SLOVENSKI STANDARD
SIST EN 3833:2004

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Aerospace series - Bolts, MJ threads, in heat resisting nickel base alloy NI-PH2601 (Inconel 718) - Classification: 1 550 MPa (at ambient temperature) / 650°C - Technical specifications

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49.030.20 Sorniki, vijaki, stebelni vijaki Bolts, screws, studs

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This European Standard was approved by CEN on 2 June 2002.

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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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

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

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Foreword

This document (EN 3833:2003) has been prepared by the European Association of Aerospace Manufacturers – Standardization (AECMA-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 AECMA, 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of an identical text or by endorsement, at the latest by July 2003, and conflicting national standards shall be withdrawn at the latest by July 2003.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard specifies the characteristics, qualification and acceptance requirements for bolts with MJ threads in NI-PH2601.

Classification: 1 550 MPa [1] /650 °C [2]

It is applicable whenever referenced.

2 Normative references

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 3452	Non-destructive testing – Penetrant inspection – General principles
ISO 3534	Statistics – Vocabulary and symbols
ISO 4288	Geometrical Product Specifications (GPS) – Surface texture: Profile method – Rules and procedures for the assessment of surface texture
ISO 5855-2	Aerospace – MJ threads – Part 2: Limit dimensions for bolts and nuts
ISO 6508	Metallic materials – Hardness test – Rockwell test (scales A -B -C -D- E -F -G -H -K)
ISO 6892	Metallic materials – Tensile testing at ambient temperature
ISO 7961	Aerospace – Bolts – Test methods
ISO 9227	Corrosion tests in artificial atmospheres – Salt spray tests

1) Minimum tensile strength of the material at ambient temperature

2) Maximum test temperature of the parts

EN 3042 Aerospace series – Quality assurance – EN aerospace products – Qualification procedure

ASTM E 112-88 Standard Test Methods for Determining Average Grain Size [3)]

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1 Batch

Quantity of finished bolts, of the same type and same diameter, produced from a 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 Surface discontinuities

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

3.2.2 Seam : open surface defect

3.2.3 Lap : surface defect caused by folding over metal fins or sharp corners and then compressing them into the surface

3.2.4 Inclusions : non-metallic particles originating from the material manufacturing process. These particles may be isolated or arranged in strings.

3.3 Test temperature

Ambient temperature, unless otherwise specified

3.4 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 [4)]

3.5 Critical defect

A 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 [4)]

3.6 Major defect

A 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 [4)]

3.7 Minor defect

A 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 [4)]

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3) Published by : American Society for Testing and Materials (ASTM), 1916 Race street, Philadelphia, PA 19103-1187, USA

3.8 Sampling plan

A plan according to which one or more samples are taken in order to obtain information and possibly to reach a decision [4)]

3.9 Limiting quality

In a sampling plan, the quality level which corresponds to the specified 10 % probability of acceptance

3.10 Acceptable quality level (AQL)

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

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 [4)].

3.11 Finished bolt

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

3.12 Definition document

Document specifying all the requirements for finished bolts

4) Definition taken from ISO 3534

4 Quality assurance

4.1 Qualification

EN 3042

Qualification inspections and tests (requirements, methods, numbers 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 batch by simple random sampling.

The test programme may possibly be reduced, or the qualification 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, numbers 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

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 [1)]	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	Tables 3 and 4
5.3	**Manufacturing**				
5.3.1	**Forging**	The head of the bolts shall be formed by hot or cold forging. If hot forged, the forging temperature shall be between 1 040 °C and 1 080 °C and they shall be air cooled. The equipment shall ensure a uniform temperature throughout the batch.	The method of forming 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. Any scale which will not be removed by subsequent machining shall be removed by abrasive blasting with an appropriate equipment. The headed blanks shall be solution treated at a temperature of 930 °C to 1 010 °C, held at the selected temperature within ± 15 °C for not less than 1 h and air cooled or faster. The headed and solution treated blanks shall be precipitation heat treated at (720 ± 5) °C, held at temperature for 8 h ± 15 min, furnace cooled at (55 ± 5) °C per hour to (620 ± 5) °C, held at 620 °C for 8 h ± 15 min, followed by air cooling or faster. Instead of the 55 °C per hour cooling rate to 620 °C, parts may be furnace cooled at any rate provided the time at 620 °C is adjusted to give a total precipitation of time of 18 h min.	Calibration of the heat treatment equipment shall be confirmed. Visual examination Examination of the heat treatment specification	Q	

continued

Table 1 (continued)

Clause	Characteristic	Requirement	Inspection and test method	Q/A [1)]	Sample size
5.3.3	**Removal of surface contamination by machining**	After solution and precipitation treatment the headed blanks shall have the shank and bearing surface of the head machined : a) for the removal of all surface contamination and oxide penetration ; b) to obtain a clean smooth surface. The amount of material removed (see figure 1) shall be as little as practicable but shall not exceed the limits of table 5	See 5.5.6 See 5.5.1		
5.3.4	**Head to shank fillet**	After completion of heat treatment and machining, the underhead fillet radius shall be cold rolled to remove all visual signs of machining and to create cold working. This may cause distortion which shall not exceed the values in figure 2, unless otherwise specified on the product standard or definition document. For parts with compound radii between head and shank (e.g. T head bolts), cold work only the radius that blends with the head, however it is acceptable for cold work to extend over the compound radius. The fillet shall not show seams or inclusions (see table 6)	Dimensional check (see 5.2) and visual examination	Q A	25 Tables 3 and 4
5.3.5	**Threads**	Shall be formed by a single rolling process after full heat treatment (see figure 3)		Q	
5.3.6	**Surface roughness**	In accordance with the product standard or definition document	ISO 4288 Visual examination	Q A	3 Tables 3 and 4
5.3.7	**Passivation treatment**	Uncoated finished bolts shall be passivated in accordance with annex A. After 2 h of salt spray, bolts shall show no evidence of corrosion or staining.	ISO 9227 Visual examination	Q A	5 100 %
5.3.8	**Surface coating**	In accordance with the product standard or definition document	See applicable coating standard	Q A	3 Tables 3 and 4

continued

Table 1 (continued)

Clause	Characteristic	Requirement	Inspection and test method	Q/A [1)]	Sample size
5.4	**Mechanical properties**	A test sample shall be selected from each diameter of bar/wire taken from each cast, and shall be heat treated together with a production batch of bolts. The sample selected shall be sufficient to provide tensile and stress rupture test pieces. The test pieces shall meet the mechanical properties required by the material standard.			
5.4.1	**Tensile strength**	The finished bolts shall withstand the minimum tensile loads specified in table 7. Externally wrenched bolts shall not fail in the head to shank area when subjected to the tensile test. Tensile tests are not applicable to the following : a) protruding head bolts of grip length < twice the nominal shank diameter ; b) countersunk head bolts of grip length < 2,5 times the nominal shank diameter ; c) threaded to head bolts of overal length < three times the nominal shank diameter or bolts having an overal length < 18 mm; d) bolts of diameters of < 4 mm. In such cases acceptability shall be based on the results from test bars of the same material heat treated within the same process cycle.			
5.4.1.1	**- at am bient temperature**		ISO 7961 for parts ISO 6892 for test pieces	Q	4
				A	Table 8, column B or table 9
5.4.1.2	**- at elevated temperature**	650 °C ± 5 °C	ISO 7961 for parts ISO 6892 for test pieces	Q	4
5.4.2	**Stress rupture**	The finished bolts shall be maintained at (650 ± 2) °C while the load specified in table 7 is applied continuously. There shall be no rupture in less than 23 h.	ISO 7961	Q	3

continued