SLOVENSKI STANDARD
oSIST prEN 4881:2021

01-julij-2021

Aeronavtika - Mikroobločna oksidacija aluminija in aluminijevih zlitin

Aerospace series - Micro-arc oxidation of aluminium and aluminium alloys

Luft- und Raumfahrt - Mikrolichtbogenoxidation von Aluminium und Aluminiumlegierungen

Série aérospatiale - Oxydation micro-arc de l'aluminium et des alliages d'aluminium

Ta slovenski standard je istoveten z: **prEN 4881**

ICS:

25.160.10	Varilni postopki in varjenje	Welding processes
49.025.20	Aluminij	Aluminium

oSIST prEN 4881:2021 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 4881

May 2021

ICS 25.160.10; 49.025.20

English Version

Aerospace series - Micro-arc oxidation of aluminium and aluminium alloys

Série aérospatiale - Oxydation micro-arc de l'aluminium et des alliages d'aluminium

Luft- und Raumfahrt - Mikrolichtbogenoxidation von Aluminium und Aluminiumlegierungen

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. prEN 4881:2021 E

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European foreword

This document (prEN 4881:2021) 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-STAN, prior to its presentation to CEN.

This document is currently submitted to the CEN Enquiry.

1 Scope

This document defines the requirements for micro-arc oxidation of aluminium and aluminium alloys for corrosion protection, wear, erosion, dielectric and thermal properties.

The purpose of this document is to give design, quality and manufacturing requirements. It does not give complete in-house process instructions; these are given in the processors detailed process instructions.

This document relates only to micro-arc oxidation. It does not relate to finishing techniques, such as mechanical post treatment.

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 6072, *Aerospace series - Metallic materials - Test methods - Constant amplitude fatigue testing*

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

EN ISO 4516, *Metallic and other inorganic coatings - Vickers and Knoop microhardness tests (ISO 4516)*

EN ISO 9227, *Corrosion tests in artificial atmospheres - Salt spray tests (ISO 9227)*

ASTM D4060, *Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser*

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 https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 General terms

3.1.1
OEM
producer who has the design authority and manufactures products or components that are purchased by a company and retailed under that purchasing company's brand name

Note 1 to entry: The manufacturer can also apply the process.

3.1.2
manufacturer
company or person who makes, manufactures, assembles components

3.1.3
processor
company or person who applies the process

3.1.4
process instruction
document that describes the application scopes, detailed process (key parameters, detailed steps, etc.), quality management, environmental and safety regulations, etc.

3.1.5
batch
parts of the same type (i.e. shape, size, material), processed at the same time in the same bath

Note 1 to entry: Unless otherwise specified.

3.2 Technical terms

3.2.1
mechanically disturbed layer
MDL
layer that is present at the surface resulting from the heat treatment and rolling process of the material

3.2.2
pit
surface corrosion defect at which the oxide layer is penetrated and/or perforated

Note 1 to entry: Typical characteristics of corrosion pits are:

— rounded or irregular or elongated geometry;

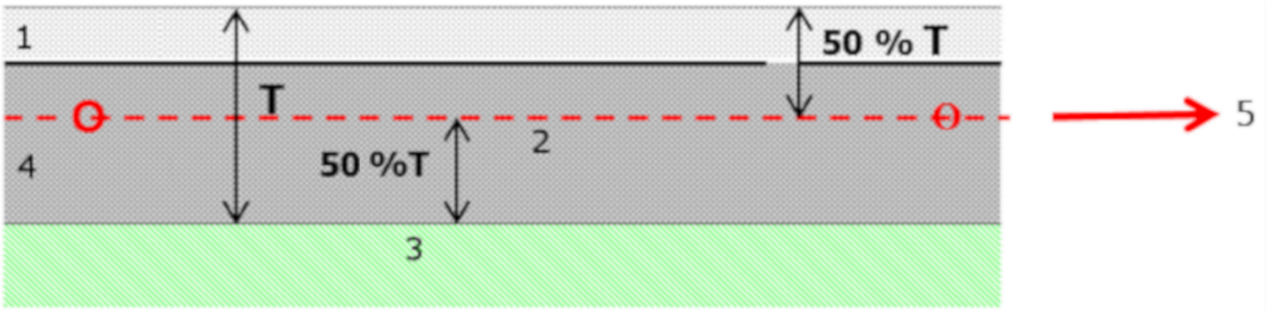
— comet tail or line or halo that emerges from the cavity;

— some corrosion by-products inside pits (on aluminium, the by-product may be granular, powdery or amorphous and white, grey or black in colour).

To be considered as a corrosion pit, a surface cavity must exhibit at least two of the above characteristics.

3.2.3
MAO layer
layer which is constituted of a friable/porous layer and a functional layer

Note 1 to entry: See Figure 1.



Key

1 Friable/porous layer
2 Hard ceramic (mainly α-Al_2O_3)
3 Aluminium
4 Functional layer
5 Initial surface

Figure 1 — MAO layer

3.2.4
functional layer
functional and hard part of the coating useful for wear application and paint adhesion (porous)

4 General principles of the process

4.1 Purpose of the process

Plasma electrolytic oxidation (PEO) or micro arc oxidation (MAO) is an electrochemical process of anodization that is performed thanks to micro-discharges created on the surface of components immersed in an electrolyte. The process is applied to aluminium, titanium, and magnesium to grow a dense ceramic oxide layer that improves mechanical, wear, thermal, dielectric, and corrosion properties.

A controlled high alternating current is applied to a metal part immersed in an electrolytic bath. Due to this current and significant voltage resulting, micro-discharges as well as the development of an intense plasma are created on the surface of the metal. This plasma oxidizes the surface of the part and a ceramic oxide layer grows from the substrate material. The oxide layer is produced by subsurface oxidation. As a result, the process can produce very thick coatings of varying porosity.

This specification applies to aluminium and aluminium alloys.

4.2 Applicability

4.2.1 Type A: As processed

This type of coating can be painted.

4.2.2 Type B: After blasting operation

It is intended for wear applications.

This type of coating can be painted.

4.2.3 Type C: After machining operation

It is intended for either wear or erosion applications when tightened geometrical tolerances may be achieved.

4.3 Limitations

All processes that can compromise the oxide layer such as forming, or heat-treatment shall be performed prior to surface preparation of the parts to be oxidized.

Oxidizing should not be applied:

- in zones/areas ensuring electric conductivity;
- for tubes, pipes and open holes with a length to diameter ratio higher than 5:1 (unless using specific cathode);
- for trapped holes with a length to a diameter ratio greater than 5:1;
- for parts or assemblies (e.g. spot-welded and riveted), which can permanently entrap treatment solutions, except components that can be adequately masked.

The formation of oxide layer influences the dimensions of the part and is to be considered for close tolerance parts (growth of 1/3 of thickness).

4.4 Classifications

4.4.1 System Types

Micro-arc oxidation layer is classified by the three following types:

- type A: as processed;
- type B: after blasting operation;
- type C: after machining operation.

4.4.2 Layer thicknesses

See Table 1.

Table 1 — Layer thicknesses corresponding to the class type

Class type	MAO typical thickness	Type correspondence	Typical final thickness	Recommended application
Class 1	30 µm to 60 µm	Type A	30 µm to 60 µm	For paint application High roughness
Class 2	60 µm to 120 µm	Type A	60 µm to 120 µm	For corrosion application No specific surface condition required
		Type B	50 µm to 90 µm	
Class 3	100 µm to 200 µm	Type C	60 µm to 100 µm	For corrosion application Low friction coefficient Close tolerances Optimized surface condition

5 Process requirements

5.1 Information for the processor

Type and class designation;

- substrate standard reference and heat treatment;
- areas to be protected;
- oxidation thickness measuring points;
- electrical contact points or areas where these are inadmissible;
- specification for testing on parts and/or test specimens.

5.2 Process schedule (information)

1) only for type C: initial grinding of the area to be coated (to the required end-dimensions);
2) alkaline degreasing or degreasing with solvent;
3) fitting of the part on the masking and treatment tooling;
4) micro-arc oxidation;
5) rinsing;
6) only for type B: glass bead blasting: removal of the friable/porous layer;
7) only for type C: final grinding.

5.3 Process conditions

5.3.1 Tooling

The tools, bars, electrical contact systems, and metal masking tooling shall be free of oxidation/corrosion or any other damage which may be detrimental to the treatment during use. The part racks and tools shall be designed and set up in such a manner as to:

- avoid any retention of air or treatment solution in the parts;
- facilitate neutralization and removal of solutions during rinsing operations;
- the electrical contacts shall be kept in good condition for the correct passage of the current;
- avoid any accidental contact between the parts to be treated and the tank equipment or electrodes, and between the different parts during all the process;
- electrical contact points should be agreed between purchaser and processor; use of screws, fixturing on threaded areas or mechanical fixtures as electrical contact area is recommended to ensure a firm contact;
- the fixturing tools (e.g. in aluminium alloy or titanium) shall provide effective electrical contact with the parts;