



SLOVENSKI STANDARD

SIST EN 2536:2001

01-junij-2001

Aerospace series - Hard anodizing of aluminium alloys

Aerospace series - Hard anodizing of aluminium alloys

Luft- und Raumfahrt - Hartanodisieren von Aluminiumlegierungen

Série aérospatiale - Anodisation dure des alliages d'aluminium

Ta slovenski standard je istoveten z: EN 2536:1995

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ICS:

49.025.20	Aluminij	Aluminium
49.040	Prevleke 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

EN 2536

NORME EUROPÉENNE

EUROPÄISCHE NORM

August 1995

ICS 49.040.40

Descriptors: aircraft industry, metal finishing, aluminium, aluminium alloys, anodizing

English version

Aerospace series - Hard anodizing of aluminium alloys

Série aérospatiale - Anodisation dure des alliages d'aluminium - Luft- und Raumfahrt - Hartanodisieren von Aluminiumlegierungen

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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

Foreword

This European Standard has been prepared by the European Association of Aerospace Manufacturers (AECMA).

After inquiries and votes carried out in accordance with the rules of this Association, this Standard has successively received the approval of the National Associations and the Official Services of the member countries of AECMA, 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of an identical text or by endorsement, at the latest by February 1996, and conflicting national standards shall be withdrawn at the latest by February 1996.

According to the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

SIST EN 2536:2001

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1 Scope

This standard specifies the hard anodizing of aluminium alloys used in aerospace construction.

It shall be 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 2360	Non-conductive coatings on non-magnetic basis metals - Measurement of coating thickness - Eddy current method
ISO 2376	Anodization (anodic oxidation) of aluminium and its alloys - Insulation check by measurement of breakdown potential
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 4516	Metallic and related coatings - Vickers and Knoop microhardness tests
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 2101	Aerospace series - Chromic acid anodizing of aluminium and wrought aluminium alloys
EN 2284	Aerospace series - Sulphuric acid anodizing of aluminium and wrought aluminium alloys
EN 2334	Aerospace series - Acid chromate pickling of aluminium alloys ¹⁾
FED STD 141C, Method 6192-1	Abrasion resistance (TABER abraser) ²⁾

3 Definitions

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

- 3.1 Batch : unless otherwise specified, it comprises parts of the same nature (form, size, material), treated at the same time in the same bath.
- 3.2 Pre-production parts : parts representing future production.

¹⁾ In preparation at the date of publication of this standard

²⁾ Published by : Department of Defense (DOD), the Pentagon, Washington DC 20301, USA

4 Classification

4.1 Types of anodizing

4.1.1 Type A: unsealed hard anodizing. It provides the maximum wear resistance but does not improve essentially the corrosion resistance.

4.1.2 Type B: sealed hard anodizing. It gives a good compromise between wear resistance and corrosion resistance.

4.2 Categories of alloys

4.2.1 Category 1

Alloys containing < 1 % of copper.

4.2.2 Category 2

Alloys containing between 1 % and 5 % of copper.

5 Purpose of process

To improve :

- the resistance to abrasive and erosive wear ;
- the electrical insulation ;
- the thermal insulation.

To use the dimensional increase produced by the process for repair of parts out of tolerance on machining or worn in service (special case).

6 Influence and limitations of process use

The anodizing produces an increase :

- of the dimensions by about 50 % of the coating thickness ;
- of the surface roughness (factor of 1,3 to 3,0, if expressed in Ra).

Anodizing results in a reduction of the fatigue strength which may reach 60 %. Shot peening before anodizing reduces the extent of this reduction.

The best results as regards the properties of the anodized layer are obtained on machined surfaces ; no grinding before anodizing. Round off sharp corners.

Not recommended for use on parts or items where there is a risk of retention of corrosive substances.

Avoid anodizing both faces on areas with a thickness ≤ 2 mm.

The thickness of the anodized layer is in general :

- 30 μm to 120 μm for alloys of category 1 ;
- 30 μm to 60 μm for alloys of category 2.

Restrict thickness to 25 μm on the splines and threads.

7 Information for the processor

In addition to the designation, the following information shall be given :

- the number of the substrate standard and the metallurgical condition of the substrate ;
- areas to be processed ;
- position of electrical contact points or alternatively areas where they are forbidden.

The boundary between the masked and processed areas shall be, if possible, in an area of a geometry change.

8 Condition of parts prior to processing

The final heat treatment shall be carried out.

9 Process schedule

Unless otherwise specified, the sequence of operations is as follows :

- masking and mounting of the parts ;
- cleaning ;
- pickling ;
- anodizing ;
- sealing, if necessary.

Information concerning the individual operations is given below :

9.1 Masking and mounting of the parts

Masking may be carried out using :

- special varnishes or waxes easily removable by solvents ;
- plugs in suitable material ;
- chromic acid anodizing (EN 2101) or sulphuric acid anodizing (EN 2284), sealed and completed with wax or varnish. Generally, the anodizing is carried out over the whole surface of the part and the area intended for hard anodizing is machined to remove the masking anodic coating.

The supporting jigs shall be in aluminium alloy or titanium. They shall make effective electrical contact with the parts.

9.2 Cleaning

Solvent degreasing with allowed products, followed by alkaline cleaning is in general sufficient (see EN 2101, annex A).

9.3 Pickling

Pickling operations are forbidden on parts masked by sealed anodizing without wax or varnish.

The pickling shall remove the natural oxides or other contamination not eliminated by the cleaning without altering the specified characteristics.

As a general rule, the pickling is done in a sulphuric-chromic bath according to EN 2334. In exceptional cases, for certain alloys in category 2, alkaline pickling may be used (see EN 2101, annex A).

9.4 Anodizing

9.4.1 Electrolyte

Aqueous sulphuric acid solution with or without additional elements. The concentration shall not vary by more than $\pm 10\%$ from the values specified by the processor.

The chloride content shall be less than 200 mg/l, expressed as NaCl.

The aluminium content shall be less than 25 g/l for the limits of concentration chosen.

The water shall have a conductivity of ≤ 1 mS/m (measured at the source of the supply).

9.4.2 Anodizing parameters

The anodizing parameters (temperature, voltage, time) shall be suitable for the alloy and the composition of the bath.

The treatment temperature may vary from $-20\text{ }^{\circ}\text{C}$ to $+15\text{ }^{\circ}\text{C}$, depending on the process.

The control systems shall make it possible to ensure in a strongly and uniformly agitated bath, a tolerance of $\pm 2\text{ }^{\circ}\text{C}$.

The current used can be :

- direct ;
- direct with superimposed alternating ;
- alternating ;
- pulsed.

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9.5 Sealing

When this operation is specified, it shall be carried out in water, without or with inhibitors under the following conditions :

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9.5.1 Without inhibitor

On making up the bath the conductivity of the water shall be less than 1 mS/m with a pH between 5,5 and 7,5 (measured at the source of the supply).

Sealing shall be carried out at a minimum temperature of $97\text{ }^{\circ}\text{C}$ for at least 10 min. The bath shall be renewed when the conductivity is greater than 10 mS/m.

9.5.2 With inhibitors

An inhibitor (e.g. potassium dichromate) shall be added to water with a conductivity < 1 mS/m.

The sealing shall be carried out at a minimum temperature of $97\text{ }^{\circ}\text{C}$ for at least 10 min. The pH shall be maintained between 5,5 and 6,9.

The concentration of inhibitor shall be established and maintained within limits ensuring the quality defined by this standard.

10 Machining after anodizing

If, for certain applications, grinding or honing is necessary, the thickness shall be chosen to take account of it. This shall be indicated in the design documents.

11 Removal of the anodic coating

The treatment used shall allow to obtain a surface roughness equal to that obtained after normal surface preparation.

If necessary, mechanical reworking may be carried out after the purchaser's agreement.

12 Required characteristics**12.1 Appearance**

Acceptable defects :

- crazing (checking of micro cracks on the surface) ;
- showing up to the grain flow ;
- fissures and cavities on the microscopic scale within the anodic coating.

Not acceptable defects :

- irregularity of colouring on the same part ;
- blistering ;
- flaking ;
- burning ;
- pitting.

12.2 Thickness

It shall comply with the requirements of the design documents.

12.3 Microhardness

See table 1, unless otherwise specified. [SIST EN 2536:2001](#)

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Table 1

Thickness of the coating µm	Min. microhardness under 50 g load HV	
	Category 1	Category 2
50 ⁺¹⁰ -5	350	300
100 ± 10	250	-

For other thickness the microhardness value shall be agreed between the purchaser and processor.

12.4 Abrasion resistance, unsealed condition

Unless otherwise specified, the max. mass losses measured on test pieces hard anodized to (50 ± 5) µm (arithmetic mean of three measurements) under a load of 1 000 g and 10 000 cycles shall be :

- category 1 : 20 mg corresponding to a removal of about 3,5 µm ;
- category 2 : 40 mg corresponding to a removal of about 7,0 µm.