BS EN 3351:2012

BSI Standards Publication

Aerospace series — Titanium alloy Ti-4Al-4Mo-2Sn — Solution treated and aged — Forgings — De ≤ 150 mm

bsi.

...making excellence a habit.™

National foreword

This British Standard is the UK implementation of EN 3351:2012. It supersedes BS 2TA 48:2009 and BS 2TA 51:2009, which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ACE/61/-/49, Titanium and its Alloys for Aerospace Purposes.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2012.

ISBN 978 0 580 78583 2

ICS 49.025.30

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2012.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 3351

October 2012

ICS 49.025.30

English Version

Aerospace series - Titanium alloy Ti-4Al-4Mo-2Sn - Solution treated and aged - Forgings - De ≤ 150 mm

Série aérospatiale - Alliage de titane Ti-4Al-4Mo-2Sn - Mis en solution et revenu - Pièces forgées ou matricées - De ≤ 150 mm

Luft- und Raumfahrt - Titanlegierung Ti-4Al-4Mo-2Sn - Lösungsgeglüht und ausgelagert - Schmiedestücke - De ≤ 150 mm

This European Standard was approved by CEN on 23 June 2012.

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, Former Yugoslav Republic of Macedonia, 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

Ref. No. EN 3351:2012: E

Contents

Page

Foreword

This document (EN 3351:2012) 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 April 2013, and conflicting national standards shall be withdrawn at the latest by April 2013.

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 organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, 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.

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 4500-004.

1 Scope

This European Standard specifies the requirements relating to: [1)]

Titanium alloy Ti-4Al-4Mo-2Sn
Solution treated and aged
Forgings
$D_e \leq 150$ mm

for aerospace applications.

NOTE Other common designation:
Ti550,
AECMA: TI-P63,
ASD-STAN: TI-P63001.

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 2032-2, *Aerospace series — Metallic materials — Part 2: Coding of metallurgical condition in delivery condition*

EN 2954-002, *Aerospace series — Macrostructure of titanium and titanium alloy wrought products — Part 002: Macrostructure of bar, section, forging stock and forgings*

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

EN 4500-004, *Aerospace series — Metallic materials — Rules for drafting and presentation of material standards — Part 004: Specific rules for titanium and titanium alloys* [2)]

EN 4800-005, *Aerospace series — Titanium and titanium alloys — Technical specification — Part 005: Forging stock*

EN 4800-006, *Aerospace series — Titanium and titanium alloys — Technical specification — Part 006: Pre-production and production forgings*

1) Quality Grade 2 according to EN 4800-005.

2) Published as ASD-STAN Standard at the date of publication of this standard (www.asd-stan.org).

1	Material designation		Titanium alloy Ti-4Al-4Mo-2Sn										
2	Chemical composition %	Element	Al	Mo	Sn	Si	O	N	H	Fe	C	Others	Ti
												Each / Total	
		min.	3,0	3,0	1,5	0,3	–	–	–	–	–	– / –	Base
		max.	5,0	5,0	2,5	0,7	0,25	0,03	0,012 5	0,20	0,08	0,10 / 0,40	
3	Method of melting		Quality Grade 2 according to EN 4800-005										
4.1	Form		Forgings										
4.2	Method of production		Forged from forging stock EN 4800-005										
4.3	Limit dimension(s)	mm	$D_e \leq 150$										
5	Technical specification		EN 4800-006										

6.1	Delivery condition	Solution treated and aged
	Heat treatment	880 °C ≤ θ ≤ 920 °C/t ≥ 20 min/AC 490 °C ≤ θ ≤ 510 °C/t = 24 h/AC
6.2	Delivery condition code	U [a]
7	Use condition	Delivery condition
	Heat treatment	–

Characteristics

8.1	Test sample(s)			See EN 4800-006.			
8.2	Test piece(s)			See EN 4800-006.			
8.3	Heat treatment			Use condition			
9	Dimensions concerned		mm	$D_e \leq 100$	$100 \leq D_e \leq 150$		
10	Thickness of cladding on each face		%	–			
11	Direction of test piece			See EN 4800-006.			
12	T	Temperature	θ °C	Ambient			
13	T	Proof stress	$R_{p0,2}$ MPa	≥ 920	≥ 870		
14	T	Strength	R_m MPa	1 050 ≤ R_m ≤ 1 220	1 000 ≤ R_m ≤ 1 220		
15	T	Elongation	A %	≥ 9	≥ 9		
16	T	Reduction of area	Z %	≥ 20	≥ 20		
17	Hardness			–			
18	Shear strength		R_c MPa	–			
19	Bending		k –	–			
20	Impact strength			–			
21	C	Temperature	θ °C	–			
22	C	Time	h	–			
23	C	Stress	σ_a MPa	–			
24	C	Elongation	a %	–			
25	C	Rupture stress	σ_R MPa	–			
26	C	Elongation at rupture	A %	–			
27	Notes (see line 98)			a			

<table>
<tr><td>30</td><td>Microstructure</td><td>–</td><td colspan="4">See EN 4800-006.</td></tr>
<tr><td></td><td></td><td>7</td><td colspan="4">Microstructure shall be resulting from processing in the alpha beta phase field. It shall consist of equiaxed and/or elongated primary alpha in a transformed beta matrix with no continuous network of alpha at prior grain boundaries. A microstructure showing a continuous network of alpha at prior beta grains boundaries is not acceptable</td></tr>
<tr><td>44</td><td>External defects</td><td>–</td><td colspan="4">See EN 4800-006.</td></tr>
<tr><td>51</td><td>Macrostructure</td><td>–</td><td colspan="4">See EN 4800-006.</td></tr>
<tr><td></td><td></td><td>7</td><td colspan="4">detection of any of the following will be cause for rejection: porosity, beta segregation, evidence of overheating, unsealed ingot cavity, cracks or laps, hard alpha defects or dense metal inclusions</td></tr>
<tr><td></td><td></td><td>1</td><td colspan="4">EN 2954-002</td></tr>
<tr><td></td><td></td><td rowspan="2">7</td><td>a or D_e
mm</td><td>Maximum acceptable macrostructure</td><td>Not acceptable macrostructure</td><td>Macrostructure submitted for approval</td></tr>
<tr><td></td><td></td><td>50 < a or D < 110</td><td>2 MA 3</td><td>2 MA 80 to 2 MA 84
and
2 MA 100</td><td>2 MA 40 to 2 MA 42
and
2 MA 60 to 2 MA 62</td></tr>
<tr><td>61</td><td>Internal defects</td><td>–</td><td colspan="4">See EN 4800-006.</td></tr>
<tr><td></td><td></td><td>2</td><td colspan="4">Pre-production part unless otherwise specified</td></tr>
<tr><td></td><td></td><td>3</td><td colspan="4">See inspection schedule.</td></tr>
<tr><td>82</td><td>Batch uniformity
(Material verification)</td><td>–</td><td colspan="4">See EN 4800-006.</td></tr>
<tr><td></td><td></td><td></td><td colspan="4"></td></tr>
<tr><td>95</td><td>Marking inspection</td><td>–</td><td colspan="4">See EN 4800-006.</td></tr>
<tr><td>96</td><td>Dimensional inspection</td><td>–</td><td colspan="4">See EN 4800-006.</td></tr>
<tr><td>98</td><td>Notes</td><td>–</td><td colspan="4">[a] According to EN 2032-2.</td></tr>
<tr><td>99</td><td>Typical use</td><td>–</td><td colspan="4">–</td></tr>
</table>

100	–	Product qualification	–	Qualification programme to be agreed between manufacturer and purchaser.

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email bsmusales@bsigroup.com.

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Copyright

Useful Contacts:

Customer Services
Tel: +44 845 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 845 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

bsi.

...making excellence a habit.™