

---

---

**Metallic and other inorganic coatings —  
Electrodeposited silver and silver alloy  
coatings for engineering purposes —  
Specification and test methods**

*Revêtements métalliques et autres revêtements inorganiques — Dépôts  
électrolytiques d'argent et d'alliages d'argent pour applications  
industrielles — Spécifications et méthodes d'essai*



**PDF disclaimer**

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

This document is a preview generated by EVS



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2008

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office  
Case postale 56 • CH-1211 Geneva 20  
Tel. + 41 22 749 01 11  
Fax + 41 22 749 09 47  
E-mail [copyright@iso.org](mailto:copyright@iso.org)  
Web [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

Foreword.....	iv
Introduction .....	v
1 Scope .....	1
2 Normative references .....	1
3 Terms and definitions.....	2
4 Information to be supplied by the purchaser to the electroplater.....	2
4.1 Essential information .....	2
4.2 Additional information.....	3
5 Designation .....	3
5.1 General.....	3
5.2 Designation specifications.....	4
5.3 Designation of the basis material .....	4
5.4 Designation of heat treatment requirements .....	4
5.5 Examples of designations .....	5
6 Requirements .....	5
6.1 General.....	5
6.2 Appearance .....	5
6.3 Thickness .....	6
6.4 Porosity.....	6
6.5 Accelerated corrosion testing .....	6
6.6 Composition .....	6
6.7 Stress-relief heat treatment prior to electroplating.....	6
6.8 Hydrogen-embrittlement-relief heat treatment after electroplating.....	6
6.9 Adhesion.....	7
6.10 Electrical properties .....	7
6.11 Microhardness .....	7
6.12 Solderability .....	7
6.13 Wear resistance .....	7
6.14 Ductility.....	7
6.15 Undercoats .....	7
6.16 Freedom from contamination .....	8
6.17 Anti-tarnish treatments .....	8
7 Sampling.....	8
Annex A (normative) Requirements for undercoats.....	9
Annex B (normative) Methods of measuring the thickness of electroplated silver and silver alloy coatings .....	11
Annex C (normative) Adhesion tests .....	15
Annex D (normative) Determination of the presence of residual salts .....	17
Bibliography .....	19

## 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 4521 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 3, *Electrodeposited coatings and related finishes*.

This second edition cancels and replaces the first edition (ISO 4521:1985), and also ISO 4522-1:1985, ISO 4522-2:1985 and ISO 4522-3:1988, which have been technically revised.

## Introduction

Electrodeposited silver and silver alloy coatings are often specified for their extremely good electrical conductivity, but corrosion protection is often an additional requirement for electrical, electronic and other applications. In many conditions of service, sulfide films may form on the coatings, increasing the contact resistance at the silver electroplated mating surface and making them unsuitable for use in low-voltage electronic circuits. Sulfide films are not especially detrimental to other electronic applications where higher voltage and higher contact pressures are used, because the films are not completely insulating.

Because the appearance and serviceability of electroplated silver coatings depend on the condition of the basis material, agreement should be reached between interested parties that the surface finish and roughness of the basis material are satisfactory for electroplating.

Electroplated silver coatings have been used as bearing surfaces for many decades and are particularly useful where the load-bearing surfaces are not well lubricated.

Electroplated silver coatings have largely replaced electroplated gold coatings on metallic lead frames, the devices that support the majority of silicon chips.

This document is a preview generated by EVS

# Metallic and other inorganic coatings — Electrodeposited silver and silver alloy coatings for engineering purposes — Specification and test methods

**WARNING** — This International Standard may not be compliant with some countries' health and safety legislations and calls for the use of substances and/or procedures that may be injurious to health if adequate safety measures are not taken. This International Standard does not address any health hazards, safety or environmental matters and legislations associated with its use. It is the responsibility of the user of this International Standard to establish appropriate health, safety and environmentally acceptable practices, and take suitable actions to comply with any national and international regulations. Compliance with this International Standard does not, in itself, confer immunity from legal obligations.

## 1 Scope

This International Standard specifies requirements for electroplated silver and silver alloy coatings for electrical, electronic and other engineering applications, including test methods. Engineering applications are defined as those in which the coating essentially serves a non-decorative purpose.

Although this International Standard does not specify the condition, finish or surface roughness of the basis material prior to electroplating, the appearance and serviceability of electroplated silver and silver alloy coatings depend on the condition of the basis material. It is essential that the purchaser specifies the surface finish and roughness of the basis material in order to conform to the product requirements.

This International Standard does not apply to coatings on screw threads or to coatings on sheet, strip or wire in the non-fabricated form.

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

ISO 2064, *Metallic and other inorganic coatings — Definitions and conventions concerning the measurement of thickness*

ISO 2080, *Metallic and other inorganic coatings — Surface treatment, metallic and other inorganic coatings — Vocabulary*

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

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 thicknesses — Fizeau multiple-beam interferometry method*

ISO 4516, *Metallic and other inorganic coatings — Vickers and Knoop microhardness tests*

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

ISO 4519:1980, *Electrodeposited metallic coatings and related finishes — Sampling procedures for inspection by attributes*

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

ISO 9587, *Metallic and other inorganic coatings — Pretreatment of iron or steel to reduce the risk of hydrogen embrittlement*

ISO 9588, *Metallic and other inorganic coatings — Post-coating treatments of iron and steel to reduce the risk of hydrogen embrittlement*

ISO 10111, *Metallic and other inorganic coatings — Measurement of mass per unit area — Review of gravimetric and chemical analysis methods*

ISO 10289, *Methods for corrosion testing of metallic and other inorganic coatings on metallic substrates — Rating of test specimens and manufactured articles subjected to corrosion tests*

ISO 10308, *Metallic coatings — Review of porosity tests*

ISO 10587, *Metallic and other inorganic coatings — Test for residual embrittlement in both metallic-coated and uncoated externally-threaded articles and rods — Inclined wedge method*

ISO 12687, *Metallic coatings — Porosity tests — Humid sulfur (powers of sulfur) test*

ISO 14647, *Metallic coatings — Determination of porosity in gold coatings on metal substrates — Nitric acid vapour test*

ISO 15724, *Metallic and other inorganic coatings — Electrochemical measurement of diffusible hydrogen in steels — Barnacle electrode method*

IEC 60068-2-20, *Basic environmental testing procedures — Part 2: Tests. Test T: Soldering*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 2064 and ISO 2080 apply.

### 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 in writing, for example, in the purchase order or contract, or on engineering drawings:

- a) the number of this International Standard (ISO 4521) and the designation (see Clause 5);
- b) the significant surface indicated, for example, on drawings or by the provision of suitably marked samples;