BRITISH STANDARD AEROSPACE SERIES

BS 2A 293:2005

Procurement of self-locking nuts with non-metallic locking elements — Metric series — Specification

ICS 49.030.30

Committees responsible for this British Standard

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Contents

Foreword

This British Standard was prepared by Technical Committee ACE/12. It supersedes BS A 293:1983, which is withdrawn.

BS 2A 293 is intended primarily for use in conjunction with those "A" series British Standard aerospace specifications in which conformity to this standard is a specific requirement.

This edition introduces technical changes in line with test methods BS 2A 295:2000 and harmonizes the procurement and testing of the metric series non-metallic self-locking nuts with the equivalent Unified series nuts contained in BS 3A 125 to 3A [...].

It may also be applied to other aerospace metric threaded fasteners if required by the relevant specification, drawing, contract or order.

This standard invokes:

a) quality assurance approval of the manufacturer; and

b) product qualification testing approval.

Annex A is included in this standard to provide information on the axial loads and torque values for thread sizes M8 × 1.25, M10 × 1.5 and M12 × 1.5. When there is no further requirement for these sizes, Annex A will be deleted by amendment.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its 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 19 and a back cover.

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1 Scope

This British Standard specifies the requirements for the procurement of self-locking nuts with non-metallic locking elements.

This standard invokes product qualification testing requirements and quality assurance approval procedures for manufacture of aerospace standard parts.

This standard is intended primarily for use with "A" series British Standard aerospace standards for metric self-locking nuts with non-metallic locking elements. It is also applicable to other aerospace self-locking nuts if required by the relevant drawing, contract or order.

NOTE Where the requirements of the nut standard or drawing differ from this standard, they take precedence over the requirements of this standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 1134, *Method for the assessment of surface texture.*

BS 1595-1, *Propan-2-ol (isopropyl alcohol) for industrial use — Part 1: Specification for propan-2-ol (isopropyl alcohol).*

BS A 352-2/ISO 5855-2, *MJ threads — Part 2: Limit dimensions for bolts and nuts.*

BS 2A 295/ISO 7481, *Methods of test for self-locking nuts with maximum operating temperature less than or equal to 425 ^{o}C.*

BS 3A 125 to 3A [...], *Specification for stiffnuts (Unified threads) for aircraft.*

BS EN 9100, *Aerospace series — Quality management systems — Requirements (based on ISO 9001:2000) and Quality systems — Model for quality assurance in design, development, production, installation and servicing (based on ISO 9001:1994).*

3 Terms and definitions

For the purposes of this British Standard the following terms and definitions apply.

3.1
self-locking nut with non-metallic locking element
self-contained unit which consists of a nut body surmounted by a non-metallic locking element which imposes friction between itself and the male screw thread upon which it is mounted

3.2
nut body
portion of the self-locking nut containing the screw thread

3.3
locking element
non-metallic portion of the self-locking nut designed to impose friction between itself and the male screw thread with which it is engaged

NOTE The locking element does not operate by means of a separate movement as a result of installation and does not depend upon pressure on the bearing surface for the locking action.

3.4
maximum locking torque
highest torque to overcome the friction encountered in any assembly or removal cycle with no axial load on the nut

3.5
minimum breakaway torque
torque required to start nut or bolt rotation from a fixed position during any removal cycle with no axial load on the nut

3.6
wrench torque
minimum torque which the driving configuration of the nut has to withstand without any permanent deformation which would interfere with the appropriate wrench and preclude the reuse of the nut

3.7
permanent set test
measure of the performance of a nut on a minimum mandrel after having been subjected to a single assembly and removal cycle on a maximum stud

3.8
reusability test
test to measure the torque required to remove a self-locking nut from a standard test bolt after a specified number of assembly and removal cycles

3.9
production lot
lot of finished nuts which have the basic part number and diameter, the individual elements of which have been fabricated by the same process from a single material batch, and which have been heat treated together to the same specified condition and produced as one continuous run

3.10
inspection lot
lot of nuts from a single production lot, of the same part number, which completely defines the nut

3.11
Discontinuities

3.11.1
crack
rupture in the material which may extend in any direction and which may be intercrystalline or transcrystalline in character

3.11.2
seam
longitudinal surface defect in the form of an unwelded open fold in the material

3.11.3
lap
surface defect caused by folding over metal fins or sharp corners and then rolling or forging them into the surface

3.12
random sample
sample taken in such a manner that each unit in the inspection lot has the same chance of being the first unit in the random sample; and, after the first unit in the sample is taken, each of the remaining units in the inspection lot has the same chance of being the second unit in the sample; and so on

3.13
acceptable quality level
AQL
maximum percentage defective (or maximum number of defects per hundred units) that, for purposes of sampling inspection, can be considered acceptable as a process average

3.14
limiting quality
LQ
magnitude of percentage defective, greater than the AQL, which, in accordance with the operating characteristic of the sampling/inspection plan, the purchaser runs a specified risk of accepting

NOTE In this standard the LQ corresponds to a purchaser's risk of 10 %.

4 Requirements and test methods

4.1 Introduction

The technical requirements and test methods given in **4.2**, **4.3**, **4.4**, **4.5** and **4.6** complement the requirements of the self-locking nut standard or drawing, but can supplement the requirements of the material specification.

Table 1 gives the testing for each characteristic of the self-locking nut sample necessary for qualification approval. Table 2 summarizes the testing required for both qualification and production acceptance testing.

All tests shall be carried out at ambient temperature unless otherwise specified in a particular test method.

NOTE 1 A nut is considered to be assembled when a minimum of two full male threads plus the chamfer extend beyond the friction element of the nut.

NOTE 2 The removal cycle is considered complete when the friction element is disengaged.

Subclause	Characteristic	Technical requirement	Inspection and test method	Q/A[a]	Sample size
4.2	**Materials**	The nut shall be made from the material specified by the nut standard or drawing.	As stated in the material specification.		
4.3	**Dimensions**				
4.3.1	**General**	The dimensions of the finished nut shall comply with the nut standard or drawing.	All dimensions shall be controlled by the manufacturer's quality system.	Q A	60 (100 %) Table 7 and Table 8
4.3.2	**Threads**	The threads shall comply with the requirements specified by the nut standard or drawing.		Q A	60 (100 %) Table 7 and Table 8
4.3.3	**Squareness**	The bearing surface of the nut shall be square to the axis of the thread within the tolerance specified by the nut standard or drawing.	Bearing surface squareness test, **3.2** of BS 2A 295:2000.	Q A	60 (100 %) Table 7 and Table 8
4.4	**Manufacture**				
4.4.1	**Nut bodies**	Nut bodies shall be produced by machining from bar or by a hot or cold forging process.	The method of manufacture shall be defined by control documentation to the satisfaction of the appropriate airworthiness authority.		
4.4.2	**Heat treatment**	The parts shall be heat treated as necessary, to satisfy the requirements of this specification.			
4.4.3	**Surface texture**	The surface texture shall be as specified by the nut standard or drawing prior to protective treatment.	BS 1134	Q A	3 Table 7 and Table 8
4.4.4	**Surface protection**	Surfaces shall be coated as specified by the nut standard or drawing.	Relevant coating specification.	Q A	3 Table 7 and Table 8
4.4.5	**Lubrication**	Surfaces shall be coated as specified by the nut standard or drawing.	Relevant coating specification.	Q A	3 Table 7 and Table 8

[a] Q is the qualification approval test requirement and A is the production acceptance test requirement.

Subclause	Characteristic	Technical requirement	Inspection and test method	Q/A[a]	Sample size
4.5	**Metallurgical properties**				
4.5.1	**Discontinuities**	Nuts shall be examined for discontinuities. Nuts having discontinuities exceeding the limitations specified in Table 3 shall be rejected.	Non-corrosion resisting steel nuts shall be magnetically inspected by both longitudinal and circular methods. The combined method is permissible.	Q A	60 (100 %) Table 7 and Table 8
		Care shall be exercised to avoid confusing cracks with other discontinuities (see **3.11**). Cracked parts shall be rejected.	Nuts made from non-magnetic material shall be subjected to a visual examination of magnification × 10.		
			Parts showing indications which are considered cause for rejection shall be subjected to metallographic examination at a magnification of × 100.	A	Table 9, column B
4.5.2	**Magnetic permeability and residual magnetism (applicable to corrosion resisting steel nuts only)**	The magnetic permeability of corrosion resisting steel nuts shall be as specified in the material specification of the product. Residual magnetism shall not exceed 0.5 gauss.	Magnetic field indicator of suitable calibration, used in accordance with the manufacturer's instructions.	Q A	3 Table 9, column B
NOTE The same test sample may be utilized for more than one test provided that none of the characteristics of the sample are altered during the examination procedure.					
[a] Q is the qualification approval test requirement and A is the production acceptance test requirement.					

Subclause	Characteristic	Technical requirement	Inspection and test method	Q/A[a]	Sample size
4.6	**Product performance**				
4.6.1	**Axial tensile strength**	Nuts shall withstand the minimum tensile load appropriate to their strength classification as defined in the nut standard or drawing, and as specified in Table 4.			
		Nuts shall support the relevant axial tensile strength load without rupture.	**3.3** of BS 2A 295:2000. This test shall be carried out at ambient temperature.	Q A	3 Table 9, column B
4.6.2	**Permanent set**	The nut shall not exceed the maximum permissible locking torque during assembly onto a maximum mandrel as specified in Table 6. During removal from a minimum mandrel the nut shall not exhibit a breakaway torque less than that specified in Table 6.	**3.11** of BS 2A 295:2000	Q A	3 Nil
4.6.3	**Accelerated environmental reusability**	Nuts shall meet the minimum breakaway torque and the maximum locking torque specified in Table 6 after each of four cycles of loaded heat soak. Each cycle shall consist of six hours at minimum operating temperature followed by six hours at maximum operating temperature.	**3.10** of BS 2A 295:2000	Q A	10 Nil
4.6.4	**Reusability**				
4.6.4.1	**Qualification acceptance**	Nuts shall be capable of 100 cycles of reuse without exhibiting locking torques outside the range specified in Table 6. Test shall be carried out on nuts in the "as received" condition.	**3.9** of BS 2A 295:2000	Q	10
4.6.4.2	**Production acceptance**	Nuts shall be capable of 30 cycles of reuse without exhibiting locking torques outside the range specified in Table 6.	**3.9** of BS 2A 295:2000	A	Table 9, column B

[a] Q is the qualification approval test requirement and A is the production acceptance test requirement.

Subclause	Characteristic	Technical requirement	Inspection and test method	Q/A[a]	Sample size
4.6.5	**Contamination**	Nuts shall be immersed in the contaminants specified in Table 10 for the specified times and at the specified temperatures. A separate nut shall be used for each contaminant. Half an hour after the immersion period the nuts shall be tested to demonstrate compliance with the reusability requirements of **4.6.4.2**.		Q A	1[b] Nil
4.6.6	**Breakaway torque after heat soak**				
4.6.6.1	**At maximum operating temperature**	Nuts shall meet the minimum breakaway torque specified in Table 6 after an eight hour heating period consisting of two hours at maximum soak temperature followed by six hours at maximum operating temperature, the breakaway torque being measured at maximum operating temperature and again at ambient temperature.	**3.10.2** of BS 2A 295:2000	Q A	5 Nil
4.6.6.2	**At minimum operating temperature**	Nuts shall meet the minimum breakaway torque specified in Table 6 after an eight hour heating period consisting of two hours at maximum soak temperature followed by six hours at minimum operating temperature, the breakaway torque being measured at minimum operating temperature and again at ambient temperature.	**3.9.2.1** of BS 2A 295:2000	Q A	5 Nil

[a] Q is the qualification approval test requirement and A is the production acceptance test requirement.
[b] One nut per contaminant.

Subclause	Characteristic	Technical requirement	Inspection and test method	Q/A[a]	Sample size
4.6.7	**Accelerated vibration (applicable only to thread sizes MJ5 to MJ12)**	A nut assembled to standard bolt and tightened to the assembly torque values specified in Table 6 shall withstand 30 000 cycles continuous vibration at frequency 30 Hz and peak to peak amplitude 11.25 mm without relative rotation exceeding 360° or cracking of the nut.	**3.12** of BS 2A 295:2000		
4.6.7.1	**At ambient temperature**	Compliance shall be demonstrated at ambient temperature.	Taking into account the capacity of vibration machines, this test applies only to nuts of diameter 5, 6, 7, 8, 10 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.	Q A	5 Nil
4.6.7.2	**At ambient temperature after heat soak at maximum operating temperature**	Compliance shall be demonstrated at ambient temperature after heat soak of six hours at maximum operating temperature ±5 °C removing and reassembling four additional times and tightening to the assembly torques specified in Table 6.	Taking into account the capacity of vibration machines, this test applies only to nuts of diameter 5, 6, 7, 8, 10 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.	Q A	5 Nil

[a] Q is the qualification approval test requirement and A is the production acceptance test requirement.

5 Quality Assurance and product qualification testing approvals

5.1 Quality Assurance approval

The nut manufacturers shall have a Quality Management System in accordance with the requirements of BS EN 9100.

NOTE 1 *Product certification/inspection/testing*. Users of this British Standard are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this British Standard. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

NOTE 2 The prime contractor, in the context of this British Standard, may also be the design authority.

5.2 Product qualification testing approval

5.2.1 Product qualification testing shall be in accordance with Clause **4** of this British Standard. A delegated representative acceptable to the design authority (who may be the prime contractor) shall independently witness product qualification testing. Records of this product qualification testing shall be retained by the manufacturer and form part of the Quality Assurance records.

5.2.2 Once qualified, the manufacturing route shall be sealed and not changed without the agreement of the qualification body, who might require re-qualification to re-establish manufacturing route compliance to specification.

5.3 Classification of tests

5.3.1 *General*

The inspection and testing of nuts shall be classified as follows:

a) product qualification approval tests (see **5.3.2**); and

b) production acceptance tests (see **5.3.3**).

5.3.2 *Production qualification approval test samples*

The qualification approval test samples shall consist of nuts for each diameter, to be qualification tested as specified in Table 1. The number of sample nuts for each test is listed in Clause **4** against the test requirement for qualification (Q).

At the option of the qualification authority, qualification of one part number may be accepted as covering nuts of adjacent diameters provided that the manufacturing method is identical.

5.3.3 *Production acceptance tests*

5.3.3.1 *General*

Production acceptance tests shall be carried out for each inspection lot (**3.10**).

The production acceptance tests shall consist of all the tests specified for acceptance (A) in Clause **4**.

The classification of defects for nuts for the visual and dimensional non-destructive tests shall be as given in Table 7. Defects not classified in Table 7 shall be classified as minor B defects. All dimensional characteristics shall be considered defective when out of tolerance.

The sample units for the metallurgical non-destructive tests may be selected from those that have been subjected to and passed the visual and dimensional inspection, with additional units selected at random from the inspection lot as necessary.

The sample units for destructive tests may be selected from those that have been subjected to and passed the non-destructive tests with additional units selected at random from the inspection lot as necessary.

5.3.3.2 *Rejection and re-test*

Lots found unacceptable shall be re-submitted for re-inspection only after all the units are re-examined or re-tested and all defective units are removed or defects corrected.

Before the inspection lot is re-submitted, full particulars concerning the cause of the previous rejection and the action taken to correct the defects found in the inspection lot shall be recorded.

Twice the normal sample size shall be used in the case of destructive tests in lots previously found unacceptable. The same acceptance level shall be used.

Lots re-submitted and found unacceptable shall be destroyed.

6 Packing, packaging and labelling

6.1 Prevention of damage

The nuts shall be packed so as to prevent damage and corrosion during handling, transportation and storage.

6.2 Unit package

Unit packages shall contain only fasteners of the same part number and production lot number.

6.3 Labelling

Each individual package of nuts shall have the complete part number, quantity, production lot number and inspector's stamp clearly shown on the label.

7 Inspection

The manufacturer is responsible for the performance of all inspection requirements as specified herein. Each manufacturer shall use his own or, exceptionally, any other facilities for approval in accordance with **5.1** and **5.2** for the implementation of these inspection requirements.

8 Production acceptance test report

A production acceptance test report showing actual numerical values shall be provided at the purchaser's option as part of the terms of the purchase order. The manufacturer shall also provide evidence that product qualification testing approval has been granted in accordance with **5.2**.

Table 1 — Qualification approval testing requirements for self-locking nut samples

Type of test	Characteristic	Subclause	Nut sample: 1 2 3 (Un-coated)	4 5 6 7 (Coated)	8 9 10	11 12 13	14 15 16 17 18	19 20 21 22 23 24 25 26 27 28	29 30 31 32 33 34 35 36 37 38	39 40 41	42 43 44	45 46 47	48 49 50	51 52 53 54 55	56 57 58 59 60
Non-destructive	Dimensions	**4.3**	× × ×	× × × ×	× × ×	× × ×	× × × × ×	× × × × × × × × × ×	× × × × × × × × × ×	× × ×	× × ×	× × ×	× × ×	× × × × ×	× × × × ×
	Surface texture	**4.4.3**	× × ×												
	Surface protection	**4.4.4**			× × ×										
	Lubrication	**4.4.5**				× × ×									
	Discontinuities	**4.5.1**	× × ×	× × × ×	× × ×	× × ×	× × × × ×	× × × × × × × × × ×	× × × × × × × × × ×	× × ×	× × ×	× × ×	× × ×	× × × × ×	× × × × ×
	Magnetic permeability	**4.5.2**					× × ×								
Destructive	Axial tensile test	**4.6.1**	× × ×												
	Permanent set	**4.6.2**								× × ×					
	Accelerated environmental reusability	**4.6.3**							× × × × × × × × × ×						
	Reusability	**4.6.4**						× × × × × × × × × ×							
	Contamination	**4.6.5**													× × × × ×
	Breakaway torque after heat soak	**4.6.6**			× ×	× × ×	× × × × ×								
	Accelerated vibration	**4.6.7**		× × × ×	×									× × × × ×	

Table 2 — Qualification and production acceptance tests

Type of test	Characteristic	Qualification		Acceptance	
		Subclause	Sample size	Subclause	Sample size
Non-destructive	Dimensions	**4.3**	60	**4.3**	Table 7 and Table 8
	Surface texture	**4.4.3**	3	**4.4.3**	Table 7 and Table 8
	Surface protection	**4.4.4**	3	**4.4.4**	Table 7 and Table 8
	Lubrication	**4.4.5**	3	**4.4.5**	Table 7 and Table 8
	Discontinuities	**4.5.1**	60	**4.5.1**	Magnetic; Table 7 and Table 8. Microscopic; Table 9, column B
	Magnetic permeability	**4.5.2**	3	**4.5.2**	Table 9, column B
Destructive	Axial tensile strength	**4.6.1**	3	**4.6.1**	Table 9, column B
	Permanent set	**4.6.2**	3		
	Accelerated environmental reusability	**4.6.3**	10		
	Reusability	**4.6.4.1**	10	**4.6.4.2**	Table 9, column B
	Contamination	**4.6.5**	5		
	Breakaway torque after heat soak	**4.6.6**	10		
	Accelerated vibration at ambient temperature	**4.6.7.1**	5		
	Accelerated vibration at ambient temperature after heat soak at minimum operating temperature	**4.6.7.2**	5		

Table 3 — Discontinuity depths

Thread nominal diameter	Discontinuity depths	
	Nuts made from sheet metal	Nuts made from bar or wire
mm	mm	mm
8 and smaller	0.13	0.25
10	0.16	0.30
12	0.22	0.35
14	0.25	0.39
16 and larger	0.30	0.44

Table 4 — Axial load values — 100 % axial load test

Thread size	Cross-sectional area, S, to be tested	Axial tensile load					
		450 MPa class (σ_B)		650 MPa class (σ_B)		900 MPa class (σ_B)	
		Full	Thin	Full	Thin	Full	Thin
	mm^2	kN	kN	kN	kN	kN	kN
MJ3 × 0.5	5.439	2.4	1.56	3.3	2.15	4.9	3.19
MJ4 × 0.7	9.517	4.3	2.8	5.7	3.71	8.6	5.59
MJ5 × 0.8	15.296	6.9	4.49	9.2	5.98	13.8	8.97
MJ6 × 1	21.753	9.8	6.37	13.1	8.52	19.6	12.74
MJ8 × 1	41.682	18.8	12.22	25.0	16.25	37.5	24.38
MJ10 × 1.25	65.136	29.3	19.05	39.1	25.42	58.6	38.09
MJ12 × 1.25	97.128	43.7	28.41	58.3	37.9	87.4	56.81
MJ14 × 1.5	131.562	59.2	38.48	78.9	51.29	118.4	76.96
MJ16 × 1.5	175.613	79.0	51.35	105.4	68.51	158.1	102.77
MJ18 × 1.5	225.949	101.7	66.10	135.6	88.14	203.4	132.21
MJ20 × 1.5	282.571	127.2	82.68	169.5	101.18	254.3	165.30

The cross-sectional area taken into consideration to calculate the axial load to be applied to a nut is the same as that of a bolt with an identical diameter and pitch. The formula for this cross-sectional area, S, is:

$$S = \frac{\pi}{4}(d_3)^2\left[2 - \left(\frac{d_3}{d_2}\right)^2\right]$$

where

S is the cross-sectional area (in mm^2);

d_2 is the maximum thread flank diameter of the bolt in accordance with BS A 358-2 (in mm);

d_3 is the maximum root diameter of the bolt in accordance with BS A 358-2 (in mm).

Axial tensile load for full nuts L_f is calculated by the formula:

$$L_f = S\sigma_B$$

and axial tensile load for thin nuts L_t is calculated by the formula:

$$L_t = 0.65S\sigma_B$$

where

S is the cross-sectional area (in mm^2);

σ_B is the strength classification (in MPa).

Table 5 — Maximum assembly and wrench torque test values

Type of nut	Thread size	450 MPa class		650 MPa class		900 MPa class		Maximum locking torque
		Maximum assembly torque	Wrench torque	Maximum assembly torque	Wrench torque	Maximum assembly torque	Wrench torque	
		N·m	N·m	N·m	N·m	N·m	N·m	N·m
Full nut	MJ3	1.5	3.0	1.7	3.4	2.1	4.2	0.8
	MJ4	3.1	6.2	3.7	7.4	4.5	9.0	1.6
	MJ5	4.6	9.2	5.4	10.8	5.7	11.4	1.8
	MJ6	8.1	16.2	9.6	19.2	9.9	19.8	3.2
	MJ8	18.0	36.0	18.0	36.0	24.7	49.4	6.0
	MJ10	28.5	57.0	35.3	70.6	48.9	97.8	9.5
	MJ12	45.0	90.0	61.4	122.8	85.0	170.0	15.0
	MJ14	67.1	134.2	97.0	194.0	134.3	268.6	22.0
	MJ16	100.7	201.4	145.4	290.8	201.4	402.8	33.0
	MJ18	145.4	290.8	210.0	420.0	290.7	581.4	44.0
	MJ20	201.6	403.2	291.2	582.4	403.2	806.4	50.0
Thin nut	MJ3	1.1	2.2	1.3	2.6	1.5	3.0	0.8
	MJ4	2.3	4.6	2.7	5.4	3.1	6.2	1.6
	MJ5	3.2	6.4	3.9	7.8	4.6	9.2	1.8
	MJ6	5.7	11.4	6.8	13.6	8.1	16.2	3.2
	MJ8	12.2	24.4	14.9	29.8	18.0	36.0	6.0
	MJ10	21.7	43.4	27.2	54.4	28.5	57.0	9.5
	MJ12	36.3	72.6	45.0	90.0	45.0	90.0	15.0
	MJ14	55.6	111.2	66.0	132.0	67.1	134.2	22.0
	MJ16	83.3	166.6	99.0	198.0	100.7	201.4	33.0
	MJ18	116.7	233.4	132.0	264.0	145.4	296.8	44.0
	MJ20	150.0	300.0	150.0	300.0	201.6	403.2	50.0

Maximum assembly torque values on full nuts are calculated to induce 50 % of the ultimate tensile stress (UTS). On thin nuts, maximum assembly torque values are calculated to induce 25 % of UTS. Where the calculated maximum assembly torque is less than three times the maximum locking torque, the maximum assembly torque is adjusted to the calculated value plus the maximum locking torque, except where this value exceeds three times the maximum locking torque, in which case three times the maximum locking torque is the value used.

$t_w = 2t$

where

t_w is the wrench torque (in N·m);

t is the maximum assembly torque (in N·m).

Table 6 — Maximum locking torque, minimum breakaway torque, assembly torque (vibration), push out and torque out values

Thread size	Maximum locking torque		Minimum breakaway torque	Assembly torque (vibration test)[c]
	Ambient temperature[a]	At ambient temperature after heat soak[b]		
	N·m	N·m	N·m	N·m
MJ3	0.80	1.60	0.10	1.60
MJ4	1.60	3.20	0.15	3.20
MJ5	1.80	3.60	0.25	3.60
MJ6	3.20	6.40	0.35	6.40
MJ8	6.00	12.00	0.70	12.00
MJ10	9.50	19.00	1.20	19.00
MJ12	15.00	30.00	1.80	30.00
MJ14	22.00	44.00	2.60	44.00
MJ16	33.00	66.00	3.70	66.00
MJ18	44.00	88.00	4.90	88.00
MJ20	50.00	100.00	6.30	100.00

[a] Maximum locking torque at ambient temperature is based on reasonable manufacturing tolerance but not less than one third of assembly torque (Table 5) (5 × 0.8 slightly exceeds one third of the maximum assembly torque).
[b] Maximum locking torque after heat soak is double the maximum locking torque at ambient temperature.
[c] Assembly torque (vibration test) is double the maximum locking torque at ambient temperature.

Table 7 — Classification of defects

Category		AQL %	Characteristic
Major	**A**	0.065	Penetrant flaw detection
	B	0.4	Visual examination of locking element
	C	1.0	Thread size Squareness of bearing surface to threads Surface protection Lubrication Shank diameter, Shank length } Clinch nuts Rivet hole diameter Rivet hole location
Minor	**A**	2.5	Wrench size and configuration Nut height Diameter of bearing surface Float Burrs and sharp corners Depth of counter bore
	B	4.0	Coaxiality wrench form to thread diameter Coaxiality wrench diameter to thread diameter

Table 8 — Sampling data for visual and dimensional characteristics

Production lot or inspection lot size	Sample size (*n*)	AQL 0.065 %		AQL 0.4 %		AQL 1.0 %		AQL 2.5 %		AQL 4.0 %	
		AC	LQ %	AC	LQ %	AC	LQ %	AC	LQ %	AC	LQ %
91 to 150	13					0	16.20				
91 to 150	20	↓	↓	↓	↓	—	—	1	18.10	2	24.50
151 to 280	32	↓	↓	0	6.94	↓	↓	2	15.80	3	19.70
281 to 500	50	↓	↓	↓	↓	1	7.56	3	12.90	5	17.80
501 to 1 200	80	↓	↓	↓	↓	2	6.52	5	11.30	7	14.20
1 201 to 3 200	125	↓	↓	1	3.11	3	5.35	7	9.42	10	12.30
3 201 to 10 000	200	0	1.20	2	2.66	5	4.64	10	7.70	14	10.10
10 001 to 35 000	315	↑	↑	3	2.12	7	3.74	14	6.39	21	8.95
35 001 to 150 000	500	↓	↓	5	1.86	10	3.08	21	5.64	1	1.00
150 001 to 500 000	800	1	0.49								

AC = Acceptance number.
↑ Use sampling plan above.
↓ Use sampling plan below.

NOTE Sampling details have been extracted from BS 6001.

Table 9 — Sampling data for mechanical and metallurgical characteristics

Production lot or inspection lot size	Sample size (*n*)		Acceptance number (AC)
	Non-destructive	Destructive	
	A	B	
Up to 500	8	3	0
501 to 3 200	13	5	0
3 201 to 35 000	20	5	0
35 001 and over	32	8	0

Table 10 — Contaminants

Contaminant	Relevant specification	Immersion	
		Time h	Temperature °C
Engine fuel	Def Stan 91-88/Issue 2[a]	24	45
De-icing fluid	BS 1595-1	24	45
Hydraulic fluid, mineral based	Def Stan 91-48[a]	24	70
Hydraulic fluid, phosphate ester	DTD 900/4881D[a]	24	70
Engine oil	Def Stan 91-100/Issue 3[a]	24	70

[a] Obtainable from UK Defence Standardization, Room 1138, Kentigern House, 65 Brown Street, Glasgow G2 8EX.

Annex A (normative)
Axial loads and torque values for thread sizes M8 × 1.25, M10 × 1.5 and M12 × 1.5

The maximum assembly and wrench torque test values, and axial load values for thread sizes M8 × 1.25, M10 × 1.5 and M12 × 1.5 are given in Table A.1 and Table A.2 respectively.

Table A.1 — Maximum assembly and wrench torque test values for thread sizes M8 × 1.25, M10 × 1.5 and M12 × 1.5

Type of nut	Thread		450 MPa class		650 MPa class		900 MPa class		Maximum locking torque
	Nominal diameter	Pitch	Maximum assembly torque	Wrench torque	Maximum assembly torque	Wrench torque	Maximum assembly torque	Wrench torque	
	mm	mm	N·m	N·m	N·m	N·m	N·m	N·m	N·m
Full nut	8.0	1.25	17.4	34.8	18.0	36.0	22.8	45.6	6.0
	10.0	1.50	28.5	57.0	33.1	66.2	45.8	91.6	9.5
	12.0	1.50	45.0	90.0	58.3	116.6	80.7	161.4	15.0
Thin nut	8.0	1.25	11.7	23.4	14.2	28.4	17.4	34.8	6.0
	10.0	1.50	21.0	42.0	26.0	52.0	28.5	57.0	9.5
	12.0	1.50	32.2	70.4	44.1	82.2	45.0	90.0	15.0

Table A.2 — Axial load values for thread sizes M8 × 1.25, M10 × 1.5 and M12 × 1.5

Thread		Tensile stress area	Axial tensile load					
Nominal diameter	Pitch		450 MPa class		650 MPa class		900 MPa class	
			Full	Thin	Full	Thin	Full	Thin
mm	mm	mm^3	kN	kN	kN	kN	kN	kN
8	1.25	40.60	18.3	9.1	26.4	13.2	36.5	18.3
10	1.50	64.0	28.8	14.4	41.6	20.6	57.6	28.8
12	1.50	95.50	43.0	21.5	62.0	31.0	86.0	43.0

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Bibliography

BS 6001, *Sampling procedures and tables for inspection by attributes.*

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