# SLOVENSKI STANDARD
# SIST EN 3999:2007

**01-november-2007**

---

**Aeronavtika - Aluminijeva zlitina AL-P2024-T351 - Pločevina in trakovi z izboljšanimi lastnostmi za kemično rezkanje 1,6 mm <= a <= 6 mm**

Aerospace series - Aluminium alloy AL-P2024-T351 - Sheet and strip with improved chemical milling capability 1,6 mm <= a <= 6 mm

Luft- und Raumfahrt - Aluminiumlegierung AL-P2024-T351 - Bleche und Bänder mit besserer Eignung zum chemischen Fräsen 1,6 mm <= a <= 6 mm



Série aérospatiale - Alliage d'aluminium AL-P2024-T351 - Tôles et bandes avec aptitude améliorée a l'usinage chimique 1,6 mm <= a <= 6 mm



**Ta slovenski standard je istoveten z:** **EN 3999:2007**

---

**ICS:**

| | | |
|---|---|---|
| 49.025.20 | Aluminij | Aluminium |

**SIST EN 3999:2007** **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 3999

August 2007

ICS 77.150.10

English Version

# Aerospace series - Aluminium alloy AL-P2024-T351 - Sheet and strip with improved chemical milling capability 1,6 mm ≤ a ≤ 6 mm

Série aérospatiale - Alliage d'aluminium AL-P2024-T351 - Tôles et bandes avec aptitude améliorée à l'usinage chimique 1,6 mm ≤ a ≤ 6 mm

Luft- und Raumfahrt - Aluminiumlegierung AL-P2024-T351 - Bleche und Bänder mit besserer Eignung zum chemischen Fräsen 1,6 mm ≤ a ≤ 6 mm

This European Standard was approved by CEN on 12 June 2006.

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 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 Management Centre has the same status as the official versions.



CEN members are the national standards bodies of Austria, Belgium, Bulgaria, 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 and United Kingdom.



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

**Management Centre: rue de Stassart, 36 B-1050 Brussels**

# Contents

Foreword ..... 3
Introduction ..... 4
1 Scope ..... 4
2 Normative references ..... 4

## Foreword

This document (EN 3999:2007) has been prepared by the AeroSpace and Defense 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 February 2008, and conflicting national standards shall be withdrawn at the latest by February 2008.

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, 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 and the United Kingdom.

## Introduction

This standard is part of the series of EN metallic material standards for aerospace applications. The general organization of this series is described in EN 4258.

This standard has been prepared in accordance with EN 4500-2.

## 1 Scope

This standard specifies the requirements relating to:

Aluminium alloy AL-P2024-T351 — Sheet and strip with improved chemical milling capability 1,6 mm $\leq a \leq$ 6 mm for aerospace application.

This material is manufactured to a minimum residual stress requirement for chemical milling applications.

## 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 4258, *Aerospace series — Metallic materials — General organization of standardization — Links between types of EN standards and their use*

EN 4400-2, *Aerospace series — Aluminium and aluminium alloy wrought products — Technical specification — Part 2: Sheet and strip* [1)]



EN 4500-2, *Aerospace series — Metallic materials — Rules for drafting and presentation of material standards — Part 2: Specific rules for aluminium, aluminium alloys and magnesium alloys* [1)]

1) Published as ASD Prestandard at the date of publication of this standard.

| 1 | Material designation | | Aluminium alloy AL-P2024- | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | Chemical composition % | Element | Si | Fe | Cu | Mn | Mg | Cr | Zn | Ti | Others | | Al |
| | | | | | | | | | | | Each | Total | |
| | | min. | — | — | 3,8 | 0,30 | 1,2 | — | — | — | — | — | Base |
| | | max. | 0,50 | 0,50 | 4,9 | 0,9 | 1,8 | 0,10 | 0,25 | 0,15 | 0,05 | 0,15 | |
| 3 | Method of melting | | — | | | | | | | | | | |
| 4.1 | Form | | Sheet and strip | | | | | | | | | | |
| 4.2 | Method of production | | Rolled | | | | | | | | | | |
| 4.3 | Limit dimension(s) | mm | $1{,}6 \leq a \leq 6$ | | | | | | | | | | |
| 5 | Technical specification | | EN 4400-2 | | | | | | | | | | |

| | | |
|---|---|---|
| 6.1 | Delivery condition | T351 |
| | Heat treatment | 490 °C ≤ $\theta$ ≤ 500 °C / WQ $\theta$ ≤ 40 °C<br>+ 0,5 % ≤ controlled stretched ≤ 3 %<br>+ $\theta$ = ambient / t ≥ 5 d |
| 6.2 | Delivery condition code | U |
| 7 | Use condition | T351 |
| | Heat treatment | Delivery condition |



Characteristics



| | | | | | |
|---|---|---|---|---|---|
| 8.1 | Test sample(s) | | | | See EN 4400-2. |
| 8.2 | Test piece(s) | | | | See EN 4400-2. |
| 8.3 | Heat treatment | | | | Use condition |
| 9 | Dimensions concerned | | | mm | $1{,}6 \leq a \leq 6$ |
| 10 | Thickness of cladding on each face | | | % | — |
| 11 | Direction of test piece | | | | LT |
| 12 | T | Temperature | $\theta$ | °C | Ambient |
| 13 | T | Proof stress | $R_{p0,2}$ | MPa | ≥ 290 |
| 14 | T | Strength | $R_m$ | MPa | ≥ 445 |
| 15 | T | Elongation | $A$ | % | $A_{50\ mm} \geq 14$ |
| 16 | T | Reduction of area | $Z$ | % | — |
| 17 | Hardness | | | | — |
| 18 | Shear strength | | $R_c$ | MPa | — |
| 19 | Bending | | $k$ | – | — |
| 20 | Impact strength | | | | — |
| 21 | C | Temperature | $\theta$ | °C | — |
| 22 | C | Time | | h | — |
| 23 | C | Stress | $\sigma_a$ | MPa | — |
| 24 | C | Elongation | $a$ | % | — |
| 25 | C | Rupture stress | $\sigma_R$ | MPa | — |
| 26 | C | Elongation at rupture | $A$ | % | — |
| 27 | Notes (see line 98) | | | | — |

| | | | | | | |
|---|---|---|---|---|---|---|
| **38** | Intergranular corrosion | — | See EN 4400-2. | | | |
| | | 7 | Dimensions (mm) | | $0,6 \leq a \leq 3,2$ | $3,2 < a \leq 6$ |
| | | | Maximum depth of penetration (µm) | | ≤ 150 | ≤ 200 |
| **44** | External defects | — | See EN 4400-2. | | | |
| **65** | Chemical millability | — | See EN 4400-2. | | | |
| | | 7 | Measurement of residual stress: h ≤ 4 mm | | | |
| **82** | Batch uniformity | — | See EN 4400-2. | | | |
| | | 7 | Electrical conductivity | γ | MS/m | 17,5 (Typical value) |
| | | or | | | | |
| | | 7 | Hardness | HB | 125 (Typical value) | |
| | | | | | δ ≤ 16 per product | Δ ≤ 24 per batch |
| | | | | | | |
| **95** | Marking inspection | — | See EN 4400-2 | | | |
| **96** | Dimensional inspection | — | See EN 4400-2 | | | |
| **98** | Notes | — | — | | | |
| **99** | Typical use | — | For parts manufactured by chemically milling through the thickness, necessitating control of residual stress | | | |