BRITISH STANDARD AEROSPACE SERIES

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ISO 8642:1986

Methods of test for

Self-locking nuts with maximum operating temperature greater than 425 °C

[ISO title: Aerospace — Self-locking nuts with maximum operating temperature greater than 425 °C — Test methods]

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Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Aerospace Standards Committee (ACE/-) to Technical Committee ACE/12 upon which the following bodies were represented:

Civil Aviation Authority (Airworthiness Division)

Electronic Engineering Association

Ministry of Defence

Society of British Aerospace Companies Limited

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Contents

National foreword

This British Standard, which has been prepared under the direction of the Aerospace Standards Committee, is identical with ISO 8642:1986 "*Aerospace — Self-locking nuts with maximum operating temperature greater than 425 °C — Test methods*" published by the International Organization for Standardization (ISO).

Terminology and conventions. The text of the International Standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever the words "International Standard" appear referring to this standard, they should be read as "British Standard".

Cross-references

International Standard	Corresponding British Standard
	BS 6293 *MJ threads for aerospace construction*
ISO 5855-1:1981	Part 1:1982 *Specification for dimensions of basic profile* (Identical)
ISO 5855-2:1981	Part 2:1982 *Specification for dimensions for bolts and nuts* (Identical)
ISO 7403:1983	BS A 294:1984 *Specification for spline drive wrenching configuration* Metric series (Identical)

The Technical Committee has reviewed the provisions of ISO 691, ISO/R 1024, ISO 6507-1, ISO 6508 and ISO 8641[1)] to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard. Related British Standards to some of the aforementioned International Standards are as follows:

International Standard	Related British Standard
ISO 691:1983	BS 192:1982 *Specification for open-ended wrenches*
ISO/R 1024:1969	BS 4175 *Method for Rockwell superficial hardness test (N and T scales)* Part 1:1967 *Testing of metals* Part 2:1970 *Verification of the testing machine* BS 427 *Method for Vickers hardness test*
ISO 6507-1:1982	Part 1:1961 *Testing of metals* BS 891 *Method for Rockwell hardness test*
ISO 6508:1986	Part 1:1962 *Testing of metals*

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 12, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

[1)] At present at stage of draft.

1 Scope and field of application

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

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 the procurement specification laid down in ISO 8641.

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

2 References

ISO 691, *Wrench and socket openings — Metric series — Tolerances for general use.*

ISO/R 1024, *Rockwell superficial hardness test (N and T scales) for steel.*

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

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

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

ISO 6508, *Metallic materials — Hardness test — Rockwell test (scales A — B — C — D — E — F — G — H — K).*

ISO 7403, *Fasteners for aerospace construction — Spline drive wrenching configuration — Metric series.*

ISO 8641, *Aerospace — Self-locking nuts with maximum operating temperature greater than 425 °C — Procurement specification*[2].

3 Inspections and tests

3.1 Hardness test

3.1.1 *Procedure*

The authorized procedures are as follows:

— Rockwell hardness, in accordance with ISO 6508;

— Vickers hardness, in accordance with ISO 6507-1;

— Rockwell superficial hardness, in accordance with ISO/R 1024;

— microhardness[3].

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 correspond to the following conditions:

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

b) deviation in 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 a resin capable of maintaining it in the correct position.

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 to be tested.

Carry out the test and then check conformity with the requirements of the 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 illustrated in Figure 1.

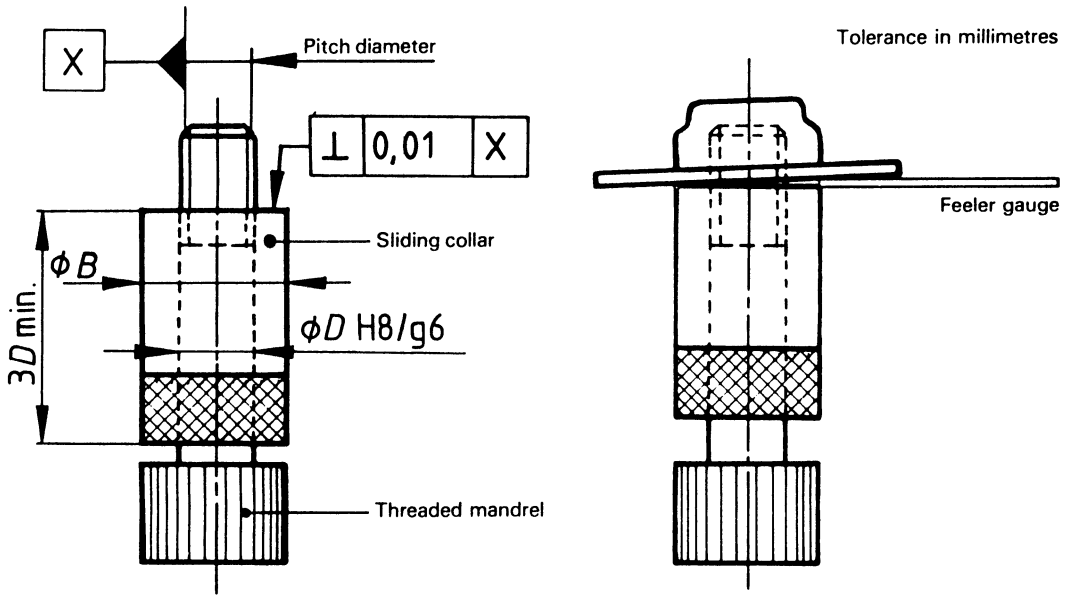
The test device includes the following elements:

a) a threaded mandrel with end in accordance with ISO 5855-1 and ISO 5855-2, except for 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 the external diameter *B* of which shall be at least equal to reference dimension *A* for types I, III and VI nuts in Figure 2 and equal to reference dimension *A* for types II, IV and V nuts in Figure 2;

c) an appropriate feeler gauge.

[2] At present at the stage of draft.
[3] Will be dealt with in a future International Standard.



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

Figure 1

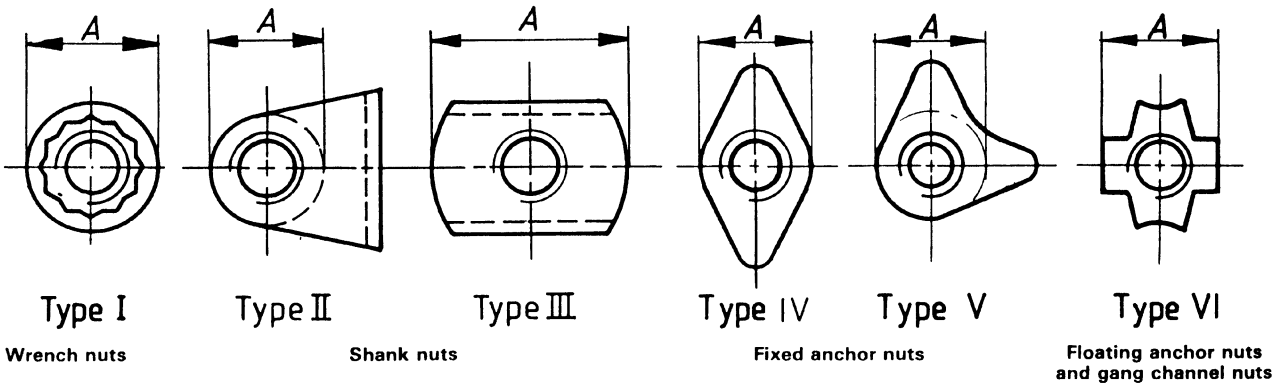


Figure 2

3.2.2 ***Method***

The test shall be carried out at ambient temperature.

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

Screw 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 the thickness of which shall correspond to the permissible squareness error as laid down in 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 HRC $\geqslant$ 40;

b) a bolt with a rolled thread and characteristics as follows:

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

2) tensile strength classification: greater than that of the nut to be tested,

3) material: alloy steel, non-coated;

c) a torque wrench.

3.3.2 ***Method***

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

3.3.2.1 *80 % test*

This test shall be carried out at ambient temperature.

Lubricate the bolt and nut threads with synthetic aero engine oil.

Assemble the bearing plate onto the bolt. Assemble the nut and measure the locking torque, using the torque wrench, when the protrusion is 2 pitches minimum (including chamfer).

Position the assembly on the tensile machine. Apply the load slowly and progressively in the direction shown in Figure 3. Reduce the load slowly and progressively when the value stipulated in the procurement specification has been reached.

Remove the assembly from the tensile machine. Unscrew the nut through half a 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, to an examination under low magnification after sectioning to check conformity with the requirements of the procurement specification.

3.3.2.2 *100 % test*

This test shall be carried out at ambient temperature.

If preliminary exposure to temperature is necessary for the test, heat the nut and maintain it at the temperature stipulated 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 described below.

Lubricate the bolt and nut threads with synthetic aero engine oil. Assemble the bearing plate 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 in the direction shown in Figure 3. Reduce the load slowly and progressively when the value stipulated 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, 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.

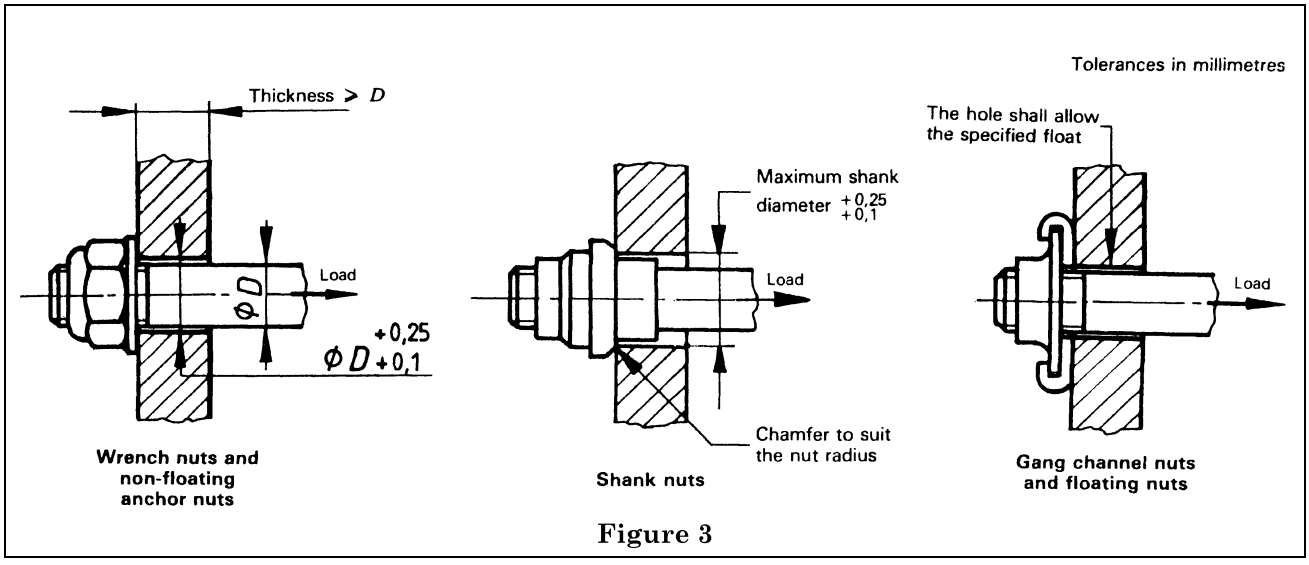


Figure 3

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.[4)]

The test device includes the following elements[4)]:

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

b) a bolt with a rolled thread and characteristics as follows:

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

2) tensile strength classification: no particular requirement,

3) material: no particular requirement;

c) a torque wrench, having a socket with an opening tolerance conforming to ISO 691 for hexagonal and bihexagonal wrenching or ISO 7403 for spline wrenching.

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 with synthetic aero engine oil. Insert the modified nut into the slot. Assemble the bolt and moderately tighten it, then assemble the block into a vice.

Repeat the operations described below the number of times specified in the procurement specification.

Apply the torque to the nut, in a tightening movement, as stipulated in the procurement specification, with the aid of the torque wrench.

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 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 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 for manufacturing purposes (fixed anchor nuts the threaded element of which is assembled to the baseplate 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.

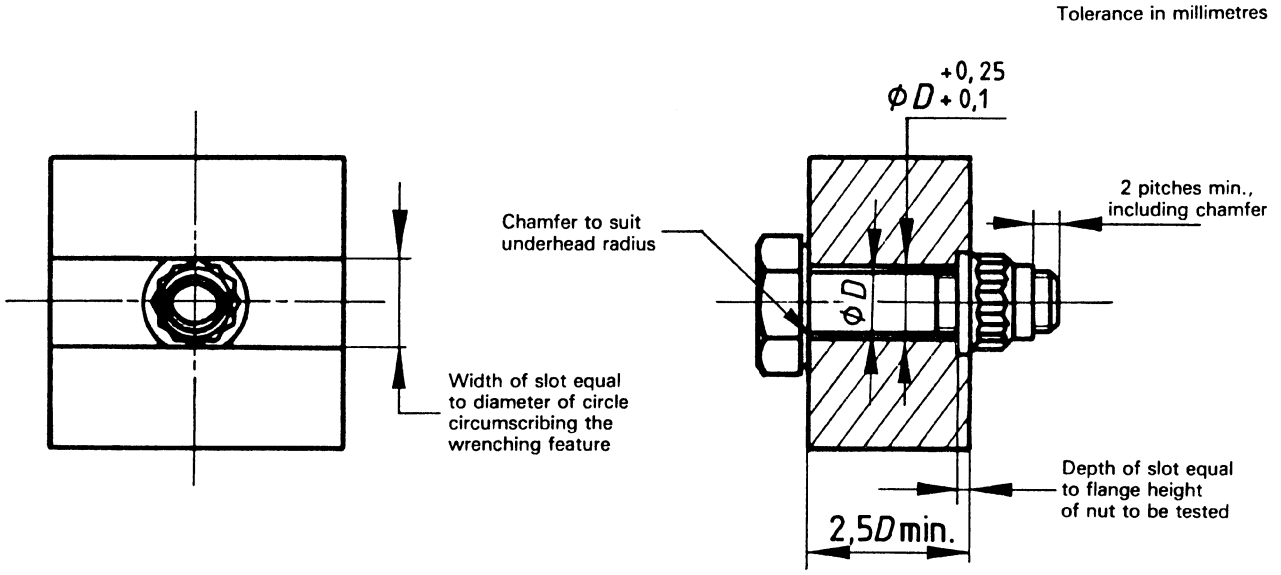
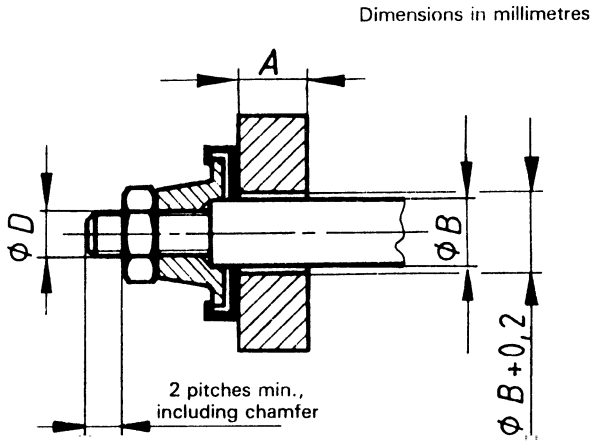


Figure 4

[4)] It is also possible to carry out this test with nuts welded on a block of the same material, the assembly being heat treated to the correct level.

3.5.1 *Test device*

The test device is illustrated in Figure 5.



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 5

The test device includes the following elements:

a) a fixing plate;

b) a shouldered mandrel threaded in accordance with ISO 5855-1 and ISO 5855-2[5)];

c) a locknut threaded in accordance with ISO 5855-1 and ISO 5855-2;

d) rivets with universal heads or bolts with cylindrical heads and hexagonal nuts to fix the nut or the portion of the channel to be tested (standardized aerospace fasteners);

e) a torque wrench.

3.5.2 *Method*

This test shall be carried out at ambient temperature.

Attach the nut or portion of the channel to be tested on the plate by means of rivets or bolts and nuts, the preformed heads of rivets or the heads of bolts being located on the same side as the element to be tested. Lubricate the mandrel and nut threads with synthetic aero engine oil. 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 stipulated in the procurement specification, using the torque wrench.

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

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, 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 Push-out test

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.

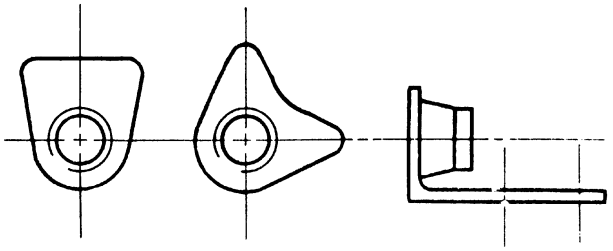
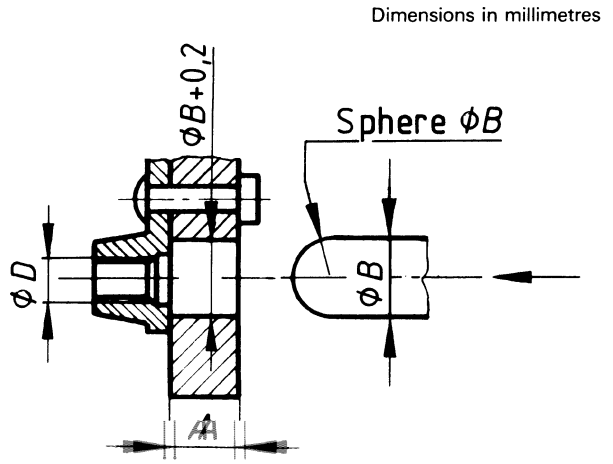


Figure 6

3.6.1 *Test device*

The test device is illustrated in Figure 7.



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 7

[5)] 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 a rolled thread and characteristics as follows:

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

2) tensile strength classification: no particular requirement,

3) material: no particular requirement;

d) rivets with universal heads or bolts with cylindrical heads and hexagonal nuts to fix the nut or the portion of the channel to be tested (standardized aerospace fasteners).

3.6.2 *Method*

This test shall be carried out at ambient temperature.

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

Using an appropriate feeler gauge, ensure that any permanent deformation is not greater than the value stipulated in the procurement specification.

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, 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 Self-locking torque at ambient temperature

3.7.1 *Test device*

The test device is illustrated in Figure 8.

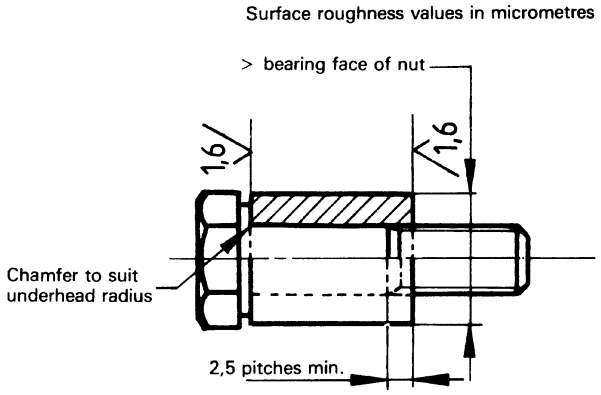


Figure 8

The test device includes the following elements:

a) a steel spacer, heat-treated to HRC $\geqslant$ 40 (this may be a cylindrical sleeve or a block with parallel faces pierced with a series of holes)[6)];

b) a bolt with a rolled thread and characteristics as follows:

For the single cycle test:

1) thread: in accordance with ISO 5855-1 and ISO 5855-2, except for the pitch diameter the minimum and maximum dimensions of which are given in Table 1,

2) tensile strength classification: greater than or equal to that of the nut to be tested,

3) material: alloy steel, non-coated,

For the multiple cycle test:

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

2) material: identical to that of the nut to be tested,

3) coating: in accordance with Table 2;

c) a torque wrench.

[6)] The same spacers as for the test described in **3.8** (see Figure 9) may be used.

Table 1 — Bolt dimensions for self-locking torque test at ambient temperature (single cycle test)

Dimensions in millimetres

Thread $D \times$ pitch	Pitch diameter (d_2)	
	min.[a]	max.[b]
MJ3 × 0,5	2,627	2,651
MJ3,5 × 0,6	3,057	3,084
MJ4 × 0,7	3,489	3,517
MJ5 × 0,8	4,420	4,450
MJ6 × 1	5,279	5,315
MJ7 × 1	6,279	6,315
MJ8 × 1	7,279	7,315
MJ10 × 1,25	9,113	9,151
MJ12 × 1,25	11,103	11,146
MJ14 × 1,5	12,936	12,981
MJ16 × 1,5	14,936	14,981
MJ18 × 1,5	16,936	16,981
MJ20 × 1,5	18,936	18,981
MJ22 × 1,5	20,936	20,981
MJ24 × 2	22,595	22,648
MJ27 × 2	25,595	25,648
MJ30 × 2	28,595	28,648
MJ33 × 2	31,595	31,648
MJ36 × 2	34,595	34,648
MJ39 × 2	37,595	37,648

[a] Values equal to d_2 min. specified in ISO 5855-2 for bolts with a tolerance class of 4h6h.

[b] Values equal to $\frac{d_2 \text{ min.} + d_2 \text{ max.}}{2}$ specified in ISO 5855-2 for bolts with a tolerance class of 4h6h.

Table 2 — Test bolt coating in relation to the coating of the nut to be tested

Coating of the nut to be tested	Test bolt coating
Silver or MoS_2	None
None	Silver

3.7.2 ***Method***

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 30 r/min.

3.7.2.1 *Single cycle test*

Lubricate the nut and bolt threads with synthetic aero engine oil, 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 2 pitches minimum (including chamfer). Apply the seating torque stipulated in the procurement specification.

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

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.

3.7.2.2 *Multiple cycle test*

Proceed as stated in **3.7.2.1** repeating the cycle on the same bolt the number of times stipulated 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 disengage the nut locking device entirely.

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

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

3.8.1 ***Test device***

The test device is illustrated in Figure 9.

The test device includes the following elements:

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

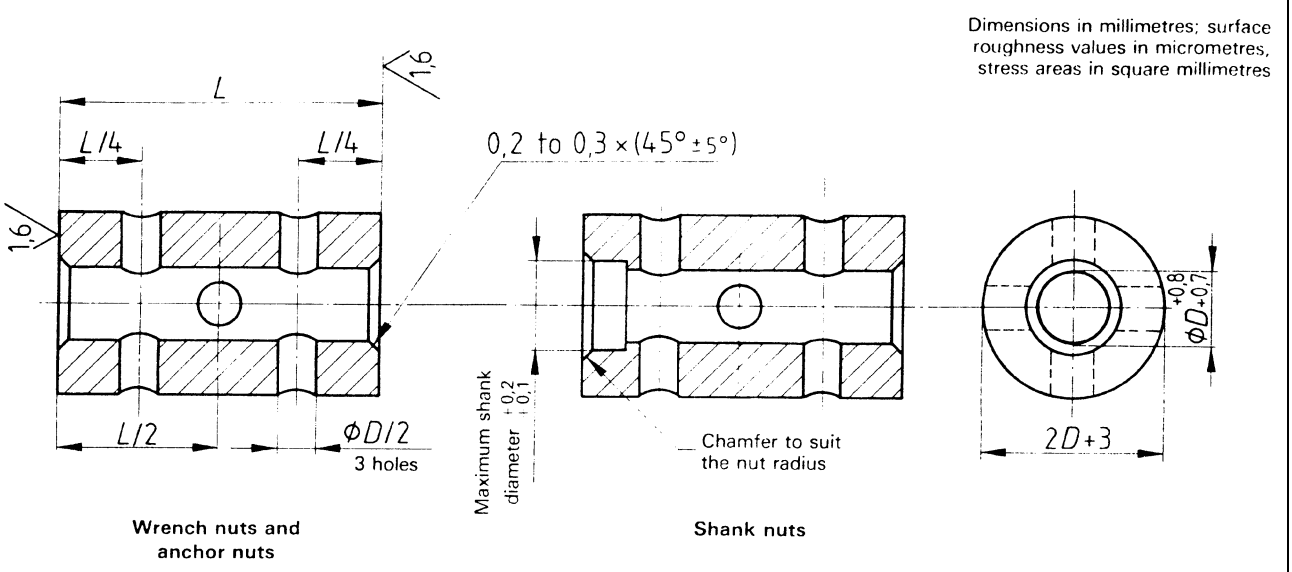
b) a bolt with a rolled thread and a normal shank (diameter of the plain portion equal to the diameter of the thread) or with a reduced shank (diameter of the plain portion equal to the pitch diameter); the characteristics of the bolt are as follows:

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

2) material: identical to that of the nut to be tested,

3) coating: in accordance with Table 2;

c) a torque wrench.



Thread D × pitch	L	Bolt length	Stress area of the bolt thread
MJ3 × 0,5	28	36	5,439
MJ3,5 × 0,6	28	36	7,335
MJ4 × 0,7	30	40	9,517
MJ5 × 0,8	30	42	15,296
MJ6 × 1	32	46	21,753
MJ7 × 1	32	46	30,930
MJ8 × 1	32	48	41,682
MJ10 × 1,25	32	52	65,136
MJ12 × 1,25	36	56	97,128
MJ14 × 1,5	36	60	131,562

Figure 9

3.8.2 *Method*

This test shall be carried out at ambient temperature.

Lubricate the nut and bolt thread with synthetic aero engine oil, 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 2 pitches minimum (including chamfer). Tighten the nut so as to obtain an elongation of the bolt, ΔL, as indicated in the formula given below (this measurement shall be carried out with an accuracy of ± 1 µm):

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

where

σ is the axial constraint to be applied to the stress area of the bolt thread specified in the table in Figure 9:

— for the A 286, (FE-PA 92 HT): σ = 520 MPa

— for the Waspaloy (NiP 101 HT): σ = 590 MPa

— for the Inconel 718 (NiP 100 HT): σ = 590 MPa

L is the length of the spacer, in millimetres;

E is the modulus of elasticity of the bolt:

— for the A 286, (FE-PA 92 HT): $E = 20{,}3 \times 10^4$ MPa

— for the Waspaloy (NiP 101 HT): $E = 21{,}1 \times 10^4$ MPa

— for the Inconel 718 (NiP 100 HT): $E = 20{,}5 \times 10^4$ MPa

M is the length of the plain portion of the bolt shank (incomplete screw-threads not included);

H is the total height of the nut to be tested;

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 load, 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 ± 1 μm).

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

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

Remove the load by unscrewing through half a turn and cease movement. Again 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 with synthetic aero engine oil so as to avoid abrasive damage to the nut. Remove the nut.

Repeat the cycle the number of times stipulated 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, 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.

3.9 Permanent set test

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

3.9.1 *Test device*

The test device consists of

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

1) threads: in accordance with ISO 5855-1 and ISO 5855-2, except for the pitch diameter and tolerances which shall be in accordance with the values specified in Table 3,

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

b) a torque wrench.

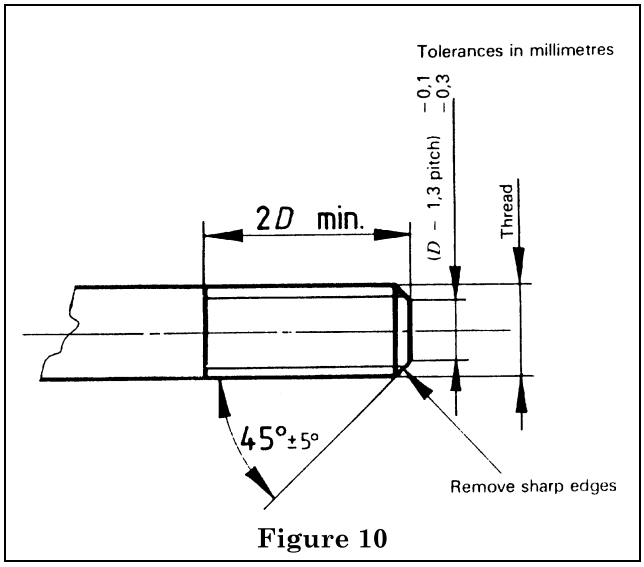


Figure 10

3.9.2 *Method*

This test shall be carried out at ambient temperature.

Check that the mandrel dimensions are within the limits given in Table 3 and that their threads have not been damaged.

Lubricate the nut thread and the maximum mandrel thread with synthetic aero engine oil; assemble the nut to the maximum mandrel and measure the locking torque, using the torque wrench, when the protrusion is 2 pitches minimum (including chamfer); then unscrew the nut.

Lubricate the nut thread and the minimum mandrel thread with synthetic aero engine oil; assemble the nut to the minimum mandrel with a protrusion of 2 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, 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 Vibration test

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

3.10.1 *Test device*

The test device is illustrated in Figure 11.

The test device includes the following elements:

a) a parallelepiped block comprising oblong openings;

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 5855-1 and ISO 5855-2;

2) material: identical to that of the nut to be tested,

3) coating: in accordance with Table 2;

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 bolt and the nut to be tested, as shown in Figure 12.

3.10.2 ***Method***

This test shall be carried out at ambient temperature.

Certain types of nuts will require preparation in the following manner:

— extract floating nuts from their cages or channels;

— saw the lugs from plate nuts symmetrically about the axis;

— flush off the skirt of shank nuts at the level of the bearing surface.

If preliminary exposure to temperature is necessary for the test, lubricate the nut and bolt threads with synthetic aero engine oil; then assemble the nut to the bolt with a protrusion of 2 pitches minimum (including chamfer). Heat the assembly to the maximum operating temperature stated in the drawing of the nut, to ± 5 °C, and maintain at this temperature for a period of 6 h ± 15 min. Allow to cool slowly outside the oven to ambient temperature. After cleaning the bolt threads protruding beyond the nut to remove the baked oil residue and after lubricating the nut with synthetic aero engine oil 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 with synthetic aero engine oil 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, stipulated in the procurement specification. Untighten the nut and unscrew so as to completely disengage the locking feature.

Table 3 — Dimensions of the mandrels for permanent set test

Dimensions in millimetres

Thread $D \times$ pitch	**Pitch diameter** (d_2)		**Tolerances**		
	Maximum mandrel	Maximum mandrel[a]	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	3,530	3,489			
MJ5 × 0,8	4,464	4,420			
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	19,000	18,936			
MJ22 × 1,5	20,999	20,936			
MJ24 × 2	22,673	22,595			
MJ27 × 2	25,672	25,595			
MJ30 × 2	28,670	28,595			
MJ33 × 2	31,670	31,595			
MJ36 × 2	34,670	34,595			
MJ39 × 2	37,670	37,595			

[a] Values equal to d_2 min. specified in ISO 5855-2 for bolts with a tolerance class of 4h6h.

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

Fix the assembly on the appropriate vibration-generating equipment having the following characteristics:

— sinusoidal form;

— frequency: 30 Hz;

— total displacement: 11,43 ± 0,4 mm.

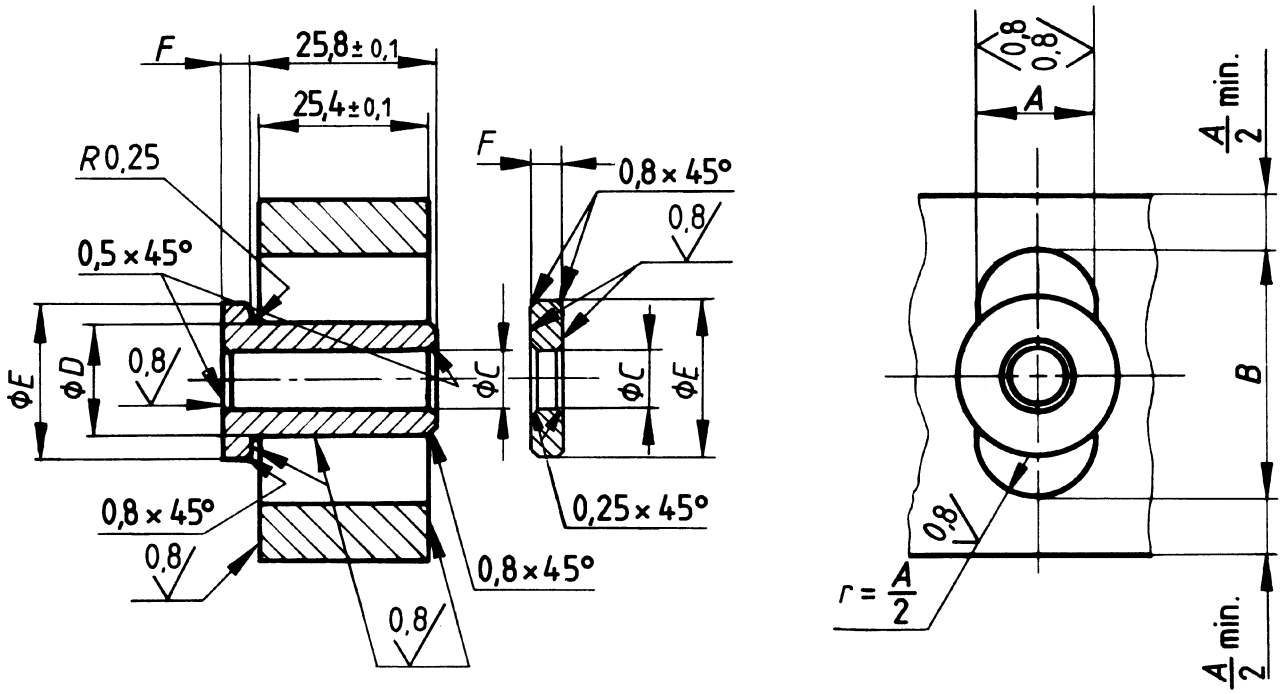
Submit the assembly to the appropriate vibratory regime for the period stipulated in the procurement specification. The test device shall be positioned to obtain a vertical displacement. Check throughout the test that the assembly moves freely within the openings.

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, 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.

Dimensions in millimetres; surface roughness values in micrometres



Material : Steel, heat-treated to HRC > 40

Surface roughness : R_a 3,2 (0,8)

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	4,19
MJ8	15,83	34,75	8,3	15,79	22,35	4,19
MJ10	19,00	37,92	10,3	18,97	25,52	4,19
MJ12	25,35	44,28	12,3	25,19	35,05	4,82

Figure 11

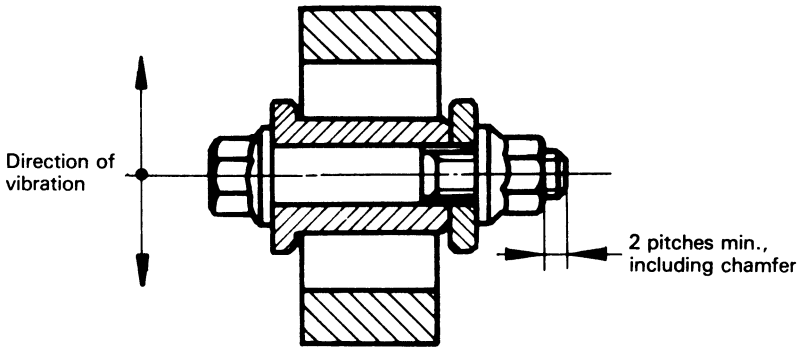


Figure 12

Publications referred to

See national foreword.

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