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**Aerospace — Bolts, with MJ threads,
made of alloy steel, strength class 1
100 MPa — Procurement specification**

*Aéronautique et espace — Vis à filetages MJ, en acier allié, de classe
de résistance 1 100 MPa — Spécification d'approvisionnement*

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 4, *Aerospace fastener systems*.

This third edition cancels and replaces the second edition (ISO 7689:2008), which has been technically revised.

The main changes compared to the previous edition are as follows:

- additional requirements in 5.2 "Dimensions";
- additional requirements in 5.4.1 "Tensile strength"
- additional values in [Table 5](#) "Minimum loads for tensile and double shear tests" for protruding head.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Aerospace — Bolts, with MJ threads, made of alloy steel, strength class 1 100 MPa — Procurement specification

1 Scope

This document specifies the characteristics and quality assurance requirements for MJ thread bolts made of alloy steel, of strength class 1 100 MPa, for aerospace construction.

It is applicable whenever it is referenced in a definition document.

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.

ISO 21920-3, *Geometrical product specifications (GPS) — Surface texture: Profile — Part 3: Specification operators*

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

ISO 6506-1, *Metallic materials — Brinell hardness test — Part 1: Test method*

ISO 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

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

ISO 7961, *Aerospace — Bolts — Test methods*

ISO 8258, *Shewhart control charts*

3 Terms and definitions

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

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

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

3.1

production batch

quantity of finished bolts, manufactured using the same process, from a single material cast (single heat of alloy), having the same number of *definition document* (3.3), same thread and diameter code, heat treated together to the same specified condition and produced as one continuous run

3.2

inspection lot

quantity of bolts from a single *production batch* (3.1) having the same number of *definition document* (3.3)

3.3

definition document

document specifying directly or indirectly all the requirements for bolts

Note 1 to entry: The definition document can be an International Standard, an in-house standard or a drawing.

3.4

crack

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

3.5

seam

open surface defect

3.6

lap

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

3.7

crevice

hollow area at thread crest

3.8

inclusions

non-metallic particles originating from the material manufacturing process

Note 1 to entry: These particles can be isolated or arranged in strings.

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

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Note 1 to entry: In this document, each sampling plan specifies the number of bolts to be inspected as a function of the size of the batch and the acceptance number [number of defective items acceptable (Ac)]. See ISO 2859-1.

3.10

simple random sampling

sampling 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

3.11

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 (bolt), or that is likely to prevent performance of the function of a major end item

3.12

major defect

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

3.13

minor defect

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

3.14 limiting quality LQ

< *sampling plan* (3.9) > quality limit that corresponds to a specified and relatively low probability of acceptance

Note 1 to entry: It is the limiting lot quality characteristic that the consumer is willing to accept with a low probability that a lot of this quality would occur.

Note 2 to entry: For the purposes of this document, the limiting quality quoted in [Table 4](#) corresponds to a probability of acceptance of 10 %.

3.15 acceptable quality limit AQL

maximum percent defective (or maximum number of defects per hundred units) that, for purposes of sampling inspection, can be considered satisfactory as a process average

Note 1 to entry: Variant: quality limit which in a *sampling plan* (3.9) corresponds to a specified but relatively high probability of acceptance.

4 Quality assurance

4.1 General

The manufacturer shall be capable of continuous production of bolts complying with the quality requirements specified in this document. It is recommended that the manufacturer be certified to a recognized quality management system. The certification authority may be the prime contractor.

The purpose of qualification inspections of bolts is to check that the design and manufacturing conditions of a bolt allow it to satisfy the requirements of this document.

NOTE In order to simplify the text the term "inspections" used in this document also refers to "inspections and tests".

Quality documentation for parts produced in accordance to this document shall be maintained for a minimum period of 10 years.

Qualification of the bolts shall be granted by the certification authorities in the purchaser's country, or their appointed representative, who may be the prime contractor.

The purpose of production acceptance inspection of a bolt is to check, as simply as possible, using a method which is inexpensive but the most representative of the actual conditions of use, with the uncertainty inherent in statistical sampling, that the bolts satisfy the requirements of this document.

Production acceptance inspections shall be carried out by the manufacturer, or under his responsibility.

4.2 Qualification inspection conditions

Unless otherwise specified, the inspection 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 granted without inspection; any such decision shall be based on the results obtained on similar types and diameters of bolt provided that the design and manufacturing conditions are identical.

The inspections shall be repeated on any bolt if the manufacturing conditions have been modified.

[Table 2](#) indicates the allocation of bolt samples for the inspections.

4.3 Acceptance inspection conditions

Inspections shall be carried out on each production batch or inspection lot. Bolts from the batch or lot to be inspected shall be selected by simple random sampling.

Each bolt may be submitted to several inspections, provided that none of the characteristics to be verified has been previously altered during any of these inspections.

The bolts to be subjected to destructive inspections may be those on which non-destructive inspections have been carried out.

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

Production batches or inspection lots declared unacceptable after the production acceptance inspections shall be submitted for re-inspection only after all the defective units have been removed and/or defects have been corrected. In this case, the attribute(s) that caused the rejection shall be verified using a sample of twice the normal size but with the same number of acceptable defective items.

4.4 Use of "statistical process control (SPC)"

When a characteristic is obtained by a controlled statistical process, in order to declare conformity of the characteristic, the manufacturer has the possibility of refraining from the final systematic sampling provided for in this document if they are capable of formally justifying this choice by using ISO/TR 13425 and the standards quoted in it as a basis.

This justification includes the following phases:

- analysis of the key characteristics of the product;
- analysis of the risks for each implemented process;
- determination of the parameters and/or characteristics to be respected under SPC;
- determination of the capabilities of each process;
- drawing up of an inspection plan and integration in the manufacturing process;
- drawing up of routes and control charts (ISO 7870-3, ISO 7870-1, ISO 8258);
- use of control charts for data consolidation;
- determination of the audits to be run and the control to be carried out to ensure reliability of the device.

To be usable in production, this process shall or should be validated beforehand by the qualifying body, either during the qualification phase or a posteriori, according to the case, by analysing the justificatory file and the results of the qualification inspections such as provided for in [Clause 5](#). **Such an SPC process is not applicable to destructive tests.**

5 Requirements

The requirements in [Table 1](#), unless otherwise specified, shall apply to bolts ready for use. The test temperature, unless otherwise specified, shall be the ambient temperature. These requirements complement the requirements of all other standards or specifications referenced in the definition document.

Table 1 — Requirements and test methods

No.		Characteristic	Requirement	Inspection and test method	Designation ^a	Sample size
5-1		Material	In accordance with the definition document.	See material standard.		As required by semi-finished product
5-2		Dimensions	In accordance with the definition document. Dimensions shall include the chemical applied or electroplated finishes designated on the detailed drawing. Dimensions shall exclude paint and similar coating, metallic dips and dry film lubricants.	Standard gauging. ISO 5855-2 shall apply.	Q	20
					A	See Table 3 and Table 4
5-3		Manufacturing				
	5-3-1	Forging	The heads of the bolts shall be formed by a hot or cold forging process before heat treatment.	According to the route of manufacture.	Q	
			In the case of hot forging, the equipment shall ensure an adequate and uniform temperature throughout the production batch.	The equipment used shall be approved.		
	5-3-2	Heat treatment	The forged blanks shall be heat-treated to produce the properties required by the definition document. Blanks shall not be heat-treated more than twice.	According to the process route.	Q	
				The equipment used shall be approved.		
	5-3-3	Removal of surface contamination (bearing face and shank)	If machining is required, it is necessary to respect the requirements of 5-5-1.			
	5-3-4	Threads	Formed by a single rolling process after full heat treatment.	According to the manufacturing route.	Q	
	5-3-5	Surface roughness	In accordance with the definition document.	ISO 21920-3 shall apply.	Q	5
				Visual examination.	A	See Table 3 and Table 4
	5-3-6	Surface coating	In accordance with the definition document.	See surface coating standard.	Q	5
					A	See Table 3 and Table 4
5-4		Mechanical properties				
	5-4-1	Tensile strength	See Table 5 .	On bolts: ISO 7961 shall apply.	Q	5
			The requirements apply on bolts except on the following:		A for bolts, not for specimens	Table 6 or Table 7
Key						
Q qualification						
A acceptance						

Table 1 (continued)

No.	Character- istic	Requirement	Inspection and test method	Designa- tion ^a	Sample size
		a) protruding head bolts of grip length < twice the nominal shank diameter; b) countersunk head bolts of grip length < two and a half times the nominal shank diameter; c) threaded to head bolts of overall length < three times the nominal thread diameter or bolts having an overall length < 18 mm; d) bolts with a thread length < one and a half times the thread nominal diameter (thread length including imperfect threads); e) bolts with a nominal diameter < 4 mm. f) Full threaded fasteners with both a recess drive and drilled lockwire holes in the head; g) Fasteners with drilled threads. User should be aware that fasteners with holes drilled in the thread area for lock wire or other applications may exhibit a reduction in tensile value.			
5-4-2	Double shear strength	See Table 5 . The requirements apply on bolts except on the following: a) protruding head bolts of grip length < twice the nominal shank diameter; b) countersunk head bolts of grip length < two and a half times the nominal shank diameter; c) bolts with a nominal diameter < 4 mm; d) threaded to head bolts.	ISO 7961 shall apply.	Q A	5 See Table 6 or Table 7
Key Q qualification A acceptance					

Table 1 (continued)

No.		Characteristic	Requirement	Inspection and test method	Designation ^a	Sample size
	5-4-3	Hardness	Before surface coating is applied, the hardness when measured at the end of the bolt (thread end) shall be: — Brinell: (327 to 370) HB; — Rockwell: (36 to 40) HRC; — Vickers: (344 to 390) HV 30.	The following shall apply: ISO 6506-1; ISO 6507-1; ISO 6508-1.	Q	5
					A	See Table 3 and Table 4
	5-4-4	Recess removal torque	The recess of the finished bolt shall withstand the torque values specified in the product standard or definition document. During the test, the driving feature shall show no camout and the recess no excessive distortion.	With the bolt fixed in rotation, submit the driving feature to an end load of (45 ± 2,5) N with the application of the required removal torque at the same time.	Q	5
5-5		Metallurgical properties				
	5-5-1	Head-to-shank grain flow	Flow lines shall closely conform to the contour indicated by Figure 1 . Breaks in flow lines, see Figure 1 .	Macroscopic examination 10× to 20× (see Figure 2), after appropriate etching.	Q	5
					A	See Table 6
	5-5-2	Thread grain flow	Shall be continuous and shall follow the general thread contour with the maximum density at the bottom of the root radius (see Figure 3).	See 5-5-1.	Q	5
					A	See Table 6
	5-5-3	Microstructure and overheating	Shall not: — have microporosity or major segregation; — show evidence of overheating, decarburization, carburization, nitrogenization or intergranular oxidation in excess of the limits specified in Table 8 . Overheating of the head, except for the bearing surface, is permitted provided that its maximum depth, measured normal to the surface of the head, does not exceed:	Microscopic examination at a magnification of 100× (see Figure 2), after appropriate etching.	Q	5
					A	See Table 6
Key						
Q qualification						
A acceptance						