
**Aeronavtika - Eloksiranje aluminija in gnetljivih (kovnih) aluminijevskih zlitin z vinsko-
žvepleno kislino (TSA) za korozijsko zaščito in barvno predobdelavo**

Aerospace series - Tartaric-Sulphuric-Acid anodizing of aluminium and aluminium wrought alloys for corrosion protection and paint pre-treatment (TSA)

Luft- und Raumfahrt - Weinsäure-Schwefelsäure-Anodisieren (TSA) von Aluminium und Aluminium-Knetlegierungen für den Korrosionsschutz und zur Vorbehandlung

Série aérospatiale - Anodisation tartrique de l'aluminium et des alliages d'aluminium corroyés pour protection contre la corrosion et peinture (TSA)

[https://standards.iteh.ai/catalog/standards/sist/e834658f-1afd-4c16-91e4-](https://standards.iteh.ai/catalog/standards/sist/e834658f-1afd-4c16-91e4-c5293775f4b0/sist-en-4704-2012)

Ta slovenski standard je istoveten z: EN 4704:2012

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

SIST EN 4704:2012**en,de**

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 4704:2012

<https://standards.iteh.ai/catalog/standards/sist/e834658f-1afd-4c16-91e4-c5293775f4b0/sist-en-4704-2012>

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 4704

February 2012

ICS 49.040

English Version

**Aerospace series - Tartaric-Sulphuric-Acid anodizing of
aluminium and aluminium wrought alloys for corrosion protection
and paint pre-treatment (TSA)**

Série aérospatiale - Anodisation tartrique de l'aluminium et
des alliages d'aluminium corroyés pour protection contre la
corrosion et peinture (TSA)

Luft- und Raumfahrt - Weinsäure-Schwefelsäure-
Anodisieren (TSA) von Aluminium und Aluminium-
Knetlegierungen für den Korrosionsschutz und zur
Vorbehandlung

This European Standard was approved by CEN on 23 December 2011.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



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

Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword.....	3
1 Scope	4
2 Normative references	4
3 Terms and definitions	4
4 Principle	5
5 Requirements	6
6 Re-anodizing	10
7 Qualification Test Report (QTR).....	11
Annex A (informative) Wöhler curves and stress levels – Reference fatigue curves	12
Bibliography	13

iTeh STANDARD PREVIEW (standards.iteh.ai)

SIST EN 4704:2012

<https://standards.iteh.ai/catalog/standards/sist/e834658f-1afd-4c16-91e4-c5293775f4b0/sist-en-4704-2012>

Foreword

This document (EN 4704:2012) 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 August 2012, and conflicting national standards shall be withdrawn at the latest by August 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

ITEH STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 4704:2012

<https://standards.iteh.ai/catalog/standards/sist/e834658f-1afd-4c16-91e4-c5293775f4b0/sist-en-4704-2012>

EN 4704:2012 (E)

1 Scope

This European Standard defines the requirement for Tartaric-Sulphuric-Acid (TSA) anodizing of aluminium and wrought alloys for corrosion protection and paint pre-treatment.

The purpose of this European Standard is to give design and quality requirements to manufactures.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 2101, *Aerospace series — Chromic acid anodizing of aluminium and wrought aluminium alloys*

EN 3665, *Aerospace series — Test methods for paints and varnishes — Filiform corrosion resistance test on aluminium alloys*

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

EN ISO 2106, *Anodizing of aluminium and its alloys — Determination of mass per unit area (surface density) of anodic oxidation coatings — Gravimetric method (ISO 2106:2011)*

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

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

EN ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling (ISO 15528)*

3 Terms and definitions

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

3.1

de-anodizing

process, which removes the anodic oxide

3.2

smut

precipitations of alloying elements (e. g. Cu, Fe, Zn, Si) on the surface of parts after a process step normally after alkaline etching step

3.3**Mechanically Disturbed Layer****MDL**

layer that is present at the surface resulting from the rolling process of the material

3.4**pit**

surface corrosion defect at which the anodic coating is penetrated

3.5**process instruction**

document that describes the detailed process, parameters, detailed steps, etc.

3.6**alloys**

all aluminium alloys, that are treated with the TSA process in the specific shop

3.7**re-anodizing**

repetition of the anodizing process step after complete de-anodizing

3.8**sealing**

sealing (of the anodized layers) is applied to close the pores produced by the acid anodizing process. It is usually applied in demineralized water bath. Sealing can improve the corrosion resistance performance of the anodic film.

3.9**dichromate sealing**

the dichromate sealing process has to be applied for unpainted parts

It contains one of the following products:

- Sodium dichromate;
- Potassium dichromate.

It includes chromate and has to be replaced by a chromium III chemical conversion coating when available.

4 Principle**4.1 General description of process**

TSA process is an electrochemical process used for generating an aluminium oxide layer for corrosion protection and surface treatment prior to application of a corrosion-inhibiting primer.

The TSA process is characterized by using an electrolyte composed of tartaric and sulphuric acid. Suitable surface preparation steps, e. g. alkaline cleaning, alkaline etching, acidic pickling/desmutting and subsequent steps such as rinsing (and sealing, if applicable), have to be defined and are integral to the TSA process.

EN 4704:2012 (E)**4.2 Limitations**

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

TSA anodizing shall not be applied:

- for metal bonding applications;
- inside of oxygen pipes;
- for tubes, pipes and open holes with a length to diameter ratio higher than 10:1;
- 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;
- for components which can permanently entrap treatment solutions, except components that can be adequately masked.

NOTE The formation of oxide layer influences the dimensions of the part and should be considered for close tolerance parts.

5 Requirements

iTeh STANDARD PREVIEW
(standards.iteh.ai)

5.1 Technical requirements**5.1.1** Prior to anodizing step:

[SIST EN 4704:2012](https://standards.iteh.ai/catalog/standards/sist/e834658f-1afd-4c16-91e4-602973460210/en-4704:2012)

<https://standards.iteh.ai/catalog/standards/sist/e834658f-1afd-4c16-91e4-602973460210/en-4704:2012>

- the parts shall be free of oil, grease, marking inks and other surface contaminations;
- the surface shall be free from precipitations or smut from alloying elements or pre-processes indicated by the bright and uniform appearance of the surface;
- parts/areas that do not require anodizing shall be masked accordingly;
- mechanically disturbed layer shall be removed either by mechanical or chemical processes;
- in case of chemical pre-treatment, the final step prior to anodizing shall be acidic pickling, preferably chromate-free;
- in case of re-anodizing all residuals from the previous anodizing shall be completely removed.

5.1.2 During the anodizing process:

- the parts shall not be subjected to any tensile, flexure, torsion or other stress;
- the process shall be performed such, that parts do not dry between single process steps (pre-treatment, anodizing, etc.).

5.1.3 After the anodizing procedure:

- parts have to be adequately rinsed with water according to 5.1.4;
- afterwards, the parts shall be either:
 - dried and painted within 16 h. The parts can be kept in a dry and dust-free atmosphere for 168 h before painting;
 - or
 - sealed to achieve the desired corrosion resistance of the anodic film;
 - appropriate measure should be taken to prevent and to eliminate possible microbiological contaminations of the rinsing bath, e.g. UV radiation.

5.1.4 Water quality:

- All water used for preparation of the TSA bath and for the final rinsing step as well as for the sealing process shall be demineralized.

The water shall comply with the following requirements:

- pH value at 25 °C : 5,0 to 7,0;
- total residue [mg/l] : ≤ 20 ;
- conductivity [$\mu\text{S}/\text{cm}$] : ≤ 20 .

STANDARD PREVIEW
(standards.iteh.ai)

5.2 Engineering requirements**5.2.1 Requirements to the anodic film**

SIST EN 4704:2012

https://standards.iteh.ai/catalog/standards/sist/e834658f-1afd-4c16-91e4-c5293775f4b0/sist-en-4704-2012

5.2.1.1 Visual aspects

The film shall be free of powdery areas, burnings, blisters and discontinuities such as scratches, ruptures or other damages.

5.2.1.2 Film thickness

The thickness of the anodic film shall be in a range of 2 μm to 7 μm . The thickness of the film can be checked by eddy current method (EN ISO 2360), optical microscope (EN ISO 1463), scanning electronic microscope (SEM), or equivalent examinations.

5.2.2 Corrosion prevention performance of unpainted parts

When tested in accordance to EN ISO 9227 the anodised and sealed post-treated specimens shall show:

- less than 2 pits/ dm^2 ;
- no pit shall exceed 0,8 mm in diameter;
- no patchy dark grey areas (spots, streaks or marks) after an exposure time of minimum 14 days according to EN ISO 9227 for 2024 T351 unclad and 7175 T7351 unclad. There can also other materials be used if they are defined between the supplier and the customer.

The area of 2 mm from the specimen edges and marks shall not be evaluated.