

---

**Aeronavtika - Jeklo FE-PM1507 (X1CrNiMoAlTi12-11-2) - Izkovki a ali  $D \leq 200$  mm -  $R_m \geq 1650$  MPa, taljeni z vakuumsko indukcijo in pretaljeni s talilno elektrodo, žarjeni v topilu in utrjeni**

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 -  $R_m \geq 1650$  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 -  $R_m \geq 1650$  MPa

*iTeh STANDARD PREVIEW*  
*(standards.it, h ai)*  
<https://standards.it/catalog/standards/sist/49d38986-e5bd-4465-ab34-cb4e4042842e/sist-en-4659-2011>

Série aérospatiale - Acier FE-PM1507 (X1CrNiMoAlTi12-11-2) - Elaboré 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 -  $R_m \geq 1650$  MPa

**Ta slovenski standard je istoveten z: EN 4659:2010**

---

**ICS:**

49.025.10      Jekla

Steels

**SIST EN 4659:2011**

**en**

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 4659:2011](#)

<https://standards.iteh.ai/catalog/standards/sist/49d38986-e5bd-4465-ab34-cb4e4042842e/sist-en-4659-2011>

EUROPEAN STANDARD

**EN 4659**

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 2010

ICS 49.025.10

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.

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 and United Kingdom.



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

**Management Centre: Avenue Marnix 17, B-1000 Brussels**

<b>Contents</b>		Page
Foreword.....		3
Introduction.....		4
1	Scope .....	5
2	Normative references .....	5

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 4659:2011](#)

<https://standards.iteh.ai/catalog/standards/sist/49d38986-e5bd-4465-ab34-cb4e4042842e/sist-en-4659-2011>

## 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.

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 and the United Kingdom.

**ITEH STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 4659:2011](https://standards.iteh.ai/catalog/standards/sist/49d38986-e5bd-4465-ab34-cb4e4042842e/sist-en-4659-2011)

<https://standards.iteh.ai/catalog/standards/sist/49d38986-e5bd-4465-ab34-cb4e4042842e/sist-en-4659-2011>

**EN 4659:2010 (E)**

## **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.

## **iTeh STANDARD PREVIEW (standards.iteh.ai)**

[SIST EN 4659:2011](https://standards.iteh.ai/catalog/standards/sist/49d38986-e5bd-4465-ab34-cb4e4042842e/sist-en-4659-2011)

<https://standards.iteh.ai/catalog/standards/sist/49d38986-e5bd-4465-ab34-cb4e4042842e/sist-en-4659-2011>

## 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  $D \leq 200$  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)* <sup>1)</sup>

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* <sup>1)</sup>

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*

---

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](http://www.asd-stan.org)).

## EN 4659:2010 (E)

1	Material designation		FE-PM1507 (X1CrNiMoAlTi12-11-2)											
2	Chemical composition %	Element	C	Si	Mn	P	S	Cr	Ni	Mo	Al	Ti	N <sub>2</sub>	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				–			

## iTech STANDARD PREVIEW

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 <sup>a</sup>				a or D ≤ 200 <sup>a</sup>				75 ≤ a or D ≤ 200 <sup>a</sup>				
10	Thickness of cladding on each face	%	–				–				–				
11	Direction of test piece		–				L				T				
12	Temperature	θ	°C	–				Ambient				Ambient			
13	Proof stress	R <sub>p0,2</sub>	MPa	–				≥ 1 520				≥ 1 520			
14	T Strength	R <sub>m</sub>	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 <sub>c</sub>	MPa	–				–				–			
19	Bending	k	–	–				–				–			
20	Impact strength		–				Notch direction T KV ≥ 15 J; ambient				Notch direction L KV ≥ 10 J; ambient				
21	Temperature	θ	°C	–											
22	Time		h	–											
23	Stress	σ <sub>a</sub>	MPa	–											
24	Elongation	a	%	–											
25	Rupture stress	σ <sub>R</sub>	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 $\delta$ 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	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 $D \leq 100$ mm may be tested either on the product or at an earlier stage of manufacturing.		
		7	Class 5		
			<p style="text-align: center;">iTech STANDARD PREVIEW (standards.iteh.ai)</p> <p style="text-align: center;">SIST EN 4659:2011  <a href="https://standards.iteh.ai/catalog/standards/sist/49d38986-e5bd-4465-ab34-cb4e4042842e/sist-en-4659-2011">https://standards.iteh.ai/catalog/standards/sist/49d38986-e5bd-4465-ab34-cb4e4042842e/sist-en-4659-2011</a></p>		
95	Marking inspection	–	See EN 4700-006.		
96	Dimensional inspection	–	See EN 4700-006.		
98	Notes	–	<sup>a</sup> 75 mm $\leq$ a or $D \leq$ 200 mm may be tested in L or T direction.		
99	Typical use	–	–		