silver electroplated mating surface and making them unsuitable for use in low voltage electronic circuits. Nevertheless, because the silver sulfide films are not completely insulating, they are not particularly detrimental to other electrical contacts where higher voltages and/or higher contact pressures are used.

Packaging materials, such as paper and cardboard, frequently contain small amounts of sulfur compounds which can cause excessive tarnishing of silver and silver alloy electrodeposited articles. Cognizance should be taken of this when silver and silver alloy electrodeposited articles are packed, stored and transported, and the packaging materials should be free from significant contamination by sulfur compounds. Anti-tarnish treatments can be applied to the silver and silver alloy coatings to prevent or delay tarnishing (see clause 12), but these treatments increase contact resistance to a greater or lesser extent and so may only prove useful in certain cases.

Attention is drawn to the possibility that

- a) ionic migration of silver will occur in electronic circuits, particularly if the insulating material is damp;
- b) galling (cold welding) will occur when two similar silver surfaces (for example two "bright" or two "dull" coatings) are used in sliding contact.

Attention is also drawn to the expression in certain contexts of silver contents in terms of parts per thousand (by mass), also

known as "thousandths" (*millièmes*) or "fineness". In this International Standard, percentages by mass to one decimal place are used.

## 1 Scope and field of application

This International Standard specifies requirements for electrodeposited coatings of silver and its alloys for electrical, electronic and other engineering applications on metallic and non-metallic materials. Such coatings may or may not be subject to subsequent machining.

It does not apply to coatings on screw threads [see ISO 4042, *Threaded components — Electroplated coatings components* (at present at the stage of draft)] or to coatings on sheet or strip in the unfabricated form.

## 2 References

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

ISO 2064, *Metallic and other non-organic coatings — Definitions and conventions concerning the measurement of thickness*.

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

ISO 4516, *Metallic and related coatings — Vickers and Knoop microhardness tests*.

ISO 4519, *Electrodeposited metallic coatings and related finishes — Sampling procedures for inspection by attributes*.

ISO 4522, *Metallic coatings — Test methods for electrodeposited silver and silver alloy coatings —*

*Part 1 : Determination of coating thickness.*

*Part 2 : Adhesion tests.*

*Part 3 : Residual salts test*.<sup>2)</sup>

ISO 4538, *Metallic coatings — Thioacetamide corrosion test (TAA test)*.

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

2) At present at the stage of draft.

IEC Publication 68-2-20, *Basic environmental testing procedures — Test T : Soldering*.

### 3 Definitions

For the purpose of this International Standard, the definitions of ISO 2064, especially the following, apply.

**significant surface** : The part of the article covered or to be covered by the coating and for which the coating is essential for serviceability and/or appearance.

### 4 Information to be supplied by the purchaser to the electroplater

#### 4.1 Essential information

The following information shall be supplied by the purchaser to the electroplater :

- a) the number of this International Standard (ISO 4521);
- b) the classification number of the coating required (see clause 8 and 11.2);
- c) the significant surface of the article to be electroplated indicated, for example, on drawings or by the provision of suitably marked samples;
- d) the surface appearance (see 11.1);
- e) the method(s) of adhesion testing to be employed (see 11.5);
- f) the sampling procedure to be adopted (see clause 7).

#### 4.2 Additional information

The following additional information may be required and, if so, shall be specified by the purchaser :

- a) the minimum silver content of the coating [see 8 c)] and details of any intentional alloying elements (see 11.4);
- b) the nature of the basis material, its surface condition and roughness (see clause 5);
- c) any requirements for stress relief before electroplating and/or hydrogen embrittlement relief after electroplating (see clause 9);
- d) any special requirements, including the thickness, for undercoats (see clauses 6 and 10);
- e) any requirements for corrosion resistance and/or porosity testing and the methods of test to be used (see 11.3);
- f) the electrical properties of the coating and the methods of test to be used (see 11.6);
- g) the microhardness of the coating and the test method from ISO 4516 to be used (see 11.7);

h) any requirements for anti-tarnish treatment, the type of treatment and methods of test to be applied;

j) requirements for solderability and the method of test to be used (see 11.8);

k) any requirements for freedom from contamination of the finished product (see 11.10).

### 5 Basis material

This International Standard specifies no requirements for the condition, finish or surface roughness of the basis material prior to electroplating. However, it should be recognized that the surface roughness of the coating will be dependent on the initial surface roughness of the basis material and this shall not, therefore, be a cause for rejection of the silver or silver alloy coating.

### 6 Pretreatment

**6.1** Mercury compounds shall not be used in the pretreatment of basis materials.

**6.2** To avoid poor adhesion, it is usual to use a silver strike to prevent the chemical deposition of silver and silver alloys on to the basis material. For electroplating certain alloys, a gold strike may be preferable.

### 7 Sampling

A random sample of the size required by ISO 4519 shall be selected from the inspection lot. The articles in the sample shall be inspected for conformance to the requirements of this International Standard and the lot shall be classified as conforming or not conforming to each requirement according to the criteria of the sampling plans in ISO 4519.

### 8 Classification number

The classification number comprises :

- a) the chemical symbol for the basis metal or for the principal metal, if an alloy, or in the case of non-metallic materials the letters NM followed by an oblique stroke;
- b) if appropriate, the chemical symbol(s) for the undercoat metal(s), as shown by the examples given in table 1, followed by an oblique stroke;
- c) the chemical symbol for silver, Ag, followed if required by a number in parentheses representing the minimum silver content, expressed as a percentage by mass, of the silver coating to one decimal place;
- d) a number indicating the minimum thickness, in micrometres, of the silver or silver alloy coating on the significant surface.