International Standard 7481

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Aerospace — Fasteners — Self-locking nuts with maximum operating temperature less than or equal to 425 °C — Test methods

Aéronautique et espace — Éléments de fixation — Écrous à freinage interne dont la température maximale d'utilisation est inférieure ou égale à 425 °C — Méthodes de contrôle et 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 developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been authorized 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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 7481 was developed by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, and was circulated to the member bodies in July 1982.

It has been approved by the member bodies of the following countries :

Australia	France	Romania
Austria	Germany, F. R.	South Africa, Rep. of
Brazil	Ireland	Spain
Canada	Italy	Sweden
China	Japan	Thailand
Czechoslovakia	Netherlands	United Kingdom
Egypt, Arab Rep. of	Pakistan	USA

No member body expressed disapproval of the document.

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Aerospace — Fasteners — Self-locking nuts with maximum operating temperature less than or equal to 425 °C — Test methods

1 Scope and field of application

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

It shall be used in conjunction with the relevant procurement specification.[1)]

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.

2 References

ISO/R 80, *Rockwell hardness test (B and C scales) for steel.*

ISO 468, *Surface roughness — Parameters, their values, and general rules for specifying requirements.*

ISO 691, *Spanner gaps and sockets — Metric series — Tolerances for general use.*

ISO 1101, *Technical drawings — Geometrical tolerances — Tolerancing of form, orientation, location and run-out — Generalities, definitions, symbols, indications on drawings.*

ISO 5855/1, *Aerospace construction — MJ threads — Part 1 : Basic profile.*

ISO 5855/2, *Aerospace — MJ threads — Part 2 : Dimensions of screws and nuts.*

ISO 6507/1, *Metallic materials — Hardness test — Vickers test — Part 1 :* HV 5 *to* HV 100.

ISO 7403, *Fasteners for aerospace construction — Spline drive 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 as per ISO/R 80;

— Vickers hardness as per ISO 6507/1;

— Rockwell superficial hardness;

— 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. True up 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.

1) In preparation.

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

NOTE — 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 portrayed in figure 1.

The test device includes the following elements :

a) a threaded mandrel with end per ISO 5855/1 and ISO 5855/2, with the exception of the pitch diameter which shall be in accordance with the values specified in table 3 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.

3.2.2 Method

The test shall be carried out at ambient temperature.

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

Screw the threaded mandrel by hand 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.

3.3 Axial load test

3.3.1 Test device

The test device is portrayed in figure 3.

The test device includes the following elements :

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

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

c) a bolt with characteristics as follows :

1) threads : per ISO 5855/1 and ISO 5855/2;

2) tensile strength classification : greater than that of the nut under test;

3) material : alloy steel, non-coated.

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 2 pitches minimum (including chamfer).

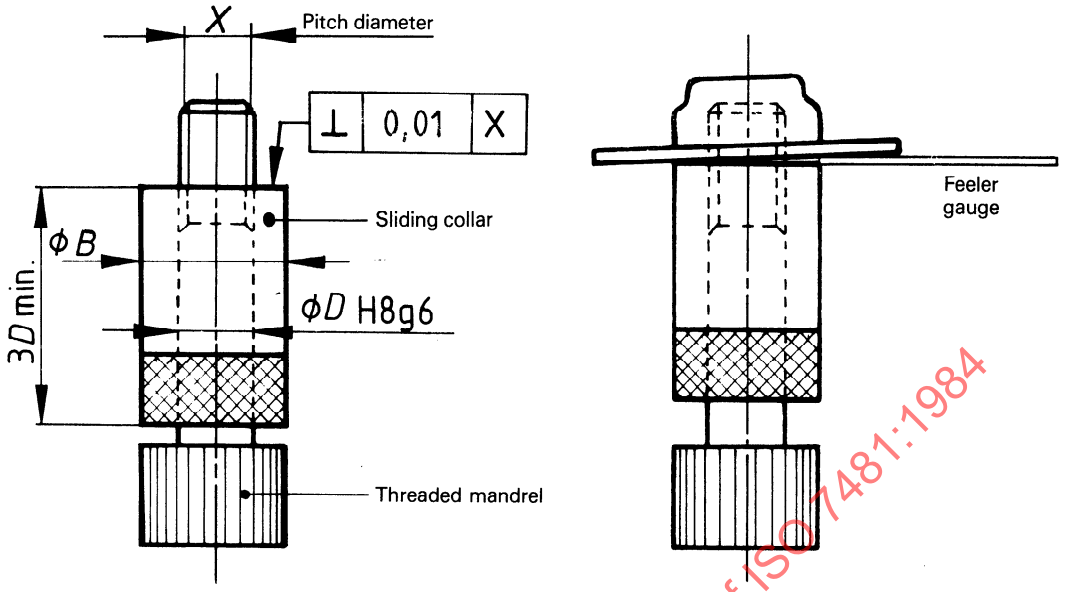
Position the assembly on the tensile machine. Apply the load slowly and progressively. Reduce the load slowly and progressively when the value quoted in the procurement specification has been reached.

Remove the assembly from the tensile machine. Unscrew the nut 1/2 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 under low magnification after sectioning, to check conformity with the requirements of the procurement specification.

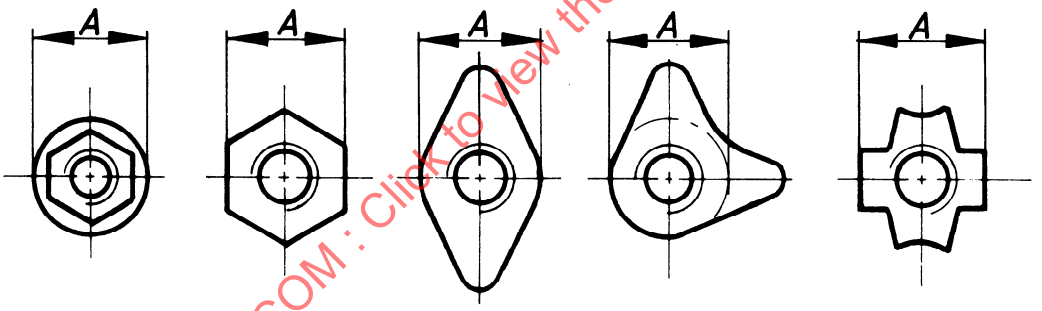
Table 1 — Test bolt and lubrication

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	



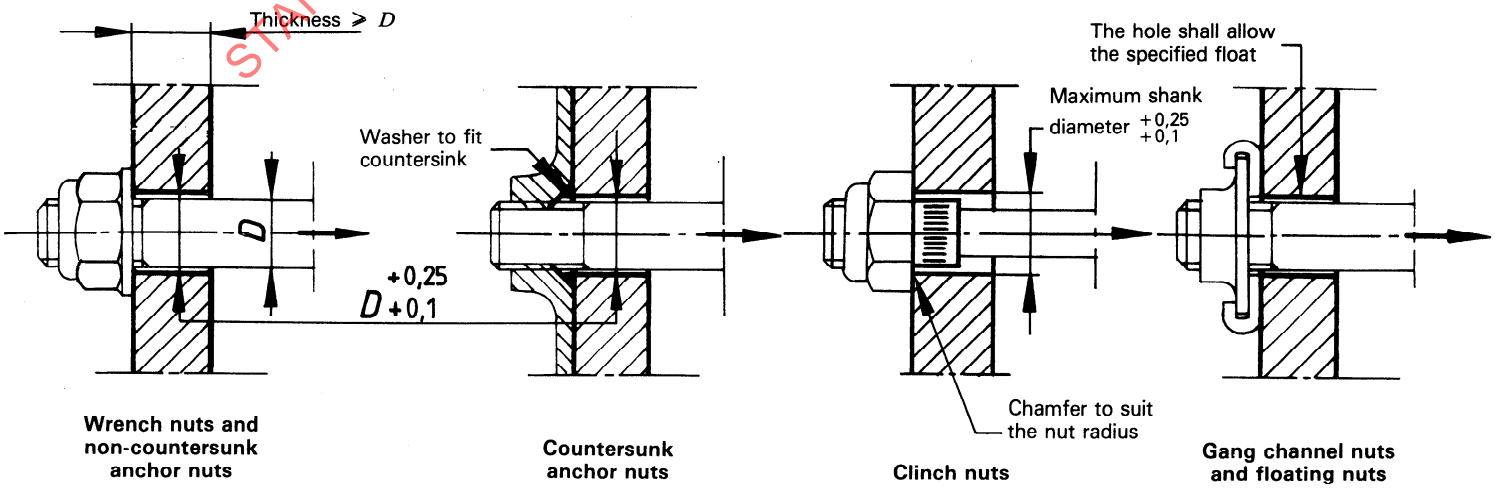
NOTE — For clinch nuts, the sliding collar shall have a counterbore to accommodate the shank.

Figure 1



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

Figure 2



Wrench nuts and non-countersunk anchor nuts | **Countersunk anchor nuts** | **Clinch nuts** | **Gang channel nuts and floating nuts**

Figure 3

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.

For all cases, 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 2 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 under low magnification after sectioning to check conformity with the requirements of the procurement specification.

NOTE — 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 portrayed in figure 4.[1)]

The test device includes the following elements :[1)]

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

b) a bolt with characteristics as follows :

1) threads : per ISO 5855/1 and ISO 5855/2;

2) tensile strength classification : no particular requirement;

3) material : no particular requirement.

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 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 conforming to 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 under low

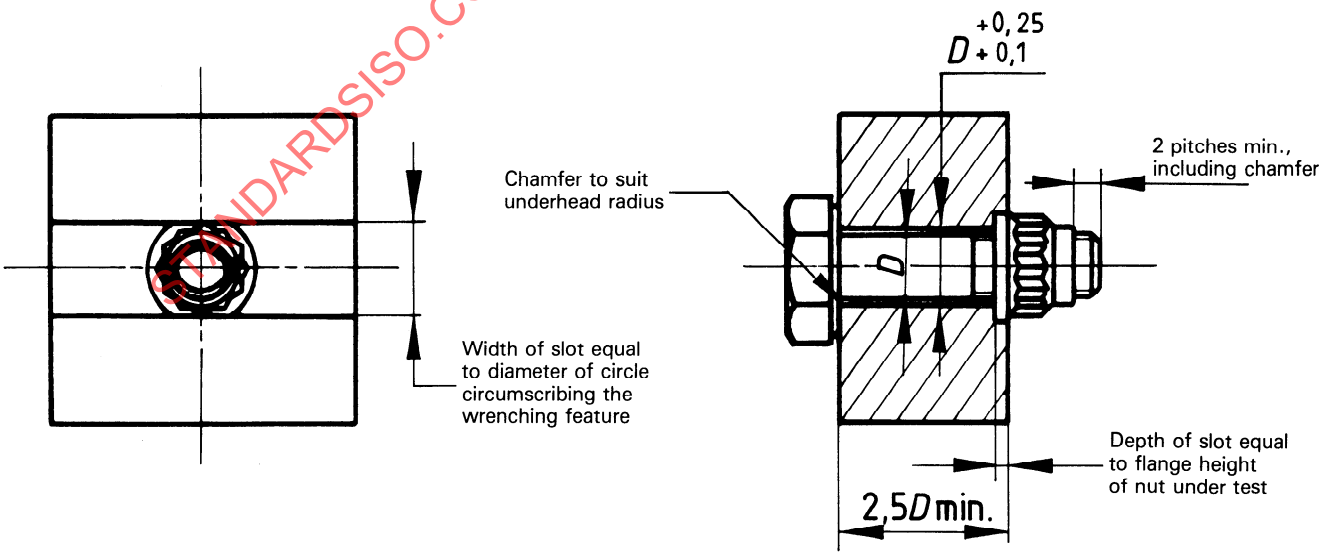


Figure 4

1) It is also possible to conduct this test with nuts welded on a block of the same material, the assembly being heat-treated to the correct level.

magnification after sectioning to check conformity with the requirements of the procurement specification.

NOTE — Nuts subjected to this test shall not be used again.

3.5 Stress embrittlement test

This test applies only to nuts heat-treated to HRC ⩾ 44.

3.5.1 Test device

The test device is portrayed in figure 5.

The test device includes the following elements :

a) a block with parallel faces in steel, heat-treated to HRC ⩾ 40;

b) a bolt with the following characteristics :

1) threads : per ISO 5855/1 and ISO 5855/2;

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

3) material : no particular 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.

Tighten the nut to the torque quoted in the procurement specification with the aid of a socket wrench conforming to ISO 691 or ISO 7403. Keep the nut under axial tension for the period quoted in the procurement specification.

At the end of this period, dismantle the assembly, then submit the nut to a visual examination and, if necessary, to an examination under low magnification after sectioning to check conformity with the requirements of the procurement specification.

NOTE — Nuts subjected to this test shall not be used again.

3.6 Torque-out test

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 baseplate by brazing or clinching).

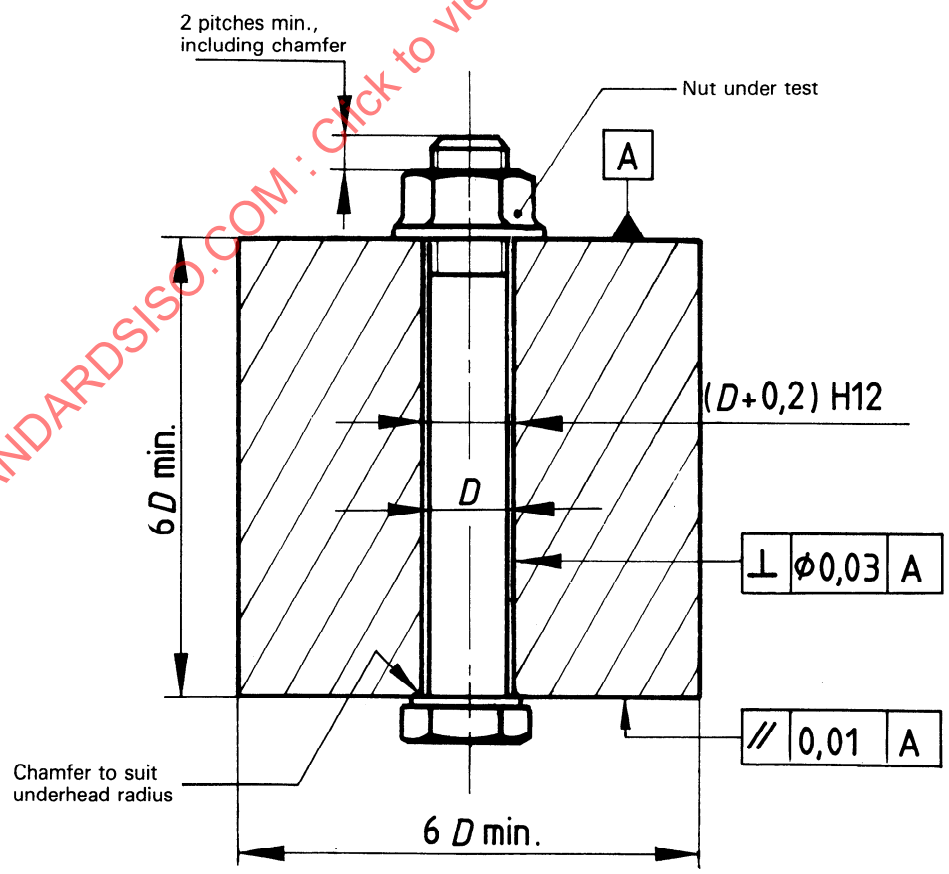
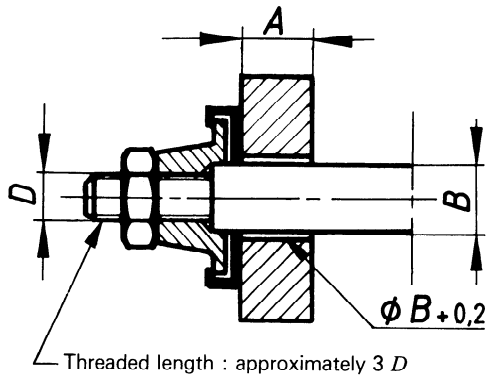


Figure 5

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

3.6.1 Test device

The test device is portrayed in figure 6.



Dimensions in millimetres

D	3	3,5	4	5	6	7	8	10
A min.	6	6	8	8	8	14	14	14
$B\,{}^{0}_{-0,05}$	3,4	3,9	4,4	5,5	6,5	7,5	8,5	10,5

Figure 6

The test device includes the following elements :

a) a fixing plate;

b) a shouldered mandrel threaded per ISO 5855/1 and ISO 5855/2; [1)]

c) a locknut threaded per ISO 5855/1 and ISO 5855/2;

d) rivets or bolts to fix the nut (no particular requirement).

3.6.2 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. Lubricate the mandrel and nut threads as specified in table 1 (if necessary). Screw in the mandrel so that the shoulder contacts the body 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.

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

Dismantle the assembly, then submit the nut as well as the cage or the channel to a visual examination and, if necessary, to an examination under low magnification after sectioning to check conformity with the requirements of the procurement specification.

NOTE — Nuts subjected to this test shall not be used again.

3.7 Push-out test

This test applies only to gang channel nuts and anchor nuts with the exception of corner nuts shown in figure 7 and reduced series single lug nuts.

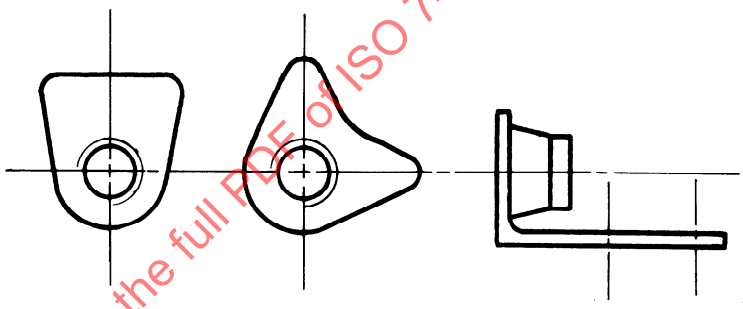
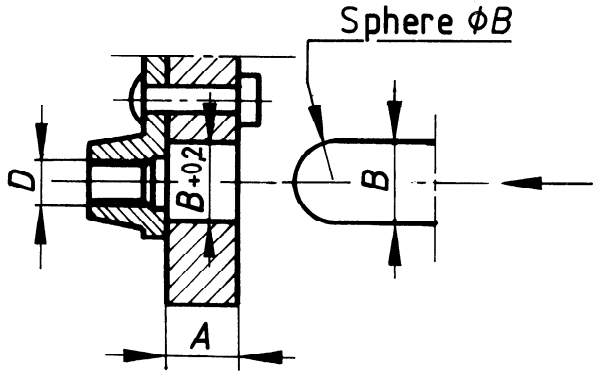


Figure 7

3.7.1 Test device

The test device is portrayed in figure 8.



Dimensions in millimetres

D	3	3,5	4	5	6	7	8	10
A min.	6	6	8	8	8	14	14	14
$B\,{}^{0}_{-0,05}$	3,4	3,9	4,4	5,5	6,5	7,5	8,5	10,5

Figure 8

1) A shouldered sleeve mounted on a bolt may also be used.

The test device includes the following elements :

a) a fixing plate;

b) a push rod with spherical end;

c) a bolt with the following characteristics :

1) thread : per ISO 5855/1 and ISO 5855/2;

2) tensile strength classification : no particular requirement;

3) material : no particular requirement;

d) rivets or bolts to fix the nut (no particular requirement).

3.7.2 Method

This test shall be carried out at ambient temperature.

Attach the nut or the portion of channel to be inspected onto the plate by means of rivets or bolts. Apply the axial load quoted in the procurement specification using the rod with the spherical end.

Ensure that any permanent deformation is not 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 low magnification after sectioning to check conformity with the requirements of the procurement specification.

NOTE — 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 portrayed in figure 9.

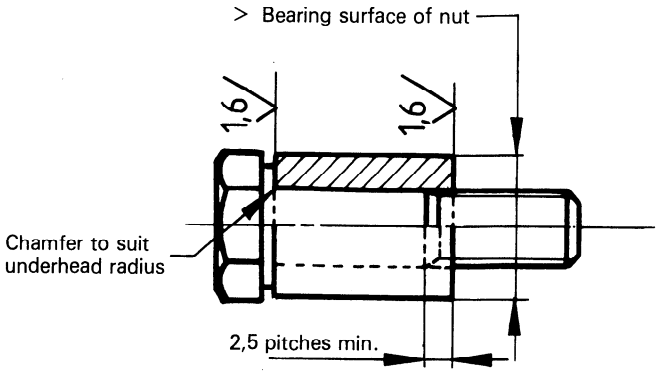


Figure 9

The test device includes the following elements :

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

b) a bolt with the following characteristics :

For the single cycle test :

1) thread : per ISO 5855/1 and ISO 5855/2 with the exception of the pitch diameter whose minimum and maximum dimensions are given in table 2;

2) tensile strength classification : greater than or equal to that of the nut under test;

3) material : non-coated alloy steel.

Table 2 — Bolt dimensions for self-locking torque test at ambient temperature (single cycle test)

Dimensions in millimetres

Thread	Pitch diameter (d_2)	
	min.	max.
3 × 0,50	2,627	2,651
3,5 × 0,60	3,057	3,084
4 × 0,70	3,489	3,517
5 × 0,80	4,420	4,450
6 × 1,00	5,279	5,315
7 × 1,00	6,279	6,315
8 × 1,00	7,279	7,315
10 × 1,25	9,113	9,151
12 × 1,25	11,103	11,146
14 × 1,50	12,936	12,981
16 × 1,50	14,936	14,981
18 × 1,50	16,936	16,981
20 × 1,50	18,936	18,981
22 × 1,50	20,936	20,981
24 × 2,00	22,595	22,648
27 × 2,00	25,595	25,648
30 × 2,00	28,595	28,648
33 × 2,00	31,595	31,648
36 × 2,00	34,595	34,648
39 × 2,00	37,595	37,648

For the multiple cycle test :

1) thread : per ISO 5855/1 and ISO 5855/2;

2) tensile strength classification : identical to that of the nut under test;

3) material and coating : in accordance with table 1.

3.8.2 Method

This test shall be carried out at ambient temperature. During the test, the nut temperature shall not exceed 45 °C.

3.8.2.1 Single 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 when the protrusion is 2 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.

Dismantle the assembly, then submit the bolt and nut to a visual examination and, if necessary, to an examination under low magnification after sectioning to check conformity with the requirements of the procurement specification.

3.8.2.2 Multiple cycle test

Proceed as stated in 3.8.2.1 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 at 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.

NOTE — 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 consists of :

a) the same spacer as for test 3.8 (see figure 9);

b) a bolt with the following characteristics :

1) threads : per ISO 5855/1 and ISO 5855/2;

2) tensile strength classification : identical to that of the nut under test;

3) material and coating : in accordance with table 1.

3.9.2 Method

This test shall be carried out at ambient temperature.

Lubricate the nut and bolt thread as stated in table 1 (if necessary), then assemble the nut to the bolt after having positioned the spacer. Measure the self-locking torque when the protrusion is 2 pitches minimum (including chamfer). Apply the seating torque quoted in the procurement specification.

Heat the assembly to the maximum operating temperature quoted in the dimensional standard or drawing of the nut ± 5 °C and maintain it at this temperature for the period given below :

— nuts locked by plastic ring : 3 h ± 15 min;

— all metal self-locking nuts : 6 h ± 15 min.

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.

Remove the nut.

Repeat the cycle the number of times stated in the procurement specification 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, to an examination under low magnification after sectioning to check conformity with the requirements of the procurement specification.

NOTE — Nuts subjected to this test shall not be used again.

3.10 Permanent set test

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

3.10.1 Test device

The test device consists of a maximum and minimum threaded mandrel, in conformity with figure 10, whose characteristics are as follows :

1) threads : per ISO 5855/1 and ISO 5855/2, with the exception of the pitch diameter and tolerances that shall be in accordance with the values stated in table 3;

2) material : steel heat-treated to HRC ⩾ 39.

3.10.2 Method

This test shall be carried out at ambient temperature.

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

Lubricate the nut thread and the maximum mandrel thread as stated in table 1 (if necessary); assemble the nut to the maximum mandrel and measure the locking torque when the protrusion is 2 pitches minimum (including chamfer); then unscrew the nut.

Lubricate the nut thread and the minimum mandrel thread as stated in table 1 (if necessary); assemble the nut to the minimum mandrel with a protrusion of 2 pitches minimum (including chamfer); then measure the breakaway torque in the unscrewing direction.

Remove the nut, then submit it to a visual examination and, if necessary, to an examination under low magnification after sectioning to check conformity with the requirements of the procurement specification.

NOTE — Nuts subjected to this test shall not be used again.