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**Metallic and other inorganic coatings —  
Electroplated coatings of cadmium with  
supplementary treatments on iron or  
steel**

*Revêtements métalliques et autres revêtements inorganiques — Dépôts  
électrolytiques de cadmium avec traitements supplémentaires sur fer ou*

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Published in Switzerland

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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 2082 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 3, *Electrodeposited coatings and related finishes*.

This third edition cancels and replaces the second edition (ISO 2082:1986), which has been technically revised.

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## Introduction

Electrodeposits of cadmium are used to protect iron and steel from corrosion. Cadmium is anodic and corrodes sacrificially, thus protecting ferrous basis metals even when exposed through pores or pits in the cadmium. Electrodeposited cadmium coatings have traditionally been applied to iron or steel from alkaline cyanide solutions, but in recent years, environmental concerns and regulations have led to increased use of acid sulphate, neutral chloride and acid fluoborate cadmium solutions.

Because the appearance and serviceability of electroplated cadmium coatings are influenced by the surface condition of the basis metal, agreement should be reached between the interested parties that the surface of the basis metal is satisfactory for electroplating.

Cadmium is highly toxic and health, safety and environmental concerns are eliminating its non-essential uses. There remain, nevertheless, critical applications, often aerospace-related, where the unique properties of electrodeposited cadmium coatings, for example, their corrosion resistance, intrinsic lubricity, ductility, electrical conductivity and low contact resistance, make continued use of cadmium coatings necessary.

The corrosion resistance of electroplated cadmium coatings and their tendency to tarnish when handled can be improved by applying chromate conversion and other supplementary coatings.

Chemical conversion coatings that do not contain hexavalent chromium are commercially available and their use is becoming more and more popular. The appearance of these substitutes may be different from those produced with hexavalent chromium. Other conversion coatings that are chromium-free are also available. Substitutes are required to satisfy the corrosion requirements given in this International Standard.

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# Metallic and other inorganic coatings — Electroplated coatings of cadmium with supplementary treatments on iron or steel

**DANGER** — Cadmium vapour is highly toxic by inhalation. During heat treatment, all precautions should be taken to ensure that no person is exposed to it. Attention is also drawn to the danger arising from welding, soldering or heating and other operations, in which the possibility that cadmium will be vaporised exists. Because of its toxicity, cadmium should not be employed as a coating for any article that will come in contact with food or beverages or containers in contact with these items or any household goods.

**WARNING** — This International Standard may not be compliant with some countries' health, safety and environmental 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 producers, purchasers and/or user of this International Standard to establish appropriate health, safety and environmentally acceptable practices and take appropriate actions to comply with any national, regional and/or international rules and regulations. Compliance with this International Standard does not, of itself, confer immunity from legal obligations.

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## 1 Scope

This International Standard specifies the requirements of electroplated coatings of cadmium with supplementary treatments on iron and steel. It includes information that is to be supplied by the purchaser to the electroplater, and describes coating requirements, including those for heat treatment before and after electroplating.

It is not applicable to coatings applied

- to sheet, strip or wire in the non-fabricated form,
- to close-coiled springs, or
- for purposes other than protective, intrinsic lubricity, ductility, electrical conductivity and low contact resistance use.

This International Standard does not specify requirements for the surface condition of the basis metal prior to electrodeposition with cadmium.

The coating thickness that can be applied to threaded components can be limited by dimensional requirements, including class or fit.

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

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 3613, *Chromate conversion coatings on zinc, cadmium, aluminium-zinc alloys and zinc-aluminium alloys — Test methods*

ISO 3892, *Conversion coatings on metallic materials — Determination of coating mass per unit area — Gravimetric methods*

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

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



### 3 Terms, definitions, abbreviated terms and symbols

#### 3.1 Terms and definitions

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

#### 3.2 Abbreviated terms

C	iridescent conversion coating
D	opaque chromate conversion coating
ER	hydrogen-embrittlement-relief heat treatment
NM	non-metallic materials
PL	plateable plastics materials
SR	stress relief heat treatment
T2	organic sealant

#### 3.3 Symbols

Cd	chemical symbol for cadmium
Fe	chemical symbol for iron

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

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#### 4.1 Essential information

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The following information shall be supplied to the electroplater in writing, for example, in the contract or purchase order or on engineering drawings:

- a) the reference to this International Standard, ISO 2082, and the designation (see Clause 5);
- b) the significant surface indicated, for example, by drawings or by the provision of suitably marked samples;
- c) the nature, condition and finish of the basis metal if they are likely to affect the serviceability and/or the appearance of the coating (see Clause 1);
- d) the position on the surface for unavoidable defects, such as rack marks (see 6.1);
- e) the finish required, for example, bright, dull or other finish, preferably accompanied by approved samples of the finish (see 6.1);
- f) the type of chromate conversion coating or supplementary treatment (see 6.3 and Annex A); chromate conversion coatings shall only be omitted, and alternative conversion coatings and/or other supplementary treatments (see Table A.2) or conformal coatings, such as lacquers, applied over the chromate coating, at the specific request of the purchaser;
- g) the requirements for thickness, adhesion and accelerated corrosion test requirements (see 6.2, 6.4, 6.5 and Annex B);
- h) the tensile strength of parts and the requirements for heat treatment before and/or after electrodeposition (see 6.6 and 6.7);
- i) sampling methods, acceptance levels or any other inspection requirements if inspection is different from that given in ISO 4519 (see Clause 7).

## 4.2 Additional information

The following additional information shall also be supplied to the electroplater:

- a) any special requirements for, or restrictions on, preparation of the article to be coated (see Bibliography);
- b) any other requirements, such as for articles of complex shape, an area for testing and rating.

## 5 Designation

### 5.1 General

The designation shall appear on engineering drawings, in the purchase order, in the contract or in the detailed product specification. The designation specifies, in the following order, the basis metal, stress relief requirements, the type and thickness of undercoats, if present, the thickness of the cadmium coating, heat treatment requirements after electroplating, and the type of conversion coating and/or supplementary treatment (see Bibliography).

### 5.2 Designation specification

The designation shall comprise the following:

- a) the term "Electrodeposited coating";
- b) the reference to this International Standard, ISO 2082;
- c) a hyphen;
- d) the chemical symbol of the basis material, Fe (iron or steel) followed by its standard designation;
- e) a solidus (/);
- f) the SR designation, if necessary, followed by a solidus;
- g) the chemical symbol for cadmium, "Cd";
- h) a number indicating the minimum local thickness, in micrometres, of the cadmium coating followed by a solidus;
- i) the ER designation, if necessary, followed by a solidus;
- j) if appropriate, codes indicating the type of chromate conversion coating (see Annex A), followed by a solidus;
- k) if appropriate, codes designating any supplementary treatments (see Annex A).

Solidi (/) shall be used to separate data fields in the designation corresponding to the different sequential processing steps. Double separators or solidi indicate that a step in the process is either not required or has been omitted (see ISO 27830).

If other supplementary treatments other than or in addition to chromate conversion coating are used, the designation for a coating thickness of 25 µm of cadmium shall be

Fe/Cd25/X/Y

where

X represents one of the chromate conversion coating codes given in Table A.1;

Y represents one of the codes for other supplementary coatings given in Table A.2.

### 5.3 Designation of heat treatment requirements

The heat treatment requirements shall be designated as follows:

- the letters SR for stress relief heat treatment prior to electroplating, and/or the letters ER for hydrogen-embrittlement-relief heat treatment after electroplating;
- in parentheses, the minimum temperature, expressed in degrees Celsius (°C);
- the duration, expressed in hours (h), of the heat treatment.

For example, SR(210)1 designates stress relief heat treatment at 210 °C for 1 h.

### 5.4 Examples

The following are examples of coating designations.

EXAMPLE 1 Designation of an electrodeposited coating of 12 µm cadmium (Cd12) on iron or steel (Fe) which has had an iridescent conversion coating (C) applied:

Electrodeposited coating ISO 2082 – Fe/Cd12/C  
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EXAMPLE 2 Designation of an electrodeposited coating of 25 µm cadmium (Cd25) on iron or steel (Fe) which is to be heat-treated after electroplating for hydrogen embrittlement relief for 8 h at 190 °C, designated as ER(190)8, and has been given a supplementary opaque chromate conversion coating (D) followed by a sealing treatment consisting of the application of an organic sealant (T2):

Electrodeposited coating ISO 2082 – Fe/Cd25/ER(190)8/D/T2

EXAMPLE 3 Same as Example 2, but in addition the articles are heat-treated prior to electroplating for stress relief purposes at 200 °C for a minimum of 3 h, designated as SR(200)3:

Electrodeposited coating ISO 2082 – Fe/SR(200)3/Cd25/ER(190)8/D/T2

## 6 Requirements

### 6.1 Appearance

Although this International Standard does not specify the condition, finish or surface roughness of the basis material prior to electroplating, the appearance of electroplated coatings depends on the condition of the basis material (see the Bibliography for surface preparation). The electroplated article on its significant surface shall be free from clearly visible plating defects such as blisters, pits, roughness, cracks or non-plated areas other than those arising from defects in the basis metal. On articles where a contact mark is unavoidable, its position shall be the subject of agreement between the interested parties (see 4.1). The articles shall be clean and free from damage.

Unless the purchaser specifies otherwise, the cadmium coating shall be bright. If necessary, a sample showing the required finish shall be supplied or approved by the purchaser [see 4.1 e)].