
**Metallic and other inorganic coatings —
Electrodeposited zinc alloys with nickel,
cobalt or iron**

*Revêtements métalliques et autres revêtements inorganiques — Dépôts
électrolytiques d'alliages de zinc au nickel, cobalt ou fer*

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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
Web www.iso.org

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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 15726 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 3, *Electrodeposited coatings and related finishes*.

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Introduction

Electrodeposited zinc alloy coatings containing nickel, cobalt or iron are significantly more corrosion-resistant than electrodeposited zinc coatings of equivalent thickness. The alloy coatings are anodic to steel, but less so than pure zinc. Although originally developed for the continuous coating of steel for the fabrication of automobile body panels, zinc alloy electroplating processes have become available that are suitable for the rack and barrel electroplating of individual components.

In the case of zinc-nickel alloys, proprietary acid and alkaline electroplating processes exist that yield deposits with controlled nickel contents. Zinc-nickel coatings containing either 8 % or 12 % nickel are most widely used, and are often considered possible substitutes for cadmium coatings. Zinc-nickel alloy coatings can reportedly be applied by brush electroplating techniques.

The alloy coatings are often used in combination with chromate conversion coatings, organic sealants and other supplementary treatments to further enhance corrosion resistance, and often serve as the base for applying organic coatings. Chromate conversion coatings formulated specifically for use with zinc-cobalt and zinc-nickel alloy coatings are available for producing yellow- to bronze-coloured surfaces.

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Metallic and other inorganic coatings — Electrodeposited zinc alloys with nickel, cobalt or iron

WARNING — This International Standard may not be compliant with some countries' health and safety legislation, 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 legislation 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 of itself confer immunity from legal obligations.

1 Scope

This International Standard covers the requirements for electrodeposited zinc alloy coatings containing either nickel, cobalt or iron. It provides a method of designating the electrodeposited coatings, chromate conversion coatings and other supplementary treatments.

2 Normative references (standards.iteh.ai)

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 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 2819, *Metallic coatings on metallic substrates — Electrodeposited and chemically deposited coatings — Review of methods available for testing adhesion*

ISO 3882, *Metallic and other inorganic coatings — Review of methods of measurement of thickness*

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

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

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 or steel to reduce the risk of hydrogen embrittlement*

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

ISO 10309, *Metallic coatings — Porosity tests — Ferroxy test*

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) — Apparatus*

3 Terms and definitions

For the purpose of this document, the terms and definitions in ISO 2064, ISO 2080, ISO 9587 and ISO 9588 apply.

4 Information to be supplied by the purchaser to the electroplater

4.1 Essential information

When ordering articles to be electroplated in accordance with this International Standard, the purchaser shall provide the following information in writing, for example in the contract or purchase order, or on engineering drawings:

- a) the number of this International Standard (ISO 15726) and the article designation (see Clause 5);
- b) the significant surface to be electroplated, as indicated, for example, by drawings or by the provision of suitably marked samples and of any surfaces that are not to be electroplated;
- c) the nature, condition and finish of the basis metal if they are likely to affect the serviceability and/or appearance of the coating;
- d) position, type, dimensions and number of unavoidable defects on the surface, such as rack marks, that can be tolerated (see 6.1);
- e) appearance of the zinc alloy coating, for example as deposited or with a chemical conversion coating and/or other supplementary treatment (see Clause 5 and 6.1);

Alternatively, samples showing the appearance shall be supplied or approved by the purchaser and used for comparison purposes (see 6.1).

- f) type of chromate conversion coating or supplementary treatment (see 5.6 and Annex B);

Chromate conversion coatings shall only be omitted, and alternative conversion coatings and/or other supplementary treatments (see Table 3) or conformal coatings, such as lacquers, applied over the chromate coating, at the specific request of the purchaser.

- g) requirements for minimum thickness, additional portions of surfaces where the minimum thickness requirements apply, adhesion test and corrosion testing and its performance rating (see 6.2, 6.3, 6.6 and Annex B);
- h) the tensile strength of the parts and the requirements for stress- and embrittlement-relief heat treatments before and/or after electrodeposition (see 6.7 and 6.8);
- i) method of porosity testing (see Annex A), and the number and location of acceptable pores (see 6.4);
- j) sampling methods, acceptance levels or any other inspection requirements, if different from those given (see Clause 7);
- k) any other relevant information.

4.2 Additional information

The following additional information, as relevant, shall also be provided:

- a) any cleaning precautions to be followed (see Note in 6.1);
- b) any special pre- and/or post-plating treatments (see Note in 6.1).

5 Designation

5.1 General

The article designation shall appear on engineering drawings, in the purchase order, in the contract or in the detailed product specification. The designation specifies the basis material, the requirements for stress relief before electroplating, the nominal composition and thickness of the zinc alloy coating, the type of chromate or other conversion coatings and other supplementary treatments, and the type of heat treatment to reduce susceptibility to hydrogen embrittlement.

5.2 Designation specification

The designation shall comprise the following, in the order given:

- a) the term "Electrodeposited coating";
- b) the number of this International Standard, ISO 15726;
- c) a hyphen;
- d) the chemical symbol of the basis metal;
- e) a solidus (/);
- f) if relevant, any SR designation (see 5.4);
- g) the chemical symbol for the metal or alloy or coating, its composition in parentheses, and its thickness, in micrometres (see 5.5), separated by solidi (/) for each stage in the coating sequence in the order of application, if more than one;
- h) a solidus (/);
- i) if appropriate, codes indicating the type of any supplementary coating (see 5.6), followed by a solidus (/);
- j) if appropriate, codes designating any supplementary treatments (see 5.6);
- k) ER designation (see 5.7).

5.3 Basis metal

The basis metal shall be designated by its chemical symbol, or its principal constituent, if an alloy. For example: Fe for iron and steel; Zn for zinc alloys; Cu for copper and copper alloys; and Al for aluminium and aluminium alloys.

The specific alloy may be identified by its standard designation (for example its UNS number or its national or regional equivalent) placed between the symbols < >, for example Fe<G434000> (see Reference [19]).

NOTE Electrodeposited zinc alloys with nickel, cobalt or iron are most often applied to steel, but can be electrodeposited on other basis metals.

5.4 Stress-relief heat treatment prior to electroplating

Stress-relief heat treatment prior to coating may be required for some basis materials. Brackets shall be placed around the letters SR, the temperature, in Celsius, and the time, in hours. The temperature shall be in parentheses after the letters SR; for example [SR(210)1].

5.5 Type and thickness of zinc alloy coating

The electrodeposited zinc alloy coating shall be designated by the chemical symbols given in Table 1 followed by a number in parentheses giving the composition of the alloy coating within 0,5 % mass fraction (*w*), followed by a number giving the minimum local thickness of the coating, in micrometres. For example, ZnNi(12)5 designates a zinc alloy coating containing 12 % nickel that is 5 µm thick.

Table 2 gives typical thickness values specified for zinc alloy coatings deposited on steel, as guidance.

Table 1 — Symbols for electrodeposited zinc alloys with nickel, cobalt or iron

Type of alloy coating	Symbol	Typical composition <i>w</i> %	Composition range <i>w</i> %
Zinc-nickel	ZnNi	12 nickel, balance zinc 8 nickel, balance zinc	6 to 18 nickel, balance zinc
Zinc-cobalt	ZnCo	1,0 cobalt, balance zinc	0,3 to 1,2 cobalt, balance zinc
Zinc-iron	ZnFe	0,5 iron, balance zinc	0,3 to 1,0 iron, balance zinc

Table 2 — Typical minimum local thickness of zinc alloy coatings on steel

Thickness µm		
ZnNi	ZnCo	ZnFe
5	6	6
8	12	12
10	18	18

NOTE Proprietary acid and alkaline processes exist from which zinc-nickel alloy coatings containing 8 % and 12 % mass fraction nickel can be electrodeposited. Suppliers of proprietary processes provide information on how to control the nickel content of the coating [see 4.1 k)].

5.6 Chromate conversion coatings and other supplementary treatments

The type of chromate conversion coating (see ISO 4520) and other supplementary treatments shall be designated by the symbols given in Table 3.

Chemical conversion coatings that do not contain hexavalent chromium, such as trivalent chromium, or are chromium-free are commercially available. All forms of chromate conversion coatings, alternative conversion coatings or substitutes, with the exception of phosphate coatings, that may be used shall meet the corrosion requirements given in this International Standard. Conversion coatings containing trivalent chromium are available for all codes. However, the surface appearance of these substitutes may be different from those produced with hexavalent chromium-conversion coatings. The tables in this International Standard reflect the requirements and products that have been used and accepted universally in practice over several decades by producers, purchasers and users in the metal finishing industry [see 4.1 f)].

Table 3 — Symbols for chromate conversion coatings and other supplementary treatments

Symbol	Description
A	Clear or transparent (blue-bright)
C	Iridescent yellow
F	Black
T2	Organic sealants applied over A, C or F

NOTE Chromate conversion coatings specifically formulated for use with zinc-cobalt and zinc-nickel alloy coatings have been developed to achieve yellow- to bronze-coloured surface finishes.

5.7 Hydrogen-embrittlement-relief heat treatment after electroplating

Heat treatment requirements, after electroplating, to reduce the susceptibility of high-strength steels to hydrogen embrittlement may be required in certain applications. Brackets shall be placed around the letters ER, the temperature, in Celsius, and the time, in hours. The temperature shall be in parentheses after the letters ER; for example [ER(200)12].

When heat treatment for stress-relief or hydrogen-embrittlement-relief purposes is specified, the requirements shall appear in the designation as shown in Example 3 in 5.8.

5.8 Examples of coating designations

EXAMPLE 1 A coating 8 µm thick containing 10 % nickel, balance zinc, on steel (Fe), with a supplementary chromate conversion coating that is iridescent yellow (C) has the following designation:

Electrodeposited coating ISO 15726 - Fe/ZnNi(10)8/C

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EXAMPLE 2 A coating 5 µm thick containing 8 % nickel, balance zinc, on steel, with a supplementary chromate conversion coating that is colourless (blue bright) and that has received a subsequent organic sealant has the following designation:

Electrodeposited coating ISO 15726 - Fe/ZnNi(8)5/A/T2

EXAMPLE 3 A coating on high-strength steel that is stress-relieved at 190 °C for 1 h before electroplating with a coating 5 µm thick containing 1,0 % cobalt, balance zinc, with a supplementary chromate conversion coating that is black (F), and that is heat-treated at 200 °C for 6 h after coating to minimize the risk of hydrogen embrittlement has the following designation:

Electrodeposited coating ISO 15726 - Fe/[SR(190)1]/ZnCo(1)5/F/[ER(200)6]

6 Requirements

6.1 Appearance

The coating on the significant surfaces of the product shall be smooth and free of visual defects such as blisters, pits, roughness, cracks, flaking, burned deposits, and non-coated areas. The boundaries of electroplating that cover only a portion of the surface shall, after finishing as indicated in the drawings, be free of beads, nodules, jagged edges and other detrimental irregularities. Imperfections and surface conditions of the basis metal (scratches, pores, roll marks, inclusions) that persist in the finish despite the observance of good metal finishing practices shall not be cause for rejection.

Approved samples of artefacts shall be used for comparison purposes to control the final appearance of the coating [see 4.1 c)].