BS EN 2133:2010

BSI Standards Publication

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

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National foreword

This British Standard is the UK implementation of EN 2133:2010. It supersedes BS EN 2133:1998, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ACE/65/-/4, Surface Finish and Protective Treatments for Aerospace Purposes.

A list of organizations represented on this committee can be obtained on request to its secretary.

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

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

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

This European Standard was approved by CEN on 30 July 2010.

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Contents

Page

Foreword

This document (EN 2133:2010) 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 Standard 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 European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2011, and conflicting national standards shall be withdrawn at the latest by April 2011.

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1 Scope

This European standard specifies the electrolytic cadmium plating of parts in steel of tensile strength R_m (max.) ≤ 1 450 MPa, copper, copper alloys and nickel alloys, whose temperature in service does not exceed 235 °C.

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.

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 9100, *Quality management systems — Requirements for Aviation, Space and Defense Organizations*

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

EN ISO 2082, *Metallic and other inorganic coatings — Electroplated coatings of cadmium with supplementary treatments on iron or steel (ISO 2082:2008)*

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

EN ISO 2178, *Non-magnetic coatings on magnetic substrates — Measurement of coating thickness — Magnetic method (ISO 2178:1982)*

EN ISO 2819, *Metallic coatings on metallic substrates — Electrodeposited and chemically deposited coatings — Review of methods available for testing adhesion (ISO 2819:1980)*

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

EN ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests (ISO 9227:2006)*

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

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

3 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.

4 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.

5 Terms and definitions

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

5.1
batch
unless otherwise specified, it comprises parts of the same type (shape, size, material), treated at the same time in the same bath

5.2
pre-production part
part representative of future production

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. The nickel strike thicknesses are considered negligible.

7 Symbols

R_m (max.): maximum specified tensile strength

8 Information for the processor

— Designation, see Clause 16;

— 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 chromating, 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 parts in steel

R_m (max.) MPa	**Stress relief heat treatment** [a]
≤ 1 100	Not necessary
> 1 100 and ≤ 1 450	(190 to 230) ± 10 °C, 1 h min.
Carburized parts	(130 to 150) ± 10 °C, 6 h min.

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

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 Covering

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

10.2 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.

10.3 Nickel strike

In order to ensure adhesion of the cadmium. nickel striking is applicable to corrosion resistant parts in steel, copper and copper alloys, nickel and nickel alloys.

10.4 Cadmium plating

Cadmium plating is performed without the addition of brighteners. 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 De-embrittlement

De-embrittlement shall be carried out within 4 h after cadmium plating, in accordance with Table 2.

Table 2 — De-embrittlement

Substrate	Temperature [a] °C	Minimum duration [a] h
Steels 1 100 MPa < R_m (max.) ≤ 1 450 MPa	(190 to 230) ± 10 °C	23
Carburized parts	(130 to 150) ± 10 °C	23
Other materials	Not required	

[a] Other conditions may be used subject to 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

Both electrochemical and chemical processes may be applied. The de-metallizing variants used, however, shall not result in any roughening, pitting or embrittling of the base material or have a negative influence on its dimensions.

NOTE No chemical de-metallizing processes should be chosen which could result in hydrogen loading of the workpieces. Unless this can be ensured, de-embrittlement in accordance with the provisions of Table 2 is required after de-metallizing.

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 iridescent, gold or brass colour.

13.2 Adhesion

See 14.1.2.

13.3 Coating thickness

See Clause 6.

13.4 Hydrogen embrittlement of steels

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

— No rupture within 200 h (EN 2832)

or

— final ductility ≥ 94 % of the initial ductility (EN 2831).

13.5 Corrosion resistance

After exposure to salt spray (EN ISO 9227):

— on chromated cadmium plated parts, white cadmium salts shall not appear within 96 h. Corrosion of the substrate shall not occur within 336 h;

— on non-chromated cadmium plated parts, corrosion of the substrate shall not occur within 240 h.

14 Test methods

14.1 For process approval

14.1.1 Appearance

Visual inspection

14.1.2 Adhesion

See EN 2828 or EN ISO 2819 (grid test).

14.1.3 Coating thickness

See EN ISO 1463, EN ISO 2082, EN ISO 2177, EN ISO 2178 and EN ISO 3497 (X-ray).

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

In cases of dispute, the method specified in EN ISO 1463 is the reference method.

14.1.4 Hydrogen embrittlement

See EN 2832 and EN 2831.

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

If agreed with the purchaser, the tensile strength of the samples may differ from that of the parts to be treated and from $R_m \geq 1\,450$ MPa.

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

14.1.5 Corrosion resistance

EN ISO 9227, in a 5 % solution of sodium chloride, on the following samples:

a) Material: heat-treated steel with a mass fraction of carbon of between 0,1 % and 0,18 %
   - 2 samples.

b) Minimum dimensions
   - Thickness: 0,8 mm;
   - Length: 120 mm;
   - Width: 60 mm.

c) Coating thickness
   - 10 µm to 20 µm.

14.2 For acceptance of parts

14.2.1 Appearance

See 14.1.1.

14.2.2 Adhesion (if agreed)

See 14.1.2.

14.2.3 Coating thickness

See 14.1.3.

15 Quality assurance

15.1 Approval of the processor

See EN 9100.

15.2 Process approval

The processor shall carry out

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

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

15.3 Acceptance

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

The appearance test (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 on one part or one sample per batch.

Unless otherwise specified, the coating thickness (see 14.2.3) shall be measured by sampling in accordance with ISO 2859-1:

— code letter of the sample size, Table 1, special inspection level S-3;

— single sampling plan for more stringent inspection;

— acceptable quality level (AQL) 1,5.

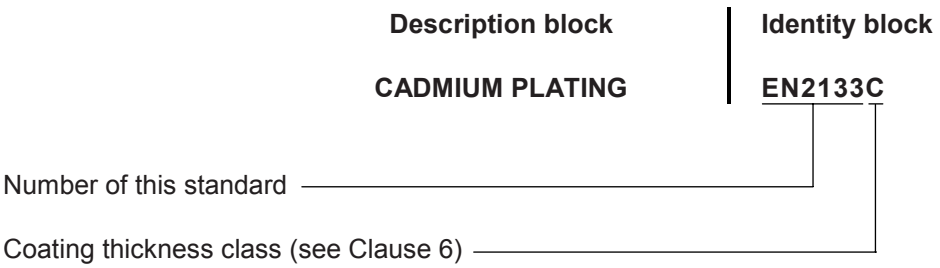
The frequency and nature of the other tests shall be determined by agreement between the processor and the purchaser.

15.4 Reprocessing

Reprocessing of parts depends on the material and may only be carried out following confirmation by the purchaser.

16 Designation

EXAMPLE



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