INTERNATIONAL STANDARD

ISO 7481

Second edition
2000-02-01

Aerospace — Nuts, self-locking, with maximum operating temperature less than or equal to 425 °C — Test methods

Aéronautique et espace — Écrous à freinage interne dont la température maximale d'utilisation est inférieure ou égale à 425 °C — Méthodes de contrôle et d'essai

Reference number
ISO 7481:2000(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 734 10 79
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 7481 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 7481:1984), which has been technically revised. Notably, a test for no rotation of the captive washer was added.

Aerospace — Nuts, self-locking, with maximum operating temperature less than or equal to 425 °C — Test methods

1 Scope

This International Standard specifies test methods for metric self-locking nuts with MJ threads intended for use in aerospace construction at maximum operating temperatures less than or equal to 425 °C. It describes the test device and the method for each test.

It applies to self-locking nuts as defined above, provided that the relevant documents (dimensional standard, drawing, procurement specification, etc.) refer to this International Standard.

This International Standard shall be used in conjunction with ISO 5858.

NOTE This International Standard only specifies tests for ambient and elevated temperature applications. Tests for applications at less than ambient temperatures, for example cryogenic, shall be as agreed upon between seller and purchaser.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 691:1997, *Assembly tools for screws and nuts — Wrench and socket openings — Tolerances for general use.*

ISO 1024:1989, *Metallic materials — Hardness test — Rockwell superficial test (scales 15N, 30N, 45N, 15T, 30T and 45T).*

ISO 5855-2:1999, *Aerospace — MJ threads — Part 2: Limit dimensions for bolts and nuts.*

ISO 5858:1999, *Aerospace — Nuts, self-locking, with maximum operating temperature less than or equal to 425 °C — Procurement specification.*

ISO 6507-1:1997, *Metallic materials — Vickers hardness test — Part 1: Test method.*

ISO 6508-1:1999, *Metallic materials — Rockwell hardness test — Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T).*

ISO 7403:1998, *Aerospace — Spline drives — Wrenching configuration — Metric series.*

3 Inspections and tests

3.1 Hardness test

3.1.1 Procedure

The choice depends on the configuration of the nut and available equipment. The authorized procedures are:

— Rockwell hardness in accordance with ISO 6508-1;

— Vickers hardness HV 5 to HV 100 in accordance with ISO 6507-1;

— Rockwell superficial hardness in accordance with ISO 1024;

— microhardness.

3.1.2 Method

This test shall be carried out at ambient temperature.

The measurement zone (bearing surface, across flats, underside of anchor nut lugs, etc.) shall correspond to the following conditions:

a) thickness at least equal to 10 times the penetration depth;

b) parallelism with respect to bearing surface not greater than 3°.

Should this not be possible, carry out this test on a cut section after moulding the nut into thermosetting resin.

Remove all possible coating (protection, lubrication, paint, etc.) in the measurement zone. Align the bearing surface to obtain the required relationship. These two operations shall not generate any heat liable to modify the characteristics of the material constituting the nut being tested.

Carry out the test and then check conformity with the requirements of the dimensional standard or drawing.

Nuts subjected to this test shall not be used again.

3.2 Bearing surface squareness test

3.2.1 Test device

The test device is illustrated in Figure 1.

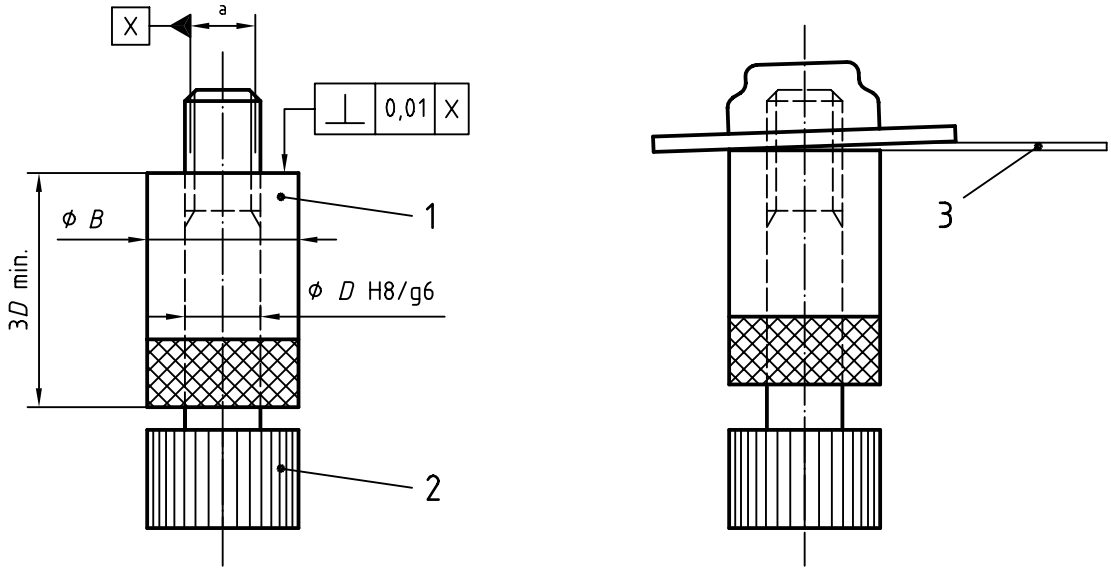
The test device includes the following elements:

a) a threaded mandrel with end in accordance with ISO 5855-2, with the exception of the pitch diameter which shall be in accordance with the values specified in Table 5 for the maximum mandrel;

b) a collar sliding on the plain portion of the threaded mandrel whose external diameter B is at least equal to reference dimension A for type I, II and V nuts in Figure 2 and equal to reference dimension A for type III and IV nuts in Figure 2;

c) an appropriate feeler gauge.

Dimensions in millimetres



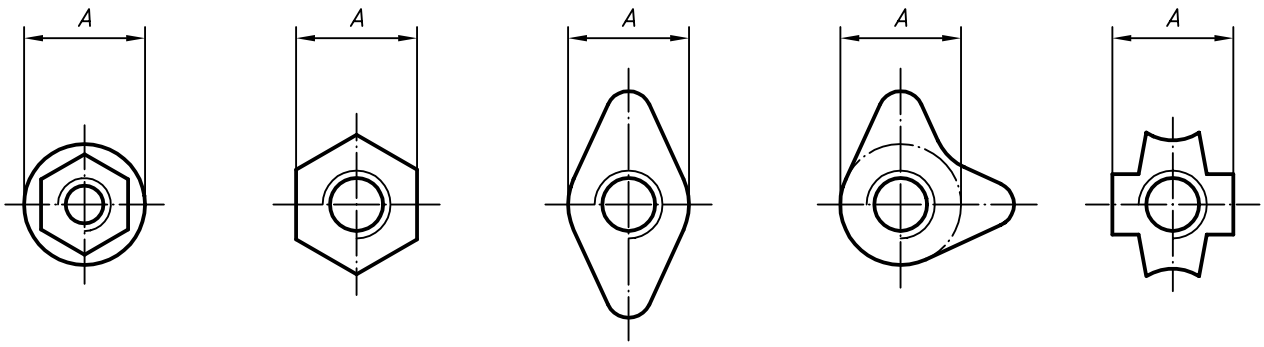
Key

1 Sliding collar
2 Threaded mandrel
3 Feeler gauge

NOTE For clinch nuts, the sliding collar shall have a counterbore to accommodate the shank.

a Pitch diameter

Figure 1



Type I **Type II** **Type III** **Type IV** **Type V**

Wrench nuts and clinch nuts **Fixed anchor nuts** **Floating anchor nuts and gang channel nuts**

Figure 2

3.2.2 Method

The test shall be carried out at ambient temperature.

For floating nuts, extract the nut from the cage or channel.

Lubricate the mandrel and nut (or threaded part) threads as stated in Table 1 (if necessary). Screw, with or without a wrench, the threaded mandrel into the nut or threaded part up to a minimum engagement of three turns.

Move the collar into contact with the bearing surface.

Evaluate the out-of-squareness by means of a feeler gauge whose thickness corresponds to the permissible squareness error permitted by the dimensional standard, the drawing or the procurement specification.

3.3 Axial load test

3.3.1 Test device

The test device is illustrated in Figure 3.

The test device includes the following elements:

a) a bearing plate in steel, heat-treated to a hardness $\geqslant$ 40 HRC;

b) a conical washer (for testing countersunk nuts);

c) a bolt with characteristics as follows:

1) threads: in accordance with ISO 5855-2,

2) tensile strength class: greater than that of the nut under test,

3) material and coating: no specific requirement.

3.3.2 Method

The axial load is transmitted to the nut by the bolt, the nut resting on the bearing plate.

For countersunk nuts, a conical washer is interposed.

3.3.2.1 80 % test

This test shall be carried out at ambient temperature.

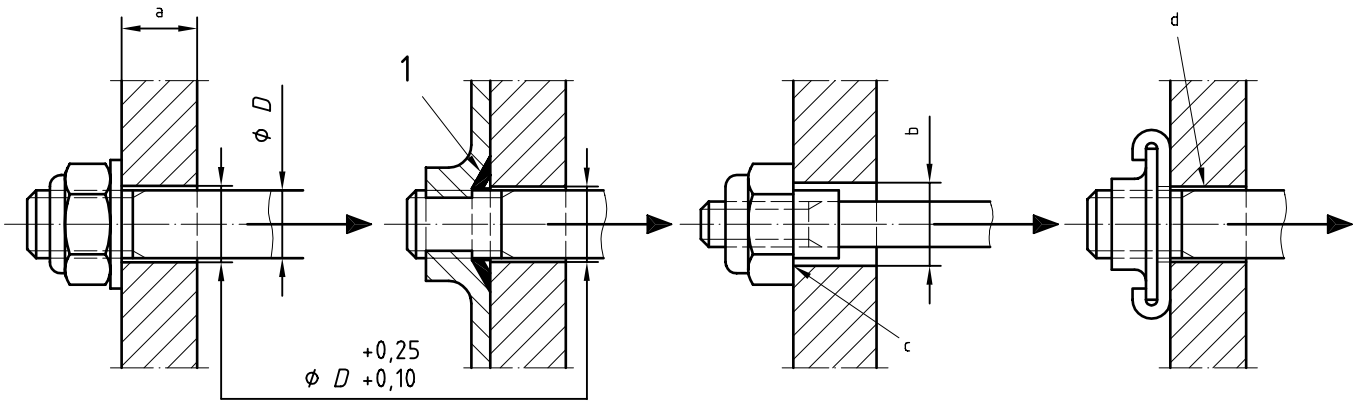
Lubricate the bolt and nut threads as stated in Table 1 (if necessary). Assemble the bearing plate, and possibly the conical washer, onto the bolt. Assemble the nut and measure the locking torque when the protrusion is two pitches minimum (including chamfer).

Position the assembly on the tensile machine. Apply the load slowly and progressively. Reduce the load slowly and progressively when the value quoted in the procurement specification has been reached.

Remove the assembly from the tensile machine. Unscrew the nut a half-turn and cease movement, then again unscrew and measure the breakaway torque.

Remove the nut, then submit it to a visual examination, and if necessary, an examination at a magnification of $\times$ 10 after sectioning, to check conformity with the requirements of the procurement specification.

Dimensions in millimetres



Wrench nuts and non-countersunk anchor nuts | **Countersunk anchor nuts** | **Clinch nuts** | **Floating anchor nuts and gang channel nuts**

Key

1 Washer to fit countersink

a Thickness $\geqslant D$

b Maximum shank diameter $^{+0,25}_{+0,10}$

c Chamfer to suit the nut radius

d The hole shall allow the specified float.

Figure 3

Table 1 — Test bolt and lubrication

Nut to be tested			Test bolt		Additional lubrication
Locking	**Material**	**Coating**	**Material**	**Coating**	
Plastic insert	Any	Any	Alloy steel	Cadmium	None
Metallic	Steel or alloy steel	Any	Alloy steel	Cadmium	None
	Stainless steel	Silver or MoS_2	Stainless steel	None	Synthetic oil
		None	Stainless steel	Silver	

3.3.2.2 100 % test

This test shall be carried out at ambient temperature.

If the test includes a heat soak, then heat the nut and maintain it at the temperature quoted in the procurement specification. Take the nut from the oven and allow it to cool slowly to ambient temperature, then proceed as follows.

Lubricate the bolt and nut threads as specified in Table 1 (if necessary), assemble the bearing plate and, if required, the conical washer, onto the bolt. Assemble the nut with a protrusion of two bolt pitches minimum (including chamfer).

Position the assembly on the tensile machine and apply the load slowly and progressively. Reduce the load slowly and progressively when the value quoted in the procurement specification has been reached.

Remove the assembly from the tensile machine. Remove the nut, then submit it to a visual examination, and if necessary, an examination at a magnification of ×10 after sectioning to check conformity with the requirements of the procurement specification.

Nuts subjected to this test shall not be used again.

3.4 Wrenching feature test

This test applies only to wrenchable nuts.

3.4.1 Test device

The test device is illustrated in Figure 4.

The test device includes the following elements:

a) a block of steel, heat-treated to a hardness of ⩾ 40 HRC;

b) a bolt with characteristics as follows:

1) threads: in accordance with ISO 5855-2,

2) tensile strength class: no specific requirement,

3) material and coating: no specific requirement.

NOTE Any other device which prevents the rotation of the nut and allows the specified torque to be applied is acceptable. For instance:

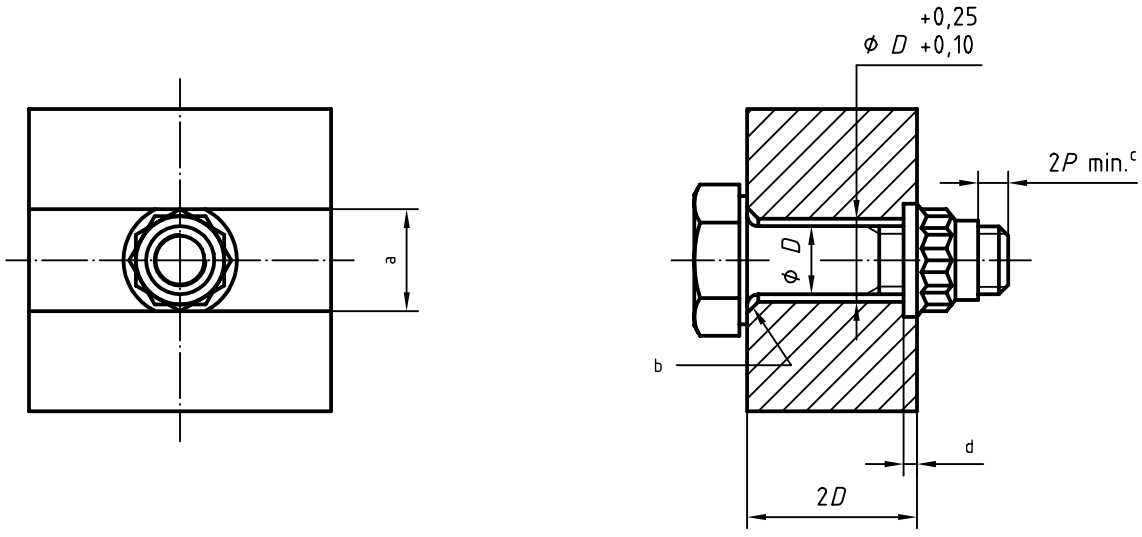
— nut welded on a block of the same material, the assembly being heat-treated to the correct level;

— nuts mounted in counter-rotation on a threaded rod of strength class appropriate to hold the required torques without deformation;

— nut mounted on a bolt of strength class appropriate to hold the required torques without deformation as a spacer is placed between the nut and the bolt head;

— etc.

Dimensions in millimetres



a Width of slot equal to diameter of circle circumscribing the wrenching feature

b Chamfer to suit underhead radius

c Including chamfer, where P is the pitch

d Depth of slot equal to flange height of nut under test

Figure 4

3.4.2 Method

This test shall be carried out at ambient temperature.

Make two flats on the flange of the nut so that it has a clearance of 0,05 mm to 0,1 mm inside the slot, lubricate the bolt and nut threads as specified in Table 1 (if necessary). Insert the modified nut into the slot. Assemble the bolt and moderately tighten it, then assemble the block into a vice.

Repeat the following operations the number of times specified in the procurement specification:

Apply the torque to the nut, in a tightening movement, as quoted in the procurement specification, with the aid of a socket wrench with an opening tolerance in conformance with ISO 691 or ISO 7403. Remove, then replace the socket wrench. Apply the same torque to the nut in an untightening direction.

Finally, dismantle the assembly, then submit the nut to a visual examination and, if necessary, to an examination at a magnification of $\times$ 10 after sectioning to check conformity with the requirements of the procurement specification.

Nuts subjected to this test shall not be used again.

3.5 Stress embrittlement test

This test applies only to nuts heat-treated to a hardness $\geqslant$ 44 HRC except for opposite indication given in the procurement specification or definition document.

3.5.1 Test device

The test device is illustrated in Figure 5.

The test device includes the following elements:

a) a block with parallel faces in steel, heat-treated to a hardness $\geqslant$ 40 HRC;

b) a bolt with the following characteristics:

   1) thread: in accordance with ISO 5855-2,

   2) tensile strength requirement greater than that of the nut under test,

   3) material and coating: no specific requirement.

3.5.2 Method

This test shall be carried out at ambient temperature.

Hold the bolt by the head, lubricate the bolt and nut threads as specified in Table 1 (if necessary), assemble the block and assemble the nut to be tested.