SLOVENSKI STANDARD
SIST EN 2133:2021

01-februar-2021

Nadomešča:
SIST EN 2133:2011

Aeronavtika - Kadmiranje jekla z določeno natezno trdnostjo ≤ 1450 MPa z bakrom, bakrovimi in nikljevimi zlitinami

Aerospace series - Cadmium plating of steels with specified tensile strength ≤ 1 450 MPa, copper, copper alloys and nickel alloys

Luft- und Raumfahrt - Kadmieren von Stählen mit einer Zugfestigkeit ≤ 1 450 MPa, von Kupfer, von Kupferlegierung und von Nickellegierungen

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

Ta slovenski standard je istoveten z: **EN 2133:2020**

ICS:

49.040	Prevleke in z njimi povezani postopki, ki se uporabljajo v letalski in vesoljski industriji	Coatings and related processes used in aerospace industry

SIST EN 2133:2021 **en,fr,de**

EUROPEAN STANDARD

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EN 2133

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English Version

Aerospace series - Cadmium plating of steels with specified tensile strength ≤ 1 450 MPa, copper, copper alloys and nickel alloys

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This European Standard was approved by CEN on 4 October 2020.

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

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European foreword

This document (EN 2133:2020) has been prepared by the Aerospace and Defence Industries Association of Europe — Standardization (ASD-STAN).

After enquiries and votes carried out in accordance with the rules of this Association, this document has received the approval of the National Associations and the Official Services of the member countries of ASD, prior to its presentation to CEN.

This document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by *month year of DOP*, and conflicting national standards shall be withdrawn at the latest by *month year of DOW*.

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The main changes with respect to the previous edition are listed in the following table.

prEN/EN number	Edition	Publication date	Modifications
prEN 2133	1	02/2010	-
	2	09/2020	1 – Scope: This document specifies the electrolytic cadmium plating of parts and fasteners (addition of "and fasteners"). 2 – Normative references: EN 9100 is not a normative reference anymore. EN 9100 has been added in bibliography. The reason is that according to CEN/CENELEC Internal regulations Part 3 (February 2017) (see 33 – Aspects of conformity assessment) "no document containing requirements for products, processes, services, persons, systems and bodies shall make conformity dependent on a quality management systems standard, i.e. it shall not, for example, make normative reference to ISO 9001". 3.1 – batch: Addition of "Note 1 to entry: For mechanical parts, hydrogen embrittlement relieved at the same time". 4 – Purpose of process: Introduction of three types: - Type 1: as plated, - Type 2: with hexavalent chromium based post-treatment,

			- Type 3: without hexavalent chromium. 8 – Information for the processor: "Requirements for finishing operations other than chromating, e.g. phosphating" has been replaced by "Requirements for finishing operations other than Type 2 or Type 3 post-treatment, e.g. phosphating". Table 1 – Stress relief heat treatment of steel parts: Removal of the tolerance of ± 10 °C. Addition of the note b. For 1 100 MPa < UTS ≤ 1 450 MPa: the duration is 4 h min. (instead of 1 h min.) and stress relief heat treatment is now from 175 °C to 215 °C (instead of 190 °C to 230 °C). For carburized parts, stress relief heat treatment is now from 130 °C to 160 °C (instead of 130 °C to 150 °C). 10 – Process schedule: Addition of a process flow chart (see Annex A). 10.2 – Masking: Editorial change: masking (instead of covering). 10.4 – Nickel strike: Nickel strike is mandatory on corrosion resisting steels and is necessary on other type of steels. 10.5 – Cadmium plating: If brighteners are used, absence of hydrogen embrittlement shall be verified in accordance with ASTM F519. 11.1 – Hydrogen-embrittlement-relief heat treatment: Editorial change: hydrogen-embrittlement-relief (instead of de-embrittlement). Table 2 – Hydrogen-embrittlement-relief of steel parts: Removal of the tolerance of ± 10 °C. Addition of the note b. For 1 100 MPa < UTS ≤ 1 450 MPa: the hydrogen-embrittlement–relief heat treatment is now from 175 °C to 215 °C (instead of 190 °C to 230 °C). For carburized or nitrited parts, the hydrogen-embrittlement –relief heat treatment is now from 130 °C to 160 °C (instead of 130 °C to 150 °C). 11.2 – Post-treatment: The term "Post-treatment" is used instead of "chromating". Introduction of Types 1, 2 and 3 within this subclause. 13.1 – Appearance: New requirements depending on the type. 13.4 – Hydrogen embrittlement of steels: Requirements are now detailed for parts and for fasteners.

			13.5 – Corrosion resistance: New requirements depending on the type. 14.1.2 – Adhesion: Addition of other test description. Requirements are now detailed for burnishing test and for grid test. 14.1.4 – Hydrogen embrittlement: Full revision of the requirements of this subclause. 14.1.5 – Corrosion resistance: Requirements are now detailed for parts and for fasteners. 14.2.3 – Coating thickness: Addition of requirements regarding the measurement of the thickness in the hard-to-reach areas. 15 – Periodic tests: Addition of this clause. Table 3 – Minimum periodic tests requirements: Addition of this table. 16.3 – Acceptance: Unless otherwise specified, the appearance test shall be performed on the whole batch. 16.5 – Periodic chemical analysis: Addition of this subclause. 17 – Designation: Addition of the Type in the designation. Annex A (normative) – Process flow: Addition of this annex. *** Note from the writers of this revision of this document: New requirements for sampling plan are currently under investigation and may be changed in the next revision.

1 Scope

This document specifies the electrolytic cadmium plating of parts and fasteners in steel of tensile strength UTS ≤ 1 450 MPa, copper, copper alloys and nickel alloys, whose temperature in service does not exceed 235 °C.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

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*

EN ISO 1463:2004, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method* (ISO 1463:2003)

EN ISO 2082:2017, *Metallic and other inorganic coatings — Electroplated coatings of cadmium with supplementary treatments on iron or steel* (ISO 2082:2017)

EN ISO 2177:2004, *Metallic coatings — Measurement of coating thickness — Coulometric method by anodic dissolution* (ISO 2177:2003)

EN ISO 2178:2016, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method* (ISO 2178:2016)

EN ISO 2409:2013, *Paints and varnishes — Cross-cut test* (ISO 2409:2013)

EN ISO 2819: 2018, *Metallic coatings on metallic substrates — Electrodeposited and chemically deposited coatings — Review of methods available for testing adhesion* (ISO 2819:2017)

EN ISO 3497:2001, *Metallic coatings — Measurement of coating thickness — X-ray spectrometric methods* (ISO 3497:2000)

EN ISO 9227:2017, *Corrosion tests in artificial atmospheres — Salt spray tests* (ISO 9227:2017)

ISO 2859-1: 1999, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 4520: 1981, *Chromate conversion coatings on electroplated zinc and cadmium coatings*

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus* [1)]

ASTM F519, *Standard test method for mechanical hydrogen embrittlement — Evaluation of plating/coating process and service environment* [1)]

NASM 1312-5, *Fastener Test Methods — Method 5 — Stress Durability* [2)]

NASM 1312-14, *Fastener Test Methods — Method 14 — Stress Durability, Internally Threaded Fasteners* [2)]

1) Published by: ASTM National (US) American Society for Testing and Materials, http://www.astm.org/.

2) Published by: AIA National (US) Aerospace Industries Association of America, http://www.aia-aerospace.org/

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at http://www.iso.org/obp
- IEC Electropedia: available at http://www.electropedia.org/

3.1
batch
unless otherwise specified, parts of the same type (shape, size, material) treated at the same time in the same baths

Note 1 to entry: For mechanical parts, hydrogen embrittlement relieved at the same time.

3.2
pre-production part
part representative of future production

4 Purpose of process

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

- Type 1: as plated;
- Type 2: with hexavalent chromium based post-treatment;
- Type 3: without hexavalent chromium.

5 Limitations of process use

Contact of cadmium plated parts with titanium, titanium alloys, fuels and fuel lines

— shall be avoided at temperatures < 150 °C;

— is inadmissible at temperatures ≥ 150 °C.

6 Coating thickness

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

— Class A: 10 µm to 20 µm;

— Class B: 5 µm to 14 µm;

— Class C: 5 µm to 10 µm.

NOTE These thicknesses refer to the cadmium coating only (including the post-treatment). The nickel strike thicknesses are considered negligible.

7 Symbols

UTS: ultimate tensile strength

8 Information for the processor

— designation, see Clause 17;

— number of the substrate standard and metallurgical condition of the substrate;

— areas to be treated;

— coating thickness measuring points;

— duration and temperature of heat treatment before and after plating;

— electrical contact points or areas where these are inadmissible;

— requirements for finishing operations other than Type 2 or Type 3 post-treatment, e.g. phosphating;

— specification for testing on parts and/or samples.

9 Condition of parts prior to the treatment

Welding, soldering/brazing, mechanical operations and heat treatments shall have been completed.

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

Table 1 — Stress relief heat treatment of steel parts

UTS MPa	**Stress relief heat treatment** [a]
≤ 1 100	Not necessary
> 1 100 and ≤ 1 450	175 °C to 215 °C [b], 4 h min.
Carburized parts	130 °C to 160 °C [b], 6 h min.

[a] Stress relief is not required for fasteners which haven't been cold worked or machined after the heat treatment operation.

[b] Temperature to be chosen based on the engineering drawings, part standards, procurement specifications or contract/purchase orders.

A slight discoloration of the surface by oxidation is admissible.

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

10 Process schedule

10.1 General

For process flow see Annex A (normative), Figure A.1.

10.2 Masking

Component areas which according to the purchaser's information shall not be cadmium plated shall be masked by suitable means.

10.3 Surface pre-treatment

Surface preparation means any method able to completely eliminate all surface contaminations.

Methods which may result in hydrogen loading of the material shall be avoided.

10.4 Nickel strike

If necessary, nickel strike should be carried out on steels, copper and copper alloy, nickel and nickel alloy in order to ensure adhesion of the cadmium plating.

On corrosion resisting steel: nickel strike is mandatory.

On other type of steels: nickel strike is necessary.

10.5 Cadmium plating

Cadmium plating should be preferably performed without the addition of brighteners. If brighteners are used, absence of hydrogen embrittlement shall be verified in accordance with ASTM F519.

The composition of the bath as well as the process parameters shall be chosen such that the requirements for the cadmium coating specified by this standard (see Clause 13) are met with the addition of wetting agents being permissible.

Wetting agents shall have no negative effect on the embrittlement behaviour.

11 Post treatment

11.1 Hydrogen-embrittlement-relief heat treatment

Hydrogen-embrittlement-relief heat treatment shall be carried out within 4 h after cadmium plating (last hydrogen-loading process), in accordance with Table 2.

Table 2 — Hydrogen-embrittlement-relief of steel parts

Substrate	Temperature [a] °C	Minimum duration [a] h
Steels 1 100 MPa < UTS ≤ 1 450 MPa	175 °C to 215 °C [b]	23
Carburized or nitrided parts	130 °C to 160 °C [b]	23
Other materials	Not required	

[a] Other conditions may be used subject to agreement between the processor and the purchaser.

[b] Temperature to be chosen based on the engineering drawings, part standards, procurement specifications or contract/purchase orders.