INTERNATIONAL STANDARD

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Aerospace — Self-locking nuts with maximum operating temperature greater than 425 °C — Procurement specification

Aéronautique et espace — Écrous à freinage interne dont la température maximale d'utilisation est supérieure à 425 °C — Spécification d'approvisionnement

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 8641 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 4, *Aerospace fastener systems*.

This second edition cancels and replaces the first edition (ISO 8641:1987) which has been technically revised.

Aerospace — Self-locking nuts with maximum operating temperature greater than 425 °C — Procurement specification

1 Scope

This International Standard specifies the required characteristics for metric self-locking nuts, with MJ thread, for use in aerospace construction at a maximum temperature greater than 425 °C.

It is applicable to nuts as defined above, provided that reference is made to this International Standard in the relevant definition document.

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.

ISO 691, *Assembly tools for screws and nuts — Wrench and socket openings — Tolerances for general use*

ISO 1463, *Metallic and oxide coatings — Measurement of coating thickness — Microscopical method*

ISO 2859-1:1999, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptable quality level (AQL) for lot-by-lot inspection*

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 7403, *Aerospace — Spline drives — Wrenching configuration — Metric series*

ISO 7870-1, *Control charts — General guidelines*

ISO 7966, *Acceptance control charts*

ISO 8258, *Shewhart control charts*

ISO 8642, *Aerospace — Self-locking nuts with maximum operating temperature greater than 425 °C — Test methods*

ISO 8788, *Aerospace — Nuts, metric — Tolerances of form and position*

ISO 9199, *Aerospace — Nuts, bihexagonal, self-locking, MJ threads, classifications: 1 100 MPa (at ambient temperature)/425 °C, 1 100 MPa (at ambient temperature)/650 °C, 1 210 MPa (at ambient temperature)/425 °C, 1 210 MPa (at ambient temperature)/730 °C, 1 550 MPa (at ambient temperature)/235 °C, 1 550 MPa (at ambient temperature)/425 °C and 1 550 MPa (at ambient temperature)/600 °C — Dimensions*

ISO/TR 13425, *Guidelines for the selection of statistical methods in standardization and specification*

3 Terms and definitions

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

3.1
definition document
document specifying all the requirements for nuts, i.e.:

— metallurgical;

— geometrical and dimensional;

— functional (strength and temperature classes)

NOTE The definition document can be an International Standard, a national standard, an in-house standard or a drawing.

3.2
finished nut
nut ready for use, inclusive of any possible treatments and/or surface coatings, as specified in the definition document

3.3
batch
definite quantity of some commodity manufactured or produced under conditions which are presumed to be uniform

NOTE For the purposes of this International Standard, a batch is a quantity of finished nuts, 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.

3.4
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 resulting from extension of the metal

3.6
lap
folding over of unwelded metal that can arise when the material is formed (drawing) or in the finished product (pressing or forging)

3.7
inclusions
non-metallic particles originating from the material manufacturing process

NOTE These particles can be isolated or arranged in strings.

3.8
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

3.9
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

3.10
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 specifications having little bearing on the effective use or operation of this product

3.11
sampling plan
plan according to which one or more samples are taken in order to obtain information and possibly reach a decision

NOTE For the purposes of this International Standard, each sampling plan specifies the number of nuts to be inspected as a function of the size of the batch and the acceptance number [number of defective items acceptable (Ac)][1)].

3.12
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

3.13
acceptance quality limit
AQL
maximum percent defective (or the maximum number of defects per hundred units) that, for purposes of sampling inspection, can be considered satisfactory as a process average

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

3.14
limiting quality
LQ
⟨sampling plan⟩ quality level that corresponds to a specified and relatively low probability of acceptance

NOTE 1 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 For the purposes of this International Standard, the limiting quality given in Table 11 corresponds to a consumer's risk of 10 %.

3.15
self-locking torque
torque to be applied to the nut or bolt to maintain its movement of rotation in relation to the associated part, the assembly being under no axial load and the nut-locking system being completely engaged with the bolt (two pitches minimum protrusion including the end chamfer)

3.16
seating torque
tightening torque to be applied to the nut or bolt to introduce or to increase the axial load in the assembly

3.17
unseating torque
untightening torque to be applied to the nut or bolt to reduce or remove the axial load in the assembly

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1) Ac = acceptance number (supplementary information taken from ISO 2859-1).

3.18
breakaway torque
torque required to start unscrewing the nut or bolt with respect to the associated part, with the nut-locking device still fully engaged on the bolt, but after the axial load in the assembly has been removed by unscrewing half a turn followed by a half in rotational movement

3.19
wrench torque
tightening and untightening torques which the driving feature of the nut shall withstand repeatedly, without any permanent deformation which would prevent the appropriate wrench from being used and preclude re-use of the nut

4 Quality assurance

4.1 General

The manufacturer shall be capable of continuous production of bolts complying with the quality requirements specified in this International Standard. 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 nuts is to check that the design and manufacturing conditions of a bolt allow it to satisfy the requirements of this International Standard.

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 nut 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 International Standard.

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

4.2 Qualification inspection and test conditions

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

— each type and diameter of nut;

— 100 nuts selected from a single batch by simple random sampling.

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

The inspections and tests shall be repeated on any nut if the supplier or the manufacturing conditions have changed. Qualification inspections and tests are summarized in Table 2.

4.3 Production acceptance inspection and test conditions

Production acceptance inspections and tests (requirements, methods, numbers of nuts) are specified in Table 1. They shall be carried out on each batch. Nuts from the batch to be tested shall be selected by simple random sampling.

Each nut may be submitted to several inspections or tests.

The nuts to be subjected to destructive inspections or tests may be those on which non-destructive inspection or testing has been carried out.

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

Batches declared unacceptable after the production acceptance inspections and tests shall be submitted for re-inspection or testing only after all the defective units have been removed and/or defects have been corrected. In this case, the attribute(s) which caused the rejection shall be verified using a sample of twice the normal size with the same number of defective items acceptable. Production acceptance inspections and tests are summarized in Table 2.

4.4 Use of "statistical process control (SPC)"

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

This justification will include the following phases:

— analysis of the product's key characteristics;

— 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 an inspection plan and integration in the manufacturing process;

— drawing up of routes and control charts (ISO 7966, 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 should have been 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.

5 Technical requirements

The technical requirements of this International Standard are given in Table 1.

They complement the requirements of all other standards or specifications referenced in the definition document of the nut.

NOTE The attention of the users of this International Standard is drawn to the fact that if there is no International Standard specifying the method to be used, a prior agreement is necessary between the user and the manufacturer with respect to the following inspections and tests:

— spectrographic analysis or spectroscopic analysis of the material (see 5.1.1);

— micrographic inspection of the structure of the material (see 5.1.2);

— fluoroscopic inspection of surface discontinuities (see 5.1.3);

— inspection by chemical reagent to determine type of surface coating (see 5.2.2);

— tactile inspection or inspection using a profilometer of the surface roughness (see 5.3.2).

Table 1 — Technical requirements and test methods

Subclause		Characteristic	Technical requirement	Inspection and test method	Test category	Sample size
5.1		Material				
	5.1.1	Type	The material shall be as specified in the definition document.	Spectrographic analysis or spectroscopic analysis (method to be agreed upon between the user and manufacturer).	Qualification	3
					Production acceptance	Table 12 column B
	5.1.2	Microstructure	Nuts shall be free from cracks. The inclusions shall not exceed the values in the material standard, when specified therein. Nuts shall display no sign of overheating (nuts comprising ground parts) or of oxidation greater than 0,01 mm deep on machined areas and bearing surfaces and no deeper than 0,1 mm on non-machined areas. Grain size, measured approximately at the geometrical centre of the half-section of the nut, shall be in accordance with the requirements of the material standard.	Micrographic inspection of a transverse section (method to be agreed upon between the user and manufacturer).	Qualification [a]	5
					Production acceptance	Table 12 column B
	5.1.3	Surface discontinuities [b]	The types of permissible surface discontinuity are given in Annex A. The maximum depth allowed for these discontinuities is given in Table 13.	Fluoroscopic inspection (method to be agreed upon between the user and manufacturer).	Qualification [a]	5
					Production acceptance	Table 12 column B
			Cracks are not permitted.	In the event of any doubt arising as to the nature of the defects detected, inspect defective nuts at a magnification of × 10 after sectioning.		
	5.1.4	Hardness	The hardness of the finished nuts shall be within the limits specified in the definition document for the nut or in the material standard.	See ISO 8642.	Qualification	5
					Production acceptance	Table 12 column B

Table 1 (*continued*)

Subclause		Characteristic	Technical requirement	Inspection and test method	Test category	Sample size
5.2		Surface coating				
	5.2.1	Presence	Surface coating shall be applied at the locations specified in the definition document.	Visual examination	Qualification	100
					Production acceptance	Tables 10 and 11
	5.2.2	Type	Surface coating shall be as specified in the definition document.	Visual examination or inspection by chemical reagent in case of doubt (method to be agreed upon between the user and manufacturer).	Qualification[a]	3
					Production acceptance	Table 12 column A
	5.2.3	Thickness	The thickness of the surface coating shall be within the limits specified in the definition document.	Device for measuring the thickness of surface coatings. In case of doubt, micrographic inspection in accordance with ISO 1463 [c]	Qualification[a]	5
					Production acceptance	Table 12 column A
	5.2.4	Adhesion			Qualification[a]	5
		a) of molybdenum disulfide (MoS_2)	There shall be no sign of flaking, cracking or softening after test.	Heat the nuts to a temperature of 260 °C for 3 h, then cool the nuts slowly to ambient temperature.	Production acceptance	Table 12 column B
		b) of silver	There shall be no sign of blisters or exfoliation after test.	Heat the nuts to a temperature of 550 °C for 4 h, then rapidly cool the nuts with compressed air [at a pressure of (0,3 to 0,4) MPa] by means of a nozzle with a diameter of 1,5 mm held close to the surface of the nuts.		
5.3		Surface condition				
	5.3.1	Appearance	Finished nuts shall be free from burrs and bumps.	Visual examination In the event of any doubt arising as to the nature of the defects detected, inspect defective nuts at a magnification of × 10 after sectioning.	Qualification[a]	100
					Production acceptance	Tables 10 and 11
	5.3.2	Surface Roughness [b]	The surface roughness of the nuts shall be as specified in the definition document.	See ISO 4288.	Qualification[a]	5
				Visual examination		
5.4		Marking	The nuts shall be marked as specified in the definition document.	Visual examination	Qualification[a]	100
					Production acceptance	Tables 10 and 11