
**Aeronavtika - Sorniki, navoj MJ, iz toplotno odpornega jekla FE-PA2601 (A286) -
Klasifikacija: 900 MPa (pri okoljski temperaturi)/650 °C - Tehnična specifikacija**

Aerospace series - Bolts, MJ threads, in heat resisting steel FE-PA2601 (A286) -
Classification: 900 MPa (at ambient temperature)/650 °C - Technical specification

Luft- und Raumfahrt - Schrauben, MJ-Gewinde, aus hochwarmfestem Stahl FE-PA2601
(A286) - Klasse: 900 MPa (bei Raumtemperatur)/650 °C - Technische
Lieferbedingungen

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Série aérospatiale - Vis à filetage MJ, en acier résistant à chaud FE-PA2601 (A286) -
Classification : 900 MPa (à température ambiante)/650 °C - Spécification technique

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 2576:2020) 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of an identical text or by endorsement, at the latest by November 2020, and conflicting national standards shall be withdrawn at the latest by November 2020.

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EN 2576:2020 (E)**1 Scope**

This document specifies the characteristics, qualification and acceptance requirements for bolts with MJ threads in heat resisting steel FE-PA2601, for aerospace applications.

Classification: 900 MPa¹/650 °C².

It is applicable whenever referenced.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 ISO 3452-1, *Non-destructive testing — Penetrant testing — Part 1: General principles*

EN ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

EN ISO 6508-1, *Metallic materials — Rockwell hardness test — Part 1: Test method*

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 5855-2, *Aerospace — MJ threads — Part 2: Limit dimensions for bolts and nuts*
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ISO 7961, *Aerospace — Bolts — Test methods*

ASTM E 112, *Standard Test Methods for Determining Average Grain Size*³

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

¹ Minimum tensile strength of the material at ambient temperature.

² Maximum test temperature of the parts.

³ Published by: ASTM International (<http://www.astm.org/>).

3.1

batch

quantity of finished parts, of the same type and same diameter, produced from the same material obtained from the same melt, manufactured in the course of the same production cycle, following the same manufacturing route and having undergone all the relevant heat treatments and surface treatments

3.2

inspection lot

quantity of parts from a single production batch of the same part number which completely defines the parts

3.3 Surface discontinuities

3.3.1

crack

rupture in the material which may extend in any direction and which may be intercrystalline or transcrystalline in character

3.3.2

seam

longitudinal surface discontinuity in the form of an unwelded open fold in the material

3.3.3

lap

surface discontinuity caused by folding over metal fins or sharp corners and then rolling or forging them into the surface

3.3.4

inclusion

non-metallic particles originating from the material manufacturing process

Note 1 to entry: These particles may be isolated or arranged in strings extending longitudinally.

3.4

test temperature

ambient temperature, unless otherwise specified

3.5

simple random sampling

the taking of n items from a population of N items in such a way that all possible combinations of n items have the same probability of being chosen

3.6

critical defect

defect that, according to judgement and experience, is likely to result in hazardous or unsafe conditions for individuals using, maintaining, or depending upon the considered product, or that is likely to prevent performance of the function of a major end item

3.7

major defect

defect other than critical, that is likely to result in a failure or to reduce materially the usability of the considered product for its intended purpose

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EN 2576:2020 (E)**3.8****minor defect**

defect that is not likely to reduce materially the usability of the considered product for its intended purpose, or that is a departure from established specification having little bearing on the effective use or operation of this product

3.9**sampling plan**

plan according to which one or more samples are taken in order to obtain information and possibly to reach a decision

3.10**limiting quality****LQ₁₀**

quality level in a sampling plan which corresponds to a specified and relatively low probability of acceptance, in this case 10 % probability of acceptance

Note 1 to entry: It is the limiting lot quality characteristic that a lot of this quality would occur.

3.11**acceptance quality limit****AQL**

quality limit which in a sampling plan corresponds to a specified but relatively high probability of acceptance

Note 1 to entry: It is the maximum per cent defective (or the maximum number of defects per hundred units) that, for purposes of sampling inspection can be considered satisfactory as a process average.

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3.12**finished bolt**

bolt ready for use, inclusive of any possible treatments and/or surface coatings, as specified in the product standard or definition document

3.13**definition document**

document specifying all the requirements for finished bolts

4 Quality assurance**4.1 Qualification**

The qualification procedure for aerospace standard products (e.g. according to EN 9133 or an equivalent aerospace accepted and established qualification procedure) shall be used and documented according to the specified tests if not otherwise agreed between customer and supplier.

Qualification inspections and tests (requirements, methods, number of bolts) are specified in Table 1. They shall be carried out on:

- each type and diameter of bolt;
- 25 bolts selected from a single inspection lot by simple random sampling.

The test programme may possibly be reduced, or the qualification of a bolt be granted without inspection or testing; any such decision shall be based on the results obtained on similar types and diameters of bolts provided that the design and manufacturing conditions are identical.

Table 2 indicates the allocation of bolt samples for the inspections and tests.

4.2 Acceptance

4.2.1 Purpose

The purpose of acceptance inspections and tests is to check, as simply as possible, by a method representative of actual use conditions, with the uncertainty inherent to statistical sampling, that the bolts constituting the batch satisfy the requirements of this standard.

4.2.2 Conditions

Acceptance inspections and tests (requirements, methods, number of bolts) are specified in Table 1; they shall be carried out on each batch. Bolts from the batch to be tested shall be selected by simple random sampling.

Each bolt may be submitted to several inspections or tests.

If a more stringent inspection is deemed necessary, all or part of the qualification inspections and tests may be performed during the acceptance inspection and testing. In this case, the number of bolts submitted to these inspections and tests is the same as that submitted for qualification inspection and tests.

4.2.3 Responsibility

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Acceptance inspections and tests shall be carried out by the manufacturer, or under his responsibility.

4.2.4 Inspection and test report

A test report showing actual numerical values shall be provided if specified in the purchase order.

5 Requirements

See Table 1.

Table 1 — Technical requirements and test methods

Clause	Characteristic	Requirement	Inspection and test method	Q/A ^a	Sample size
5.1	Material	In accordance with the product standard or definition document	Chemical analysis or certificate of compliance issued by the manufacturer of the semi-finished product	Q	
				A	
5.2	Dimensions, tolerances and tolerances of form and position	In accordance with the product standard or definition document	Standard gauging	Q	25
				A	Table 3 and Table 4
5.3	Manufacturing				
5.3.1	Forging	The heads of the bolts shall be formed by hot or cold forging. If hot forged, the forging temperature shall not exceed 1 150 °C and they shall be air cooled. The equipment shall ensure a uniform temperature throughout the batch.	The method of forging shall be indicated.	Q	
5.3.2	Heat treatment	The heat treatment medium or atmosphere shall not cause any surface contamination except as permitted by 5.5.6.	Calibration of the heat treatment equipment shall be confirmed.	Q	
		Any scale not removed by subsequent machining shall be removed by abrasive blasting with appropriate equipment.	Visual examination		
5.3.2.1	Solution heat treatment	The headed blanks shall be solution treated at a temperature of (980 ± 15) °C, held at this temperature and quenched in oil, water or equivalent.	Examination of the heat treatment specification		
5.3.2.2	Precipitation heat treatment	Before cold rolling the underhead radius, and thread rolling, the parts shall be precipitation heat treated at 710 °C to 730 °C, holding the selected temperature within ± 8 °C for not less than 16 hours and cooling in air or equivalent.			

Clause	Characteristic	Requirement	Inspection and test method	Q/A ^a	Sample size
5.3.3	Removal of surface contamination by machining or sand blasting.	<p>After heat treatment the headed blanks shall have the shank and bearing surface of the head machined:</p> <p>a) for the removal of all surface contamination and oxide penetration;</p> <p>b) to obtain a clean smooth surface.</p> <p>The amount of material removed (see Figure 1) shall be as little as practicable and shall not exceed the limits of Table 5.</p>	<p>See 5.5.6.</p> <p>See 5.5.1.</p>		
5.3.4	Head to shank fillet	<p>After completion of solution, precipitation heat treatment and machining, the underhead fillet radius shall be cold rolled to remove all visual signs of machining and to create cold working.</p> <p>This may cause distortion which shall not exceed the values in Figure 2, unless otherwise specified on the product standard or definition document.</p> <p>For parts with compound radii between head and shank (e. g. T head bolts), only the radius that blends with the head shall be cold worked, however it is acceptable for cold work to extend over the compound radius.</p> <p>The fillet shall not show seams or inclusions (see Table 6).</p>	Dimensional check (see 5.2) and visual examination	Q	25
				A	Table 3 and Table 4
5.3.5	Threads	Shall be formed by a single rolling process after all heat treatment and machining (see Figure 3).		Q	
5.3.6	Surface roughness	In accordance with the product standard or definition document	EN ISO 4288	Q	3
			Visual examination	A	Table 3 and Table 4
				A	100 %
5.3.7	Surface coating	In accordance with the product standard or definition document	See applicable coating standard.	Q	3
				A	Table 3 and Table 4

Clause	Characteristic	Requirement	Inspection and test method	Q/A ^a	Sample size
5.4	Mechanical properties				
5.4.1	Tensile strength at ambient temperature	<p>The finished bolts shall withstand the minimum tensile loads specified in Table 7.</p> <p>Bolts with external drive shall not fail in the head to shank area when subjected to the tensile test.</p> <p>Tensile tests are not applicable to the following:</p> <p>a) protruding head bolts of nominal length $< 3 D$;</p> <p>b) countersunk head bolts of nominal length $< 3 D$ or bolts having a nominal length < 18 mm;</p> <p>c) bolts of nominal diameter < 5 mm.</p> <p>In such cases acceptability shall be based on the results from test bars of the same material heat treated within the same process cycle (see 5.4).</p>	ISO 7961 for parts	Q	4
			EN ISO 6892-1 for test pieces	A	Table 8, column B or Table 9
5.4.2	Stress rupture	<p>The finished bolts shall be maintained at $(650 \pm 2)^\circ\text{C}$ while the load specified in Table 7 is applied continuously.</p> <p>There shall be no rupture in less than 23 hours.</p>	ISO 7961	Q	3
5.4.3	Hardness	<p>Before surface coating is applied, the hardness shall be uniform within the batch and be within the range 26 HRC to 35 HRC when measured at thread end of bolt. Non-conforming hardness shall not be cause for rejection providing tensile requirement of 5.4.1 is met.</p> <p>The hardness of the threads and the head to shank fillet area may be higher.</p>	EN ISO 6508-1	Q	4
				A	Table 8, column A