



BSI Standards Publication

**Aerospace series — Steel FE-
PM1506 (X1CrNiMoAlTi12-10-2)
— Vacuum induction melted
and consumable electrode
remelted — Solution treated
and precipitation treated —
Forgings — a or $D \leq 200$ mm
— $R_m \geq 1400$ MPa**

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National foreword

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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.

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Date	Text affected
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EUROPEAN STANDARD

EN 4671

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2010

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English Version

**Aerospace series - Steel FE-PM1506 (X1CrNiMoAlTi12-10-2) -
Vacuum induction melted and consumable electrode remelted -
Solution treated and precipitation treated - Forgings - a or D ≤
200 mm - Rm ≥ 1400 MPa**

Série aérospatiale - Acier FE-PM1506 (X1CrNiMoAlTi12-10-2) - Élaboré sous vide par induction et refondu à l'électrode consommable - Mis en solution et vieilli - Pièces forgées et matricées - a ou D ≤ 200 mm - Rm ≥ 1 400 MPa

Luft- und Raumfahrt - Stahl FE-PM1506 (X1CrNiMoAlTi12-10-2) - Vakuuminduktionserschmolzen und mit selbstverzehrender Elektrode umgeschmolzen - Lösungsgeglüht und ausgelagert - Schmiedestücke - a oder D ≤ 200 mm - Rm ≥ 1 400 MPa

This European Standard was approved by CEN on 9 October 2010.

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Foreword

This document (EN 4671:2010) 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of an identical text or by endorsement, at the latest by June 2011, and conflicting national standards shall be withdrawn at the latest by June 2011.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 European 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 4500-3.

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1 Scope

This European Standard specifies the requirements relating to:

Steel FE-PM1506 (X1CrNiMoAlTi12-10-2)
Vacuum induction melted and consumable electrode remelted
Solution treated and precipitation treated
Forgings
 a or $D \leq 200$ mm
 $R_m \geq 1\,400$ 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 4436, *Aerospace series — Steel — Test methods — Determination of Delta ferrite content* ¹⁾

EN 4500-3, *Aerospace series — Metallic materials — Rules for drafting and presentation of material standards — Part 3: Specific rules for heat resisting alloys* ¹⁾

EN 4672, *Aerospace series — Steel FE-PM1504 (X1CrNiMoAlTi12-10-2) — Vacuum induction melted and consumable electrode remelted — Softened — Forging stock — a or $D \leq 300$ mm* ¹⁾

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

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

1	Material designation		FE-PM1506 (X1CrNiMoAlTi12-10-2)											
2	Chemical composition %	Element	C	Si	Mn	P	S	Cr	Ni	Mo	Al	Ti	N ₂	Fe
		min.	–	–	–	–	–	11,5	9,2	1,85	0,80	0,28	–	base
		max.	0,015	0,10	0,10	0,010	0,005	12,5	10,2	2,25	1,10	0,40	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 4672											
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		820 °C ≤ θ ≤ 860 °C / OQ, AQ or WQ + cooling to θ ≤ 20 °C				820 °C ≤ θ ≤ 860 °C / OQ, AQ or WQ + cooling to θ ≤ 20 °C + 530 °C ≤ θ ≤ 550 °C / t ≥ 4 h / AC			
6.2	Delivery condition code		W				U			
7	Use condition		Solution treated and precipitation treated				Delivery condition			
	Heat treatment		Delivery condition + 530 °C ≤ θ ≤ 550 °C / t ≥ 4 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				a or D ≤ 200 ^a				
10	Thickness of cladding on each face	%	–				–				–				
11	Direction of test piece		–				L				T				
12	Temperature	θ	°C	–				Ambient				Ambient			
13	Proof stress	R _{p0.2}	MPa	–				≥ 1 300				≥ 1 300			
14	T Strength	R _m	MPa	–				≥ 1 400				≥ 1 400			
15	Elongation	A	%	–				≥ 9				≥ 8			
16	Reduction of area	Z	%	–				≥ 50				≥ 45			
17	Hardness		≤ 363 HB				≥ 400 HB				≥ 400 HB				
18	Shear strength	R _c	MPa	–				–				–			
19	Bending	k	–	–				–				–			
20	Impact strength		–				Notch direction T KV ≥ 50 J, ambient + KV ≥ 20 J, at – 40 °C				Notch direction L KV ≥ 40 J, ambient + KV ≥ 15 J, at – 40 °C				
21	Temperature	θ	°C	–											
22	Time		h	–											
23	C 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 4436			
		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	$G \geq 6$, some 5 accepted			
44	External defects	-	See EN 4700-006.			
		1	Visual			
50	Cleanliness / inclusion content (micro-cleanness)	1	See 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 $D \leq 200$ 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 $75 \text{ mm} \leq a \text{ or } D \leq 100 \text{ mm}$ 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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