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

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

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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 8642 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 8642:1986) which has been technically revised.

Aerospace — Self-locking nuts with maximum operating temperature greater than 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 temperature greater than 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.

Other test devices or test methods than those specified in this International Standard may be used, but, in the event of a dispute, the requirements laid down in this International Standard shall take precedence.

This International Standard shall be used in conjunction with ISO 8641.

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

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

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

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

ISO 8641, *Aerospace — Self-locking nuts with maximum operating temperature greater than 425 °C — Procurement specification*

3 Inspections and tests

3.1 Hardness test

3.1.1 Procedure

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 6508-1;

— microhardness.

It is strongly recommended to use the method corresponding to the hardness unit indicated. Should this not be possible, the use of conversion charts is allowed, but, given their inaccuracy, the results obtained shall be used warily. In the event of a dispute, the results obtained using the method corresponding to the hardness unit indicated shall take precedence.

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 satisfy the following conditions:

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

b) parallelism with respect to bearing surface no greater than 3°.

Should this not be possible, carry out this test on a cut section after moulding the nut into a resin capable of maintaining it in the correct position.

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 and 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, III and VI nuts in Figure 2 and equal to reference dimension A for type II, IV and V nuts in Figure 2;

c) an appropriate feeler gauge.

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 threads (or threaded part) as stated in Table 1 (if necessary). Screw, with or without using a spanner, the threaded mandrel into the nut or threaded part until it engages with the self-locking zone.

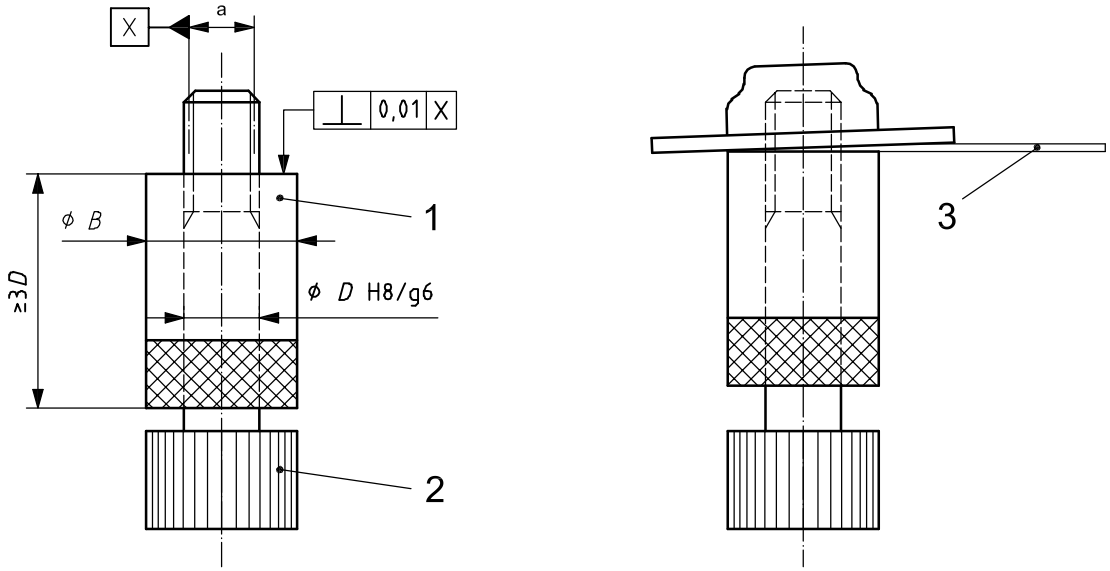
Move the collar into contact with the bearing surface.

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.

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

Table 1 — Test bolt and lubrication

Nut to be tested		Test bolt		Additional lubrication
Material	Coating	Material	Coating	
Steel or alloy steel	Any	Alloy steel	None	Synthetic oil
Stainless steel	Silver or MoS_2	Stainless steel	None	
	None		Silver	

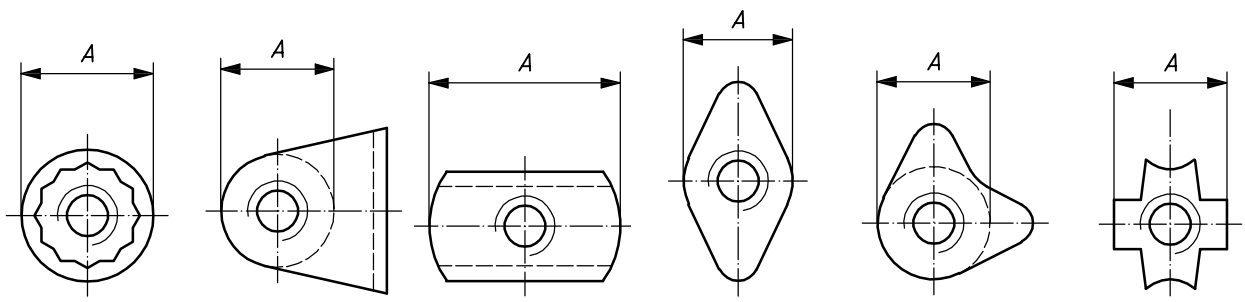


Key

1 sliding collar
2 threaded mandrel
3 feeler gauge

a Pitch diameter.

Figure 1



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

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

Figure 2

3.3 Axial load test

3.3.1 Test device

The test device is illustrated in Figure 3 and includes the following elements:

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

b) a bolt with a rolled thread and the following characteristics:

   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;

c) a torque wrench.

3.3.2 Method

3.3.2.1 Principle

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

3.3.2.2 80 % test

This test shall be carried out at ambient temperature.

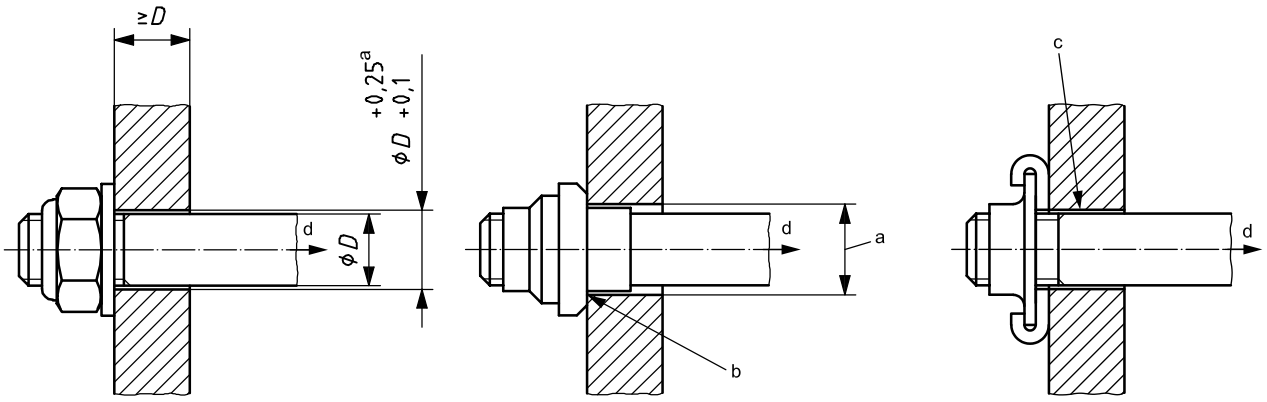
Lubricate the bolt and nut threads as stated in Table 1 (if necessary). Assemble the bearing plate on the bolt. Assemble the nut and measure the locking torque, using the torque wrench, when the protrusion is two pitches minimum (including chamfer).

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, using the torque wrench.

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-floating anchor nuts | **Clinch nuts** | **Floating anchor nuts and gang channel nuts**

a Maximum shank diameter.

b Chamfer to suit the nut radius.

c Hole to allow the specified float.

d Loading direction.

Figure 3

3.3.2.3 Test at ambient temperature and test at ambient temperature after maximum operating temperature baking (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, in all cases, proceed as follows.

Lubricate the bolt and nut threads as specified in Table 1 (if necessary), assemble the bearing plate on 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 $\times 10$ after sectioning to check conformity with the requirements of the procurement specification.

Nuts subjected to this test shall not be used again.

3.4 Wrenching feature test

3.4.1 General

This test applies only to wrenchable nuts.

3.4.2 Test device

The test device is illustrated in Figure 4 and includes the following elements:

a) a steel block, heat-treated to a hardness of $\geqslant$ 40 HRC;

b) a bolt with a rolled thread and the following characteristics:

1) threads in accordance with ISO 5855-2;

2) tensile strength class: no specific requirement;

3) material and coating: no specific requirement;

c) a torque wrench.

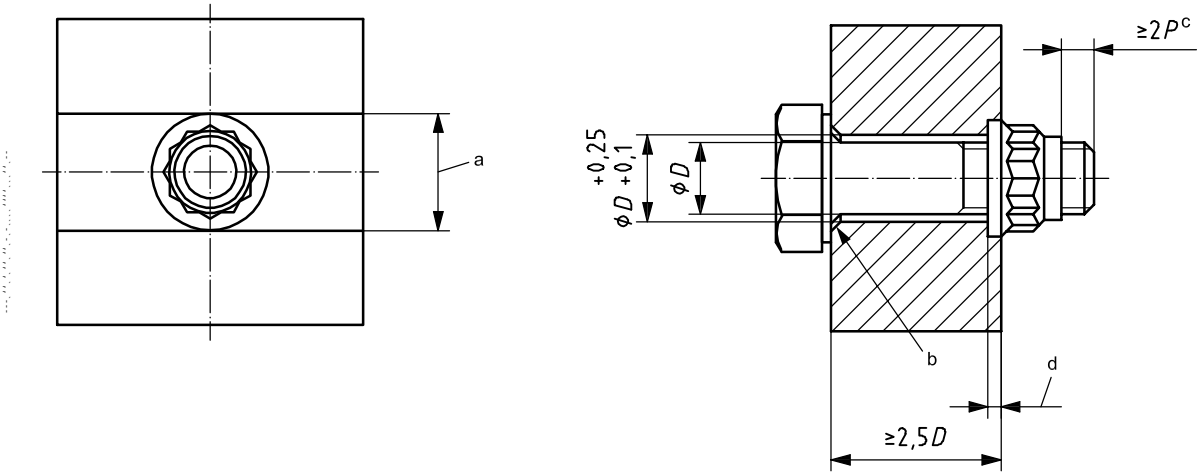
NOTE Any other device that prevents the rotation of the nut and allows the specified torque to be applied is acceptable; for example:

— a 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;

— a 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.

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

3.4.3 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 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 torque wrench having a socket 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, 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.

3.5 Torque-out test

3.5.1 General

This test applies only to nuts made from more than one part, either by design (floating anchor nuts or gang channel nuts), or by the needs of manufacture (fixed anchor nuts whose body is assembled to the base-plate by brazing or clinching).

It aims to check that the retention device is able to resist rotation of the threaded portion during tightening and untightening.

3.5.2 Test device

The test device is illustrated in Figure 5, dimensions are given in Table 2 and it includes the following elements:

a) a fixing plate;

b) a shouldered mandrel, threaded in accordance with ISO 5855-2. (A shouldered sleeve mounted on a bolt may also be used.)

c) a locknut threaded in accordance with ISO 5855-2;

d) rivets with universal head or bolts with cylindrical head and hexagonal nuts to fix the nut or the portion of the gang channel under test (standardized aerospace fasteners);

e) a torque wrench.

3.5.3 Method

This test shall be carried out at ambient temperature.

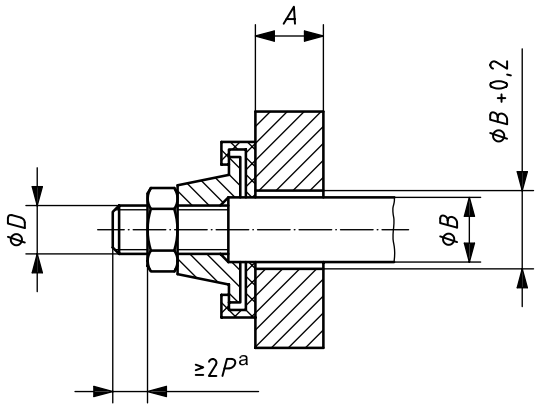
Attach the nut, or portion of channel to be tested, on the plate by means of rivets or bolts and nuts, the preformed head of rivets or the head of bolts being located on the same side as the element under test. Lubricate the mandrel and nut threads as specified in Table 1 (if necessary). Screw in the mandrel so that the shoulder contacts the threaded element of the nut (on bearing surface or bottom of counterbore). Apply the torque to the nut, in a tightening movement, as quoted in the procurement specification, using the torque wrench.

Assemble the locknut and apply to it the same torque in the reverse direction.

Dismantle the assembly, then submit the threaded element as well as the base-plate, the cage or the channel 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.

Dimensions in millimetres



a Including chamfer, where P is the pitch.

Figure 5

Table 2 — Dimensions of the device for torque-out test

Dimensions in millimetres

D	3	3,5	4	5	6	7	8	10
A min.	6	6	8	8	8	14	14	14
$B\ ^{0}_{-0,5}$	3,4	3,9	4,4	5,5	6,5	7,5	8,5	10,5

3.6 Test of no rotation of the captive washer

3.6.1 General

This test applies only to nuts with captive washer.

3.6.2 Test device

The test device includes the following elements:

a) a bearing plate in usual sheet (light alloy with anodizing, $R_a \leqslant 0{,}8$ µm on the nut side), minimum thickness 2 mm;

b) a steel spacer (to compensate the bolt shank length excess);

c) a bolt with a rolled thread and the following characteristics:

   1) threads in accordance with ISO 5855-2;

   2) tensile strength class at least equal to that of the nut to be tested;

   3) length between (1,5 and 3) D.

3.6.3 Method

The test shall be carried out at ambient temperature.

Apply the squeeze torque to the nut to be tested as quoted in the procurement specification. Mark the washer position and apply a seating torque double to the torque applied for squeeze torque to the nut to be tested.

The bearing plate must be replaced for each test.

The test bolt may be re-used several times if its threads do not have seams or traces of wear or seizing.

During application of the seating torque, the washer shall not rotate on the bearing plate.

3.7 Push-out test

3.7.1 General

This test applies only to gang channel nuts and anchor nuts with the exception of corner nuts shown in Figure 6 and reduced series single lug nuts.

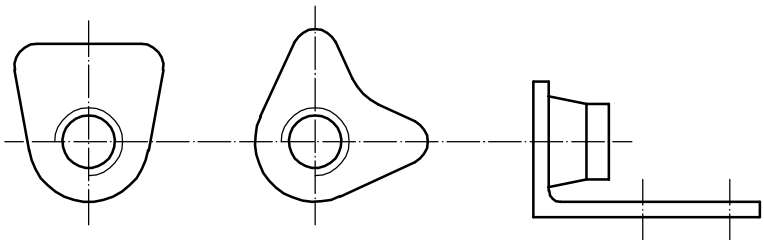
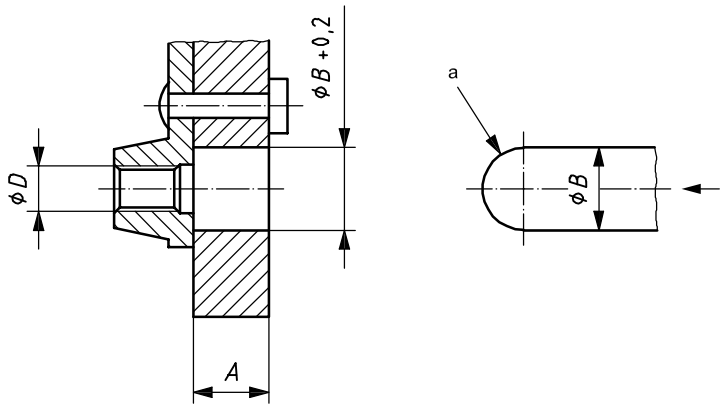


Figure 6

3.7.2 Test device

The test device is illustrated in Figure 7 and dimensions are given in Table 3.

Dimensions in millimetres



a Sphere with diameter B.

Figure 7

Table 3 — Dimensions of the device for push-out test

Dimensions in millimetres

D	3	3,5	4	5	6	7	8	10
A min.	6	6	8	8	8	14	14	14
$B\ ^{0}_{-0,5}$	3,4	3,9	4,4	5,5	6,5	7,5	8,5	10,5

The test device includes the following elements:

a) a fixing plate;

b) a push rod with spherical end;

c) a bolt with a rolled thread and the following characteristics:

   1) thread in accordance with ISO 5855-2;

   2) tensile strength class: no specific requirement;

   3) material: no specific requirement;

   4) coating not coated or silver plated;

d) rivets with universal head or bolts with cylindrical head and hexagonal nuts to fix the nut or the gang channel under test (standardized aerospace fasteners).

3.7.3 Method

This test shall be carried out at ambient temperature.

Attach the nut or the portion of channel to be inspected on the plate by means of rivets or bolts and nuts, the preformed head of rivets or the head of bolts being located on the same side as the element under test. Apply the axial load quoted in the procurement specification using the rod with the spherical end.

Ensure that any permanent deformation is no greater than the value allowed in the procurement specification using an appropriate feeler gauge.

Try to screw a standard bolt manually into the nut, even if deformed, as far as the locking device.

Dismantle, then subject the nut as well as the cage and the channel to a visual examination and, if necessary, 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.

3.8 Self-locking torque at ambient temperature

3.8.1 Test device

The test device is illustrated in Figure 8 and includes the following elements:

a) a steel spacer heat-treated to a hardness $\geqslant$ 40 HRC (this may be a cylindrical sleeve or a block with parallel faces pierced with a series of holes);

b) a bolt with a rolled thread and the following characteristics:

   1) for the three cycle test:

      i) thread in accordance with ISO 5855-2 with the exception of the pitch diameter whose minimum and maximum dimensions are given in Table 4;

      ii) tensile strength class greater than or equal to that of the nut under test;

      iii) material: non-coated alloy steel;

   2) for the fifteen cycle test:

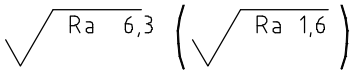
      i) thread in accordance with ISO 5855-2;

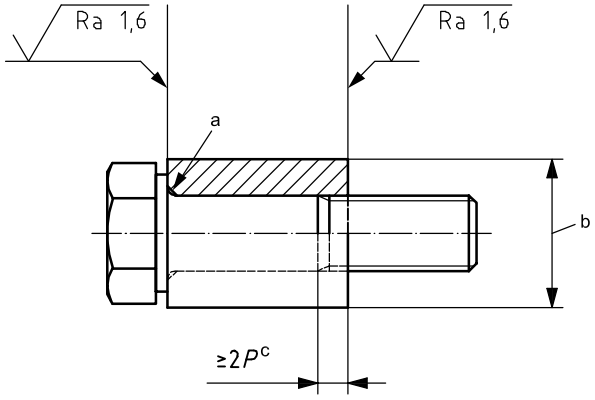
ii) tensile strength class at least equal to that of the nut to be tested;

iii) material and coating in accordance with Table 1;

c) a torque wrench.

Roughness values in micrometres





a Chamfer to suit underhead radius.

b Greater than bearing surface of nut.

c Where P is the pitch.

Figure 8

Table 4 — Bolt pitch diameter dimensions for self-locking torque test at ambient temperature (three cycle test)

Dimensions in millimetres

Thread	Pitch diameter (d_2)	
	max.	min.
MJ3 × 0,5	2,651	2,627
MJ3,5 × 0,6	3,084	3,057
MJ4 × 0,7	3,517	3,489
MJ5 × 0,8	4,45	4,42
MJ6 × 1	5,315	5,279
MJ7 × 1	6,315	6,279
MJ8 × 1	7,315	7,279
MJ10 × 1,25	9,151	9,113
MJ12 × 1,25	11,146	11,103
MJ14 × 1,5	12,981	12,936
MJ16 × 1,5	14,981	14,936
MJ18 × 1,5	16,981	16,936
MJ20 × 1,5	18,981	18,936
MJ22 × 1,5	20,981	20,936
MJ24 × 2	22,648	22,595
MJ27 × 2	25,648	25,595
MJ30 × 2	28,648	28,595
MJ33 × 2	31,648	31,595
MJ36 × 2	34,648	34,595
MJ39 × 2	37,648	37,595

3.8.2 Method

3.8.2.1 General

This test shall be carried out at ambient temperature. During the test, the nut temperature shall not exceed 45 °C and the cycling shall not exceed 0,5 s^{-1} (30 rpm).

3.8.2.2 Three cycle test

Lubricate the nut and bolt threads as stated in Table 1 (if necessary), then assemble the nut to the bolt after having added the spacer. Measure the self-locking torque, using the torque wrench, when the protrusion is two pitches minimum (including chamfer). Apply the seating torque quoted in the procurement specification.

Remove the load by unscrewing a half turn and cease movement. Again unscrew and measure the breakaway torque, using the same procedure.

Each disassembly shall be sufficient to entirely disengage the nut locking device.

Repeat the cycle on the same bolt the number of times specified in the procurement specification, and measure the self-locking torque under the same conditions as the first assembly and at each disassembly. It is mandatory that the first assembly be carried out on a new bolt.

Dismantle the assembly, then submit the bolt and nut 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.

3.8.2.3 15 cycle test

Proceed as stated in 3.8.2.2 repeating the cycle on the same bolt the number of times specified in the procurement specification, and measure the self-locking torque under the same conditions as the first assembly and at each disassembly. It is mandatory that the first assembly be carried out on a new bolt. Each disassembly shall be sufficient to entirely disengage the nut locking device.

Nuts having been subjected to the multiple cycle test shall not be used again.

3.9 Self-locking torque at ambient temperature after heat soak at maximum operating temperature

3.9.1 Test device

The test device is illustrated in Figure 9, dimensions are given in Table 5 and it includes the following elements:

a) a spacer in a material identical to that of the nut to be tested;

b) a bolt with a rolled thread and a normal shank (diameter of the plain portion equal to the diameter of the thread) or with a stepped shank (diameter of the plain portion equal to the pitch diameter) and with the following characteristics:

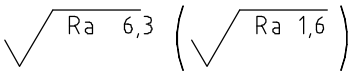
   thread in accordance with ISO 5855-2;

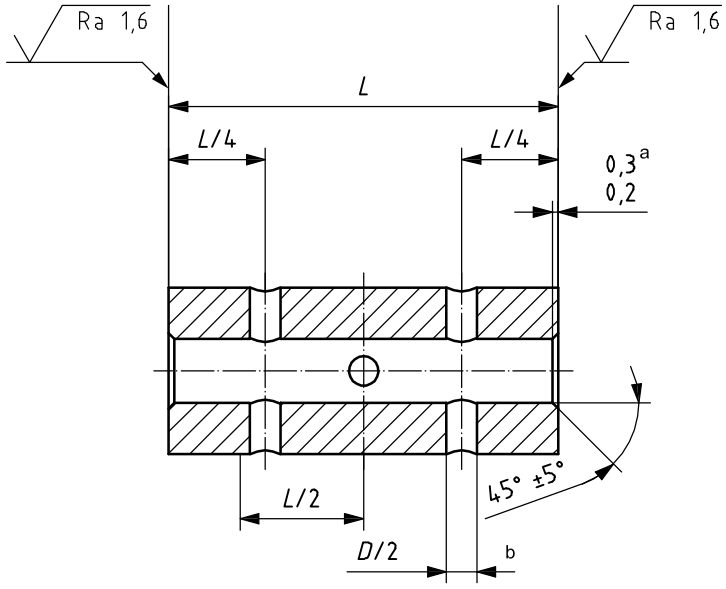
   tensile strength class at least equal to that of the nut to be tested;

   material and coating in accordance with Table 1;

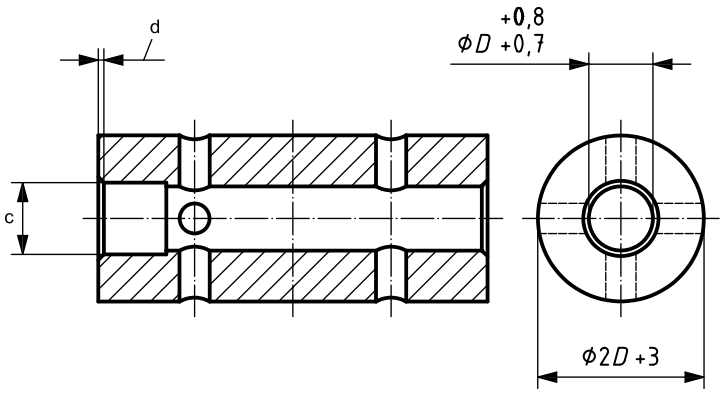
c) a torque wrench.

Dimensions in millimetres
Stress areas in square millimetres
Roughness values in micrometres





Wrench nuts and anchor nuts



Clinch nuts

a Angle of 45° ± 5°.

b There are three holes.

c Maximum shank diameter.

d Chamfer to suit the nut radius.

Figure 9

Table 5 — Spacer and bolt dimensions for self-locking torque test at ambient temperature after heat soak at maximum operating temperature

Dimensions in millimetres

Thread	L [a] mm	Bolt length [a] mm	Stress area of the bolt thread mm^2
MJ3 × 0,5	28	36	5,439
MJ3,5 × 0,6			7,335
MJ4 × 0,7	30	40	9,517
MJ5 × 0,8		42	15,296
MJ6 × 1	32	46	21,753
MJ7 × 1			30,93
MJ8 × 1		48	41,682
MJ10 × 1,25		52	65,136
MJ12 × 1,25	36	56	97,128
MJ14 × 1,5		60	131,562

[a] Possibly, these values can be changed to use the bolts specified in 3.11.

3.9.2 Method

This test shall be carried out at ambient temperature.

Lubricate the nut and bolt threads as stated in Table 1 (if necessary), then assemble the nut to the bolt after having positioned the spacer. Measure the self-locking torque, using the torque wrench, when the protrusion is two pitches minimum (including chamfer). Tighten the nut so as to obtain an elongation of the bolt, ΔL, as indicated in Equation (1) (this measurement shall be carried out with an accuracy of ± 1 µm).

$$\Delta L = \frac{\sigma}{E}\left[L + \frac{3H}{4} + \left(\frac{M\,(d_3)^2}{D^2} - M \right) \right] \tag{1}$$

where

σ is the axial constraint to be applied to the stress area of the bolt threads specified in Table 5;

— for A286 material, $\sigma = 520$ MPa;

— for Inconel 718 and Waspaloy materials, $\sigma = 590$ MPa;

L is the length of the spacer, in millimetres;

E is the modulus of elasticity of the bolt:

— for A286 material, $E = 20{,}3 \times 10^4$ MPa;

— for Inconel 718 material, $E = 20{,}5 \times 10^4$ MPa;

— for Waspaloy material, $E = 21{,}1 \times 10^4$ MPa;

M is the length of the plain portion of the bolt shank (incomplete screw-threads non included);

H is the total height of the nut under test;

d_3 is the maximum root diameter of the threaded part, in accordance with ISO 5855-2;

D is the actual diameter of the plain portion of the test bolt shank (measured on length M).

After submitting the assembly to loading, leave it under tension at room temperature for at least 1 h. Measure the elongation again and, if necessary, readjust it so as to obtain the desired preload (this measurement shall be carried out with an accuracy of $\pm$ 1 µm).

Heat the assembly to the temperature and for the length of time quoted in the procurement specification.

Remove the assembly from the oven and allow it to cool slowly to ambient temperature.

Remove the load by unscrewing a half turn and cease movement. Begin again to unscrew and measure the breakaway torque, using the torque wrench.

Stop the motion again, clean the bolt threads protruding beyond the nut to remove the baked oil residue and lubricate it as stated in Table 1 (if necessary), so as to avoid abrasive damage to the nut.

Remove the nut.

Repeat the cycle the number of times stated in the procurement specification, the bolt being cleaned and brushed after each removal, and measure the self-locking torque at each cycle under the same conditions.

Dismantle, then submit the bolt and nut 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.

Nuts subjected to this test shall not be used again.

3.10 Permanent set test

3.10.1 General

This test details the method for checking the thread possibility of re-use of self-locking nuts on bolts whose thread is at the tolerance limit.

3.10.2 Test device

The test device includes the following elements:

a) a maximum and minimum threaded mandrel, in conformity with Figure 10, whose characteristics are as follows:

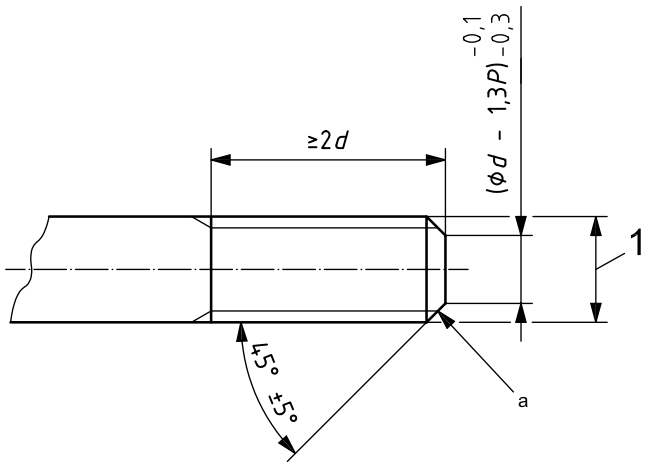
   1) threads in accordance with ISO 5855-2, with the exception of the pitch diameter and tolerances that shall be in accordance with the values stated in Table 6;

   2) material: steel, heat-treated to a hardness $\geqslant$ 39 HRC;

b) a torque wrench.

This test also may be carried out with a bolt of tensile strength class equal to or greater than that of the nut to be tested on condition that their pitch diameter is inside the tolerance given Table 6. However, in case of dispute, only the results obtained with the mandrels in heat-treated steel, shall be taken into consideration.

Dimensions in millimetres



Key

1 thread

a Remove sharp edges.

Figure 10

Table 6 — Dimensions of the mandrels for permanent set test

Dimensions in millimetres

Thread	Pitch diameter d_2		Tolerance		
	Maximum mandrel	Minimum mandrel	on d_2 of maximum and minimum mandrels	on half angle	on pitch
MJ3 × 0,5	2,662	2,627	0 −0,01	± 15'	± 0,008 whatever the pitch
MJ3,5 × 0,6	3,096	3,057			
MJ4 × 0,7	3,53	3,489			
MJ5 × 0,8	4,464	4,42			
MJ6 × 1	5,333	5,279			
MJ7 × 1	6,333	6,279			
MJ8 × 1	7,332	7,279			
MJ10 × 1,25	9,169	9,113			
MJ12 × 1,25	11,167	11,103			
MJ14 × 1,5	13,003	12,936		± 10'	
MJ16 × 1,5	15,002	14,936			
MJ18 × 1,5	17,001	16,936			
MJ20 × 1,5	19	18,936			
MJ22 × 1,5	20,999	20,936			
MJ24 × 2	22,673	22,595			
MJ27 × 2	25,672	25,595			
MJ30 × 2	28,67	28,595			
MJ33 × 2	31,67	31,595			
MJ36 × 2	34,67	34,595			
MJ39 × 2	37,67	37,595			

3.10.3 Method

This test shall be carried out at ambient temperature.

Check that the mandrel dimensions are within the limits given in Table 6 and that their threads have not been damaged.

Lubricate the nut threads and the maximum mandrel threads as stated in Table 1 (if necessary). Assemble the nut to the maximum mandrel and measure the locking torque, using the torque wrench, when the protrusion is two pitches minimum (including chamfer). Then unscrew the nut.

Lubricate the nut threads and the minimum mandrel threads as stated in Table 1 (if necessary). Assemble the nut to the minimum mandrel with a protrusion of two pitches minimum (including chamfer). Then measure the breakaway torque, using the same procedure, in the unscrewing direction.

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.

Nuts subjected to this test shall not be used again.

3.11 Vibration test

3.11.1 General

Taking into account the capacity of vibration machines, this test applies only to nuts of thread nominal diameter 5 mm, 6 mm, 7 mm, 8 mm, 10 mm and 12 mm.

For nuts of different diameter, the capability of resisting vibration is evaluated from results obtained on one or more of the aforementioned diameters, on condition that these nuts are of identical design and manufacture.

3.11.2 Test device

The test device is illustrated in Figure 11, dimensions are given in Table 7, and it includes the following elements:

a) a block with parallel surfaces in which oblong openings have been made;

b) spacers;

c) washers;

d) bolts with a rolled thread and normal shank (diameter of the plain portion equal to nominal thread diameter), having the following characteristics:

   1) threads in accordance with ISO 5822-2;

   2) tensile strength class at least equal to that of the nut to be tested;

   3) material and coating in accordance with Table 1;

e) a torque wrench.

Each spacer is held captive in the block by the addition of the washer on the side opposite the shoulder, the two parts being assembled by the use of the bolt and the nut under test, as shown in Figure 12.

The assembly (block plus assembled spacers) is submitted to vibration with the following characteristics:

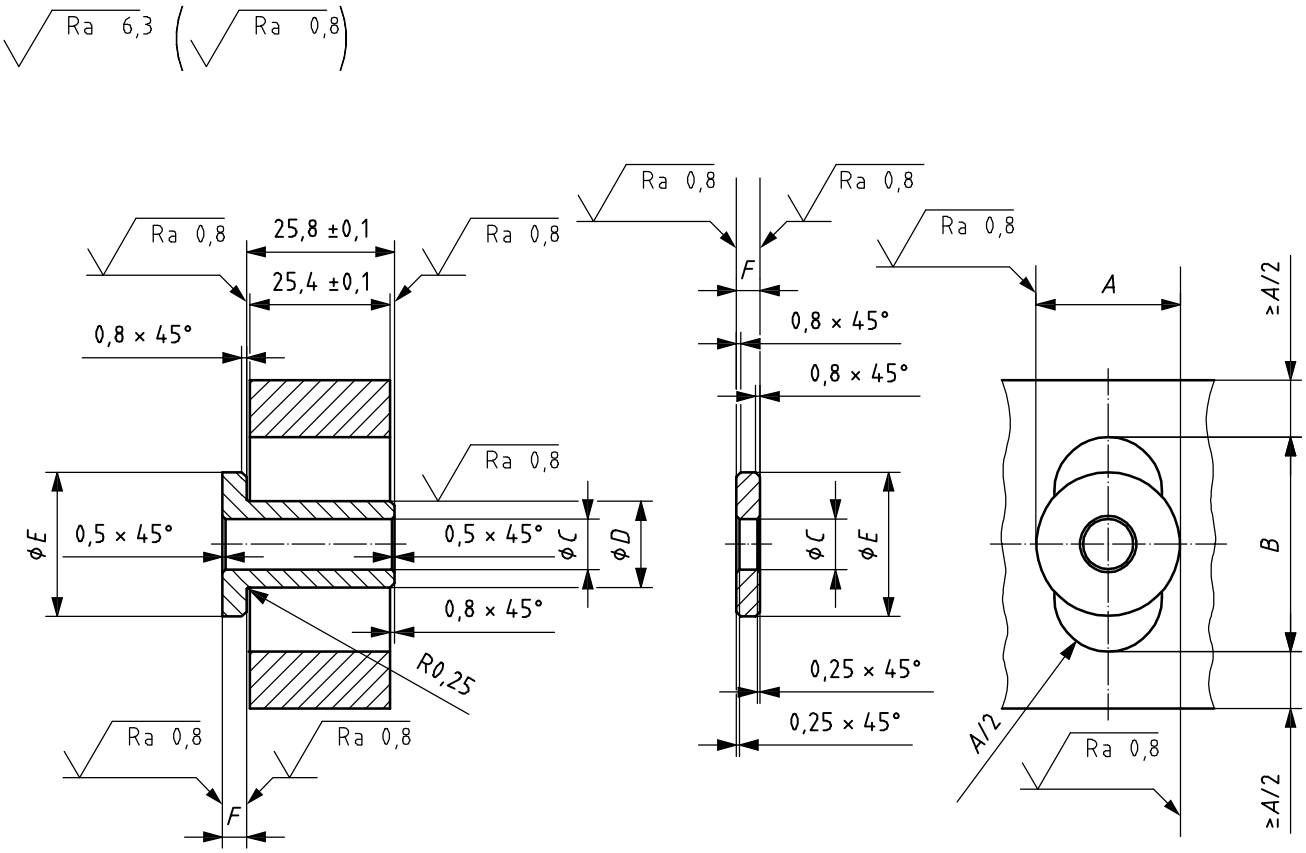
— form: sinusoidal;

— frequency: 30 Hz;

— total movement: (11,43 ± 0,4) mm.

The test device shall be positioned in such a way that displacement is vertical.

Dimensions in millimetres
Roughness values in micrometres



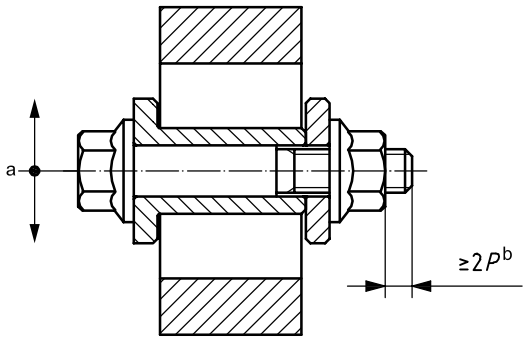
NOTE Material: steel heat-treated to a hardness ⩾ 40 HRC.

Figure 11

Table 7 — Dimensions of the device for vibration test

Dimensions in millimetres

Nominal thread diameter	*A* +0,15 0	*B* +0,1 0	*C* +0,1 0	*D* 0 −0,1	*E* 0 −0,25	*F* 0 −0,1
MJ5	8,29	27,16	5,2	8,22	14,09	3,17
MJ6	12,65	31,58	6,3	12,62	19,17	4,19
MJ7	14,25	33,18	7,3	14,22	20,77	
MJ8	15,83	34,75	8,3	15,79	22,35	
MJ10	19	37,92	10,3	18,97	25,52	
MJ12	25,35	44,28	12,3	25,19	35,05	4,82



[a] Direction of vibration.

[b] Including chamfer, where P is the pitch.

Figure 12

3.11.3 Method

This test shall be carried out at ambient temperature.

Certain types of nut shall require preparation in the following manner:

— floating nuts shall be extracted from their cage or channel;

— lugs from plate nuts shall be sawn symmetrically about the axis;

— shanks of clinch nuts shall be flush at the level of the bearing surface.

If preliminary exposure to temperature is necessary for the test, lubricate the nut and bolt threads as stated in Table 1 (if necessary) and assemble the nut to the bolt with a protrusion of two pitches minimum (including chamfer). Heat the assembly to the maximum operating temperature stated in the dimensional standard or drawing of the nut $\pm$ 5 °C, and maintain this temperature for a period of 6 h $\pm$ 15 min. Allow to cool slowly outside the oven to ambient temperature, then remove the nut. After cleaning the bolt threads protruding beyond the nut to remove the baked oil residue and after lubricating the nut as stated in Table 1 so as to avoid abrasive damage to the nut, remove the nut.

Then, in all cases, proceed as described below.

Lubricate the bolt and nut threads as stated in Table 1 (if necessary) and assemble the nut to the bolt after having positioned the spacer and the washer (the nuts subjected to preliminary exposure to temperature shall be assembled in the same bolts).

Apply the tightening torque, using the torque wrench, quoted in the procurement specification. Untighten the nut and unscrew so as to completely disengage the locking feature.

Repeat the tighten-untighten cycle four times and then carry out a fifth tightening, always on the same bolt, after mounting the assembly in the slot in the block. Mark a reference line over the end of the bolt on the nut. Lightly lubricate the friction surfaces with synthetic aero engine oil and check that the spacer moves freely within its slot.

Fix the assembly on the vibration generating equipment (vibration table or any other appropriate apparatus) and submit the assembly to the vibratory regime for the period stipulated in the procurement specification. Check throughout the test that the assembly moves freely within the slots.

If a nut unscrews completely, stop the test, pick up the defective nut and the failed parts of the assembly, then continue the test on the other nuts for a period equal to that remaining. At the end of the period, stop the test and remove the assembly from the vibration generating equipment. Examine the assemblies and any rotation of the nut relative to the bolt.

Finally, unscrew the nuts, then submit them 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.

3.12 Swaging test

3.12.1 General

Without cracking or fracturing, the shank of finished clinch nuts shall be capable of being flared using a 60° conical tool to 1,2 × its original diameter for A286 and Inconel 718 nuts and to 1,15 × its original diameter for Waspaloy nuts.

3.12.2 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.

ICS 49.030.30

Price based on 20 pages