
Aerospace series - Cadmium plating of steels with specified tensile strength \leq 1450 MPa, copper, copper alloys and nickel alloys

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Luft- und Raumfahrt - Verkadmen von Stählen mit einer Zugfestigkeit \leq 1 450 MPa, von Kupfer, von Kupferlegierungen und von Nickellegierungen

Série aérospatiale - Cadmiage électrolytique des aciers de résistance \leq 1 450 MPa, du cuivre, des alliages de cuivre et des alliages de nickel

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ICS:

49.040	Prevlake in z njimi povezani postopki, ki se uporabljajo v letalski in vesoljski industriji	Coatings and related processes used in aerospace industry
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EUROPEAN STANDARD
 NORME EUROPÉENNE
 EUROPÄISCHE NORM

EN 2133

November 1997

ICS 49.040.00

Descriptors: aircraft industry, steels, tensile strength, copper, copper alloys, nickel alloys, corrosion prevention, electrodeposited coatings, cadmium, thickness, characteristics, tests, quality assurance, designation

English version

Aerospace series - Cadmium plating of steels with specified
 tensile strength $\leq 1\,450$ MPa, copper, copper alloys and nickel
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 Zugfestigkeit $\leq 1\,450$ MPa, von Kupfer, von
 Kupferlegierungen und von Nicklegierungen

This European Standard was approved by CEN on 22 June 1997.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
 COMITÉ EUROPÉEN DE NORMALISATION
 EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

1 Scope

This standard specifies the electrolytic cadmium plating of parts in steels of tensile strength R_m (max.) $\leq 1\ 450$ MPa, copper, copper alloys and nickel alloys, the temperature in service of which does not exceed 235 °C.

This standard is applicable whenever referenced.

2 Normative references

This European Standard incorporates by dated or undated reference provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 1463	Metallic and oxide coatings - Measurement of coating thickness - Microscopical method
ISO 2082	Metallic coatings - Electroplated coatings of cadmium on iron or steel
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 2859-1	Sampling procedures for inspection by attributes - Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection
ISO 4520	Chromate conversion coatings on electroplated zinc and cadmium coatings
ISO 9227	Corrosion tests in artificial atmospheres - Salt spray tests
EN 2000	Aerospace series - Quality assurance - EN aerospace products - Approval of the quality system of manufacturers
EN 2828	Aerospace series - Adhesion test for metallic coatings by burnishing
EN 2831	Aerospace series - Hydrogen embrittlement of steels - Test by slow bending
EN 2832	Aerospace series - Hydrogen embrittlement of steels - Notched specimen test

3 Purpose of process

To ensure protection against corrosion or to reduce the effects of the galvanic coupling when assembling different materials, e.g. steel, aluminium or magnesium

4 Limitations of process use

The contact of cadmium-plated parts with titanium, titanium alloys, fuels and fuel lines:

- is to be avoided at temperatures < 150 °C;
- is prohibited at temperatures ≥ 150 °C.

5 Definitions

For the purposes of this standard, the following definitions apply:

5.1 Batch: unless otherwise specified, it comprises parts of the same nature (form, size, material), treated at the same time in the same bath.

5.2 Pre-production parts: parts representing future production

6 Thickness

Unless otherwise specified in the product standard or definition document, the thicknesses are:

- Class A: 10 μm to 20 μm ;
- Class B: 5 μm to 14 μm ;
- Class C: 5 μm to 10 μm .

NOTE: These thicknesses are those of the cadmium coating alone; the nickel strike thicknesses are considered negligible.

7 Symbols

R_m (max.): maximum specified tensile strength

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8 Information for the processor

- Designation, see 17;
- number of the substrate standard and metallurgical condition of the substrate;
- areas to be coated;
- thickness measuring points;
- time and temperature of heat treatment before and after processing;
- electrical contact points or areas where these are prohibited;
- requirements for finishing operations other than chromating, e.g. phosphating, etc. (see 11.2).

9 Condition of parts prior to processing

Welding, brazing, mechanical operations and heat treatments shall be completed.

Unless otherwise specified, the stress relief heat treatment conditions for parts in steel shall conform to table 1.

Table 1

R_m (max.) MPa	Stress relieving	
$\leq 1\ 100$	Not necessary	
$> 1\ 100$ and $\leq 1\ 450$	190 °C to 230 °C	min. 1 h
Carburized parts	130 °C to 150 °C	min. 6 h

A slight coloration by superficial oxidation is permitted.

When shot peening is specified, it shall be performed after the stress relief operations.

10 Process schedule

Unless otherwise specified, see annex A.

10.1 Surface preparation

See annex B.

10.2 Nickel strike

Applicable to corrosion resisting steels, copper and copper alloys, nickel and nickel alloys

See annex C.

10.3 Cadmium plating

See annex D.

11 Post-treatment

11.1 De-embrittlement

It shall be carried out within 4 h after cadmium plating, according to table 2.

Table 2

Substrate	Temperature ¹⁾ °C	Time min. ¹⁾ h
Steels $100 \text{ MPa} < R_m \text{ (max.)} \leq 1450 \text{ MPa}$	190 to 230	8
Carburized parts	130 to 150	8
Other materials	Not required	

1) Other conditions may be used after agreement between the processor and the purchaser.

11.2 Chromating

Unless otherwise specified, chromating shall be applied.

It shall be carried out after de-embrittlement, in accordance with ISO 4520, type B (yellow), class 2C.

12 Removal of the plating

The solution used shall not attack the base metal.

EXAMPLE: Immersion of parts in a solution of ammonium nitrate (e.g. 100 g/l to 300 g/l at ambient temperature for approx. 10 min).

After removal of the plating, parts shall be de-embrittled in accordance with table 2.

13 Required characteristics

13.1 Appearance

The surface shall be satin, uniform and free from:

- rough, burnt or powdery areas;
- pits;
- exfoliations;
- blisters.

In the case of chromate coating, the surface shall be of an iridescent, gold or brass colour.

13.2 Adhesion

See 14.1.2.

13.3 Thickness

See 6.

13.4 Composition of the plating

Unless otherwise specified, it shall contain at least 99,9 % cadmium and less than 0,004 % mercury.

13.5 Hydrogen embrittlement of steels

Unless otherwise specified, these tests are applicable to steels with a tensile strength of $R_m \geq 1\ 100$ MPa.

- No rupture within 200 h (for EN 2832)
- or
- final ductility ≥ 94 % of the initial ductility (for EN 2831).

13.6 Corrosion resistance

After exposure to salt spray:

- for chromated cadmium-plated parts, white cadmium salts shall not appear within 96 h and corrosion of the substrate not within 336 h,
- for non-chromated cadmium-plated parts, corrosion shall not appear within 240 h.

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14 Test methods

14.1 For process approval

14.1.1 Appearance

Visual inspection

14.1.2 Adhesion

See EN 2828 or ISO 2819 (cross-cut test).

14.1.3 Thickness

See ISO 1463, ISO 2082, ISO 2177 and ISO 2178.

The choice of the method shall be subject to an agreement between the processor and the purchaser.

In case of dispute, the method defined in ISO 1463 is the reference method.

14.1.4 Composition of the plating

The method of analysis shall be agreed between the processor and the purchaser.

14.1.5 Hydrogen embrittlement

See EN 2832 and EN 2831.

The choice of the method shall be subject to an agreement between the processor and the purchaser.

Upon agreement from the purchaser, the tensile strength of the specimens may differ from the parts to be treated and from $R_m \geq 1\ 450$ MPa.

Other methods may be used subject to the purchaser's agreement.

14.1.6 Corrosion resistance

ISO 9227, in a 5 % solution of sodium chloride, on the following test pieces:

a) Material

Annealed steel with a carbon content of between 0,1 % and 0,18 %

b) Minimum dimensions

Thickness: not specified

Length: 120 mm

Width: 60 mm

c) Thickness of the plating

10 µm to 15 µm

14.2 For acceptance of parts

14.2.1 Appearance

See 14.1.1.

14.2.2 Adhesion

See 14.1.2.

14.2.3 Thickness

Steel: see ISO 2178.

Copper, copper alloys and nickel alloys: as agreed between the processor and the purchaser.

14.2.4 Other tests

Tests other than those specified in 14.1 may be carried out after agreement between the processor and the purchaser.

15 Quality assurance

15.1 Approval of the processor

See EN 2000.

15.2 Process approval

The processor shall carry out:

- the plating on pre-production parts and/or test pieces determined by agreement between the processor and the purchaser;
- the tests specified in this standard, unless otherwise agreed between the processor and the purchaser.

When the test results have been recognized as satisfactory by the purchaser, he shall give his written approval to start production.

The process schedule shall not be changed without previous agreement from the purchaser.

15.3 Acceptance

During production, the tests may be carried out on parts and/or test pieces coated under the same conditions as the parts.

The visual inspection (see 14.2.1) shall be performed on the whole batch, unless otherwise specified.

Unless otherwise specified, the adhesion tests (see 14.2.2) shall be carried out at a rate of one part or one test piece per batch.