BS EN 4659:2010

BSI Standards Publication

Aerospace series — Steel FE-PM1507 (X1CrNiMoAlTi12-11-2) — Vacuum induction melted and consumable electrode remelted — Solution treated and precipitation treated — Forgings — *a* or *D* ≤ 200 mm — $R_m \geq 1\,650$ MPa

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National foreword

This British Standard is the UK implementation of EN 4659:2010.

The UK participation in its preparation was entrusted to Technical Committee ACE/61/-/15, Steels 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.

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English Version

Aerospace series - Steel FE-PM1507 (X1CrNiMoAlTi12-11-2) - Vacuum induction melted and consumable electrode remelted - Solution treated and precipitation treated - Forgings - *a* or $D \leq$ 200 mm - $R_m \geq 1\,650$ MPa

Série aérospatiale - Acier FE-PM1507 (X1CrNiMoAlTi12-11-2) - Élaboré sous vide par induction et refondu à l'électrode consommable - Mis en solution et vieilli - Pièces forgées et pièces matricées - *a* ou $D \leq 200$ mm - $R_m \geq 1\,650$ MPa

Luft- und Raumfahrt - Stahl FE-PM1507 (X1CrNiMoAlTi12-11-2) - Vakuuminduktionserschmolzen und mit selbstverzehrender Elektrode umgeschmolzen - Lösungsgeglüht und ausgelagert - Schmiedestücke - *a* oder $D \leq 200$ mm - $R_m \geq 1\,650$ MPa

This European Standard was approved by CEN on 7 August 2010.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

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Foreword

This document (EN 4659:2010) 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of an identical text or by endorsement, at the latest by June 2011, and conflicting national standards shall be withdrawn at the latest by June 2011.

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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 4500-5.

1 Scope

This standard specifies the requirements relating to:

Steel FE-PM1507 (X1CrNiMoAlTi12-11-2)
Vacuum induction melted and consumable electrode remelted
Solution treated and precipitation treated
Forgings
a or *D* ≤ 200 mm
$R_m \geq 1\,650$ MPa

for aerospace 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 2043, *Aerospace series — Metallic materials — General requirements for semi-finished product qualification (excluding forgings and castings)* [1)]

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

EN 4500-5, *Aerospace series — Metallic materials — Rules for drafting and presentation of material standards — Part 5: Specific rules for steels* [1)]

EN 4670, *Aerospace series — Steel FE-PM1507 (X1CrNiMoAlTi12-11-2) — Vacuum induction melted and consumable electrode remelted — Softened — Forging stock — a or D 300 mm*

EN 4700-006, *Aerospace series — Steel and heat resisting alloys — Wrought products — Technical specification — Part 006: Pre-production and production forgings*

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1) Published as ASD-STAN Prestandard at the date of publication of this standard by Aerospace and Defence Industries Association of Europe-Standardization (ASD-STAN) (www.asd-stan.org).

1	Material designation		FE-PM1507 (X1CrNiMoAlTi12-11-2)											
2	Chemical composition %	Element	C	Si	Mn	P	S	Cr	Ni	Mo	Al	Ti	N_2	Fe
		min.	–	–	–	–	–	11,0	10,25	1,75	1,35	0,20	–	base
		max.	0,015	0,10	0,10	0,010	0,005	12,5	11,25	2,25	1,75	0,50	0,01	
3	Method of melting		Vacuum induction melted and consumable electrode remelted											
4.1	Form		Forgings											
4.2	Method of production		Forged from forging stock EN 4670											
4.3	Limit dimension(s)	mm	*a* or *D* ≤ 200											
5	Technical specification		EN 4700-006											

6.1	Delivery condition	Solution treated	Solution treated and precipitation treated
	Heat treatment	840 °C ≤ θ ≤ 860 °C / 2 h / WQ + Sub-zero to θ – 75 °C / 8 h	840 °C ≤ θ ≤ 860 °C / 2 h / WQ + Sub-zero to θ – 75 °C / 8 h + 500 °C ≤ θ ≤ 520 °C / t ≥ 8 h / AC
6.2	Delivery condition code	W	U
7	Use condition	Solution treated and precipitation treated	Delivery condition
	Heat treatment	Delivery condition + 500 °C ≤ θ ≤ 520 °C / t ≥ 8 h / AC	–

Characteristics

8.1	Test sample(s)			See EN 4700-006.			
8.2	Test piece(s)			See EN 4700-006.			
8.3	Heat treatment			Delivery condition	Use condition		
9	Dimensions concerned		mm	*a* or *D* ≤ 200	*a* or *D* ≤ 200 [a]	75 ≤ *a* or *D* ≤ 200 [a]	
10	Thickness of cladding on each face		%	–	–	–	
11	Direction of test piece			–	L	T	
12	T	Temperature	θ °C	–	Ambient	Ambient	
13		Proof stress	$R_{p0,2}$ MPa	–	≥ 1 520	≥ 1 520	
14		Strength	R_m MPa	–	≥ 1 650	≥ 1 650	
15		Elongation	A %	–	≥ 10	≥ 8	
16		Reduction of area	Z %	–	≥ 45	≥ 35	
17	Hardness			≤ 363 HB	≥ 448 HB	≥ 448 HB	
18	Shear strength		R_c MPa	–	–	–	
19	Bending		k –	–	–	–	
20	Impact strength			–	Notch direction T KV ≥ 15 J; ambient	Notch direction L KV ≥ 10 J; ambient	
21	C	Temperature	θ °C	–			
22		Time	h	–			
23		Stress	σ_a MPa	–			
24		Elongation	a %	–			
25		Rupture stress	σ_R MPa	–			
26		Elongation at rupture	A %	–			
27	Notes (see line 98)			a			

30	Microstructure	1	EN 4700-006		
		2	One per cast		
		3	Corresponding to ingot top		
		7	The δ ferrite content shall not exceed 2 %.		
34	Grain size	–	See EN 4700-006.		
		7	G ≥ 6, some 5 accepted		
44	External defects	–	See EN 4700-006.		
		1	Visual		
50	Cleanliness / inclusion content (micro-cleanness)	1	EN 4700-006		
		7	Category 5		
51	Macrostructure	–	See EN 4700-006.		
		7	Class	Condition	Severity
			1	Freckles	A
			2	White spots	A
			3	Radial segregation	A
			4	Ring pattern	B
61	Internal defects	–	See EN 4700-006.		
		6	*a* or *D* ≤ 100 mm may be tested either on the product or at an earlier stage of manufacturing.		
		7	Class 5		
95	Marking inspection	–	See EN 4700-006.		
96	Dimensional inspection	–	See EN 4700-006.		
98	Notes	–	[a] 75 mm ≤ *a* or *D* ≤ 200 mm may be tested in L or T direction.		
99	Typical use	–	–		

100	–	Product qualification	–	See EN 2043.
				Qualification programme to be agreed between manufacturer and purchaser.

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