BRITISH STANDARD

BS 4A 100:2003

Incorporating Amendment No. 1 and Corrigendum No. 1

Aerospace series — Specification for general requirements for bolts and free running nuts of tensile strength not exceeding 1 249 MPa

ICS 49.030.20; 49.030.30

Confirmed December 2009

BSI British Standards

Committees responsible for this British Standard

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

The Association of Electronics, Telecommunications and Business Equipment Industries

British Industrial Fasteners Federation

Ministry of Defence

Society of British Aerospace Companies Ltd.

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Amendments/corrigenda issued since publication

Amd. No.	Date	Comments
17434	28 September 2007	See foreword
C1	31 July 2008	Revision of **10.5.2.1**

Contents

Foreword

This new edition of BS 3A 100 incorporates technical changes only (a new Clause **10**). It does not reflect a full review, or revision, of the standard which will be undertaken in due course.

The start and finish of text introduced or altered by Amendment No. 1 is indicated in the text by tags ▌A1⟩ ⟨A1▐.

This British Standard, prepared under the direction of the Aerospace Standards Policy Committee, it is intended primarily to improve the manufacture of aerospace bolts and free running nuts and the quality of their inspection. It also brings these requirements up to date in relation to current specifications for aerospace fasteners either published or in the course of publication. It constitutes a new edition of BS 3A 100:1991.

This new edition does not affect the interchangeability of items manufactured to their own individual or nut standard, and fasteners manufactured in compliance with BS 2A 100:1968, may continue to be furnished until stocks are exhausted.

This British Standard is intended for use in conjunction with those "A" series British Standards in which compliance with this standard is a specific requirement. It may also be applicable to other aerospace bolts and nuts if required by the contract, drawing or order.

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 cannot confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 20, an inside back cover and a back cover.

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1 Scope

This British Standard specifies the general requirements for aerospace bolts and free running nuts of tensile strength not exceeding 1 249 MPa.

2 Material

The bolts and nuts shall be manufactured from the material specified in the relevant bolt or nut standard.

NOTE Bolts or nuts may be rejected at any time for faults in or revealed by manufacture although they have been made from material passed previously.

3 Manufacture

3.1 Bolts

Bolts shall be manufactured by machining from bar, by cold-forging or hot-forging.

3.2 Cold-forged or hot-forged steel bolts

Cold-forged or hot-forged steel bolts shall be manufactured by a process to fulfil the requirements in Clause **10**.

3.3 Screw threads

3.3.1 All unified class 3A threads that comply with BS 1580 and all threads that comply with A1 ISO 3161 A1 shall be rolled in the finally heat treated condition

3.3.2 Unless otherwise specified by the bolt standard all other threads shall be cut or rolled at the option of the bolt manufacturer, however the lead end chamfer of bolts $\frac{3}{8}$ in nominal size and under may deviate from that indicated on the bolt standard or drawing, due to metal extrusion on thread rolling, subject to the following requirements being met.

a) The minor diameter of the lead thread shall be continuous.

b) The lead end face shall be square to the axis of the thread within the tolerance permitted by the following test.

The bolt shall be screwed into a ring gauge the face of which is square to the axis of the thread, until the low point of the lead end is flush with the gauge face. The protrusion shall not exceed one pitch or 0.030 in, whichever is the smaller.

4 Dimensions

All bolts and nuts shall comply with the dimensions and tolerances specified in the relevant standard.

5 Runout and lead threads for rolled threads

Rolled threads shall have runout and lead threads complying with BS A 231.

6 Screw thread form and class of fit

6.1 When British Association (BA) threads are specified for bolts they shall comply with the close class limits and fits specified in BS 93[1)].

In view of the tendency for closely fitting bolts and nuts in corrosion resisting steel to seize when tightened together, the major, effective and minor diameters of unplated corrosion resisting steel bolts shall be 0.001 in smaller than the maximum limits for close class bolts specified in BS 93[1)].

NOTE In order to avoid any undue restriction of the tolerance allowed for screwing, the major, effective and minor diameters may be 0.001 in smaller than the minimum limits for close class bolts specified in BS 93[1)].

6.2 When BA threads are specified for nuts they shall comply with the limits and fits specified in BS 93[1)].

[1)] Obsolescent.

6.3 When British Standard Fine (BSF) threads are specified for bolts they shall comply with the medium class limits and fits specified in BS 84[2)].

In view of the tendency for closely fitting bolts and nuts in corrosion resisting steel to seize when tightened together, the major, effective and minor diameters of unplated corrosion resisting steel bolts $\frac{7}{8}$ in BSF and larger shall be 0.002 in smaller than the maximum limits for medium class bolts specified in BS 84[2)].

NOTE In order to avoid any undue restriction of the tolerance allowed for screwing, the major, effective and minor diameters of $\frac{7}{8}$ in BSF and larger may be 0.002 in smaller than the minimum limits for medium class bolts specified in BS 84[2)].

6.4 When BSF threads are specified for nuts they shall comply with the normal class limits and fits specified in BS 84[2)].

6.5 Unless otherwise specified in the product standard unified threads for bolts shall comply with the class 2A limits and fits specified in BS 1580 or BS A 346 as applicable.

6.6 Unless otherwise specified in the product standard unified threads for nuts shall comply with the class 2B limits and fits specified in BS 1580 or BS A 346 as applicable.

7 Anti-corrosion treatment

7.1 Anti-corrosion treatments specified for the bolts or nuts in the relevant standard shall, unless otherwise specified, comply with the requirements of the latest issue of the following appropriate process specification:

anodizing: Defence Standard 03-24 (chromic process);
cadmium plating: Defence Standard 03-19.

7.2 Colour identification on anodised fasteners

Due to the difficulties of uniformly colourising the anodic coating, it shall be acceptable for up to 10 % of each batch supplied to exhibit variations in colour, which shall not be the cause for rejection.

8 Identification marking

8.1 Hexagonal-headed bolts

8.1.1 Unless otherwise stated on the product standard, fasteners shall be identified as stated in **8.1.2**, **8.1.3**, **8.1.4** and **8.1.5**.

8.1.2 Bolts of 2 BA and No. 10 nominal size and larger shall have the complete part number (e.g. A 102 3D) applied to the upper face of the head.

8.1.3 Bolts with unified threads shall have the appropriate identification applied as indicated in Appendix A of this standard.

8.1.4 Each individual package of bolts shall have the complete part number and batch identification number or code clearly shown on each label.

8.1.5 Bolts shall have the manufacturer's identification applied to the upper face of the head.

8.2 Bolts with other than hexagon heads

8.2.1 Unless otherwise stated on the product standard, fasteners shall be identified as stated in **8.2.2**, **8.2.3** and **8.2.4**.

8.2.2 Pan head and mushroom head bolts with unified threads shall have the appropriate identification applied as indicated in Appendix A of this standard.

8.2.3 Pan, mushroom and countersunk head bolts of 2 BA and No. 10 nominal size and larger shall have the length identification only as given in the appropriate bolt standard marked on the head, unless otherwise stated in the individual product standard.

8.2.4 Each individual package of bolts shall have the complete part number and batch identification number or code clearly shown on each label.

[2)] Obsolescent.

8.3 Hexagon nuts

8.3.1 Unless otherwise stated on the product standard, fasteners shall be identified as stated in **8.3.2**, **8.3.3**, **8.3.4** and **8.3.5**.

8.3.2 Nuts of $\frac{7}{16}$ in nominal diameter and larger shall have the number of the relevant British Standard (e.g. A 103) applied on one or more of the hexagonal surfaces.

8.3.3 Nuts of 2 BA and No. 10 nominal size and larger with left hand threads shall have the letter "L" applied to one of the hexagon surfaces.

8.3.4 Nuts with unified threads of No. 8 nominal size and larger shall be marked with the identification as indicated in Appendix A of this standard.

8.3.5 Each individual package of nuts shall have the complete part number and batch identification number or code clearly shown on each label.

8.4 Method of marking

The method of marking shall be at the option of the manufacturer when in accordance with one of the following. All marking shall be applied to the fasteners in the uncoated condition.

8.4.1 Marking shall be applied by use of controlled pressure die stamping using a Character marking die of a rounded tip form not less than 0.025 inch height. The depth of impression shall be kept to a minimum consistent with legibility and not more than 0.010 inch depth.

8.4.2 Marking shall be integrally forged with a Character that is not less than 0.025 inch height.

8.4.3 Marking shall be by microprocessor "controlled dot peen" with a spherical indenting stylus of 0.005 inch an indentation depth of 0.001 to 0.002 inch for steel with a hardness less than 54 Rockwell "C" and indentation depth of not more than 0.003 inch for aluminium.

9 Quality assurance procedure

9.1 General

9.1.1 *Quality Assurance Authority*

The quality assurance system selected shall satisfy the requirements of the quality assurance authority.

NOTE 1 The appropriate quality assurance system for the manufacture of aerospace products is ISO 9000:2000 with AS/EN 9100.

NOTE 2 Manufacturers and users are advised that in respect of CAA certification, this is no longer appropriate for the manufacturer of standard parts (fasteners). Manufacturers and users should therefore check with their local CAA office for eligibility.

9.1.2 *Responsibility for inspection and tests*

The manufacturer shall be responsible for the performance of all inspection and test requirements specified herein. Each manufacturer shall use their own or, exceptionally, any other facilities approved in accordance to Notes 1 and 2 of **9.1.1** for the implementation of these quality assurance and test requirements.

9.2 Acceptance of production batches

9.2.1 *Definition of batch*

A batch shall consist of finished bolts or nuts which are of the same type and diameter, fabricated by the same process from material of the same cast, heat treated as one lot and plated as one lot and produced as one continuous run, free from any interruptions or changes.

9.2.2 *Sampling*

Random samples shall be taken from each batch in accordance with **9.2.3** for dimensional and non-destructive inspection, and in accordance with **10.1** for destructive testing.

9.2.3 *Samples for dimensional and non-destructive inspection*

Samples for dimensional and non-destructive inspection shall be taken from each batch in accordance with BS 6001 at the levels given in Table 1.

The acceptance or rejection shall depend upon the acceptable quality levels (AQLs) applied to the characteristics as given in Table 1.

9.3 Surface texture

Surface texture shall be as specified in Table 2 and shall be determined visually except in cases of dispute when measurements shall be made in accordance with BS 1134.

Table 1 — Inspection levels

AQL	Inspection level II	Inspection level S-I
0.065	Magnetic flaw detection after plating	—
1.0	Thread size Shank diameter (where tolerance is 0.001 in or less)	Thread run-out Underhead radius Squareness Driving geometry
2.5	Surface texture (visual) Burrs and plating (visual) Identifications (visual)	Plain shank length Straightness of shank (except when ground) Concentricity
4.0	Nut thickness Overall length Shank diameter (where tolerance exceeds 0.001 in) Point chamfer (visual) Other dimensional characteristics	Head height

Table 2 — Surface texture

	Features	Surface roughness to BS 1134 R_e max µm (µin)
Bolts	Shank, head bearing face and fillet radius	Close tolerance shank 0.8 (32)
		Other than close tolerance shank 1.6 (63)
	Thread flank and root radius	Rolled thread 0.8 (32)
		Cut thread 1.6 (63)
	Other surfaces	3.2 (125)
Nuts	Bearing faces	3.2 (125) (circular lay)
	Other surfaces	3.2 (125)

9.4 Geometrical tolerances

9.4.1 The geometrical features of bolts shall comply with the tolerances shown in Figure 1 and given in Table 3. (Sampling shall be carried out in accordance with **9.2.3**.)

9.4.2 The geometrical features of nuts shall comply with the tolerances shown in Figure 2. (Sampling shall be carried out in accordance with **9.2.3**.)

9.4.3 The squareness between the nut bearing faces and the screw thread shall comply with the tolerances in Table 4 when checked with a squareness gauge of the type indicated in Figure 3.

The nut shall be screwed by hand onto a tapered truncated screw gauge until the thread of the nut is tight onto the thread of the screw gauge. A sliding sleeve having a face diameter equal to the maximum distance across flats of the nut, and a face at 90° to the axis of the screw gauge, shall then be brought into contact with the leading face of the nut. It shall not be possible for a feeler gauge of thickness equal to the squareness tolerance given in Table 4 to enter between the leading face of the nut and the face of the sleeve (see Figure 3).

9.5 Freedom from material defects

9.5.1 *Magnetic flaw detection of steel bolts and nuts*

Samples of steel bolts and nuts in the finished condition in sizes 2 BA and No. 10 and larger shall be selected for magnetic flaw detection tests in accordance with **9.2.3**.

NOTE If the bars from which nuts are to be machined have been subjected to magnetic flaw detection to the level required by this standard and found satisfactory, then the nuts made from such bars need not be individually examined.

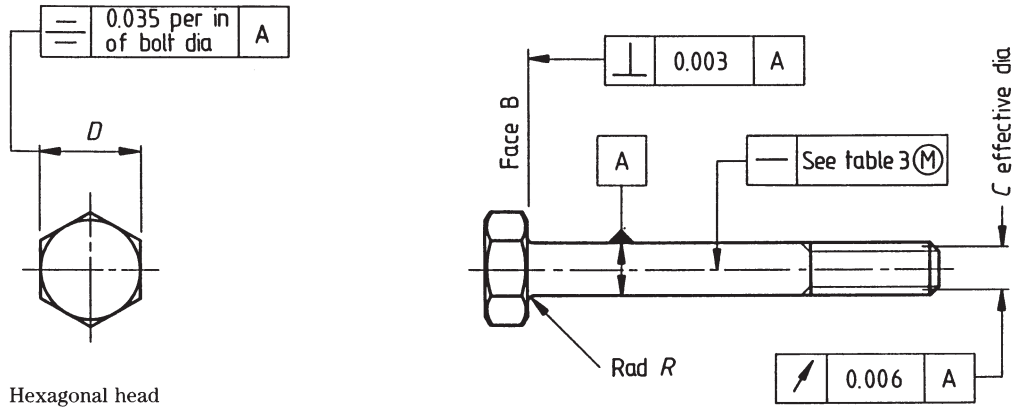
9.5.2 *Method of examination*

The implementation of the technique and demagnetization shall be in accordance with BS 6072. Bolts and, where applicable, bars shall be subjected to longitudinal current flow (LF) and nuts to a threaded bar test. For bolts the current value shall be 500 amperes per inch diameter of the shank. For nuts (or the bar used in making them) the current value shall be 500 amperes per inch of outside diameter or 500 amperes per inch of the dimensions across flats.

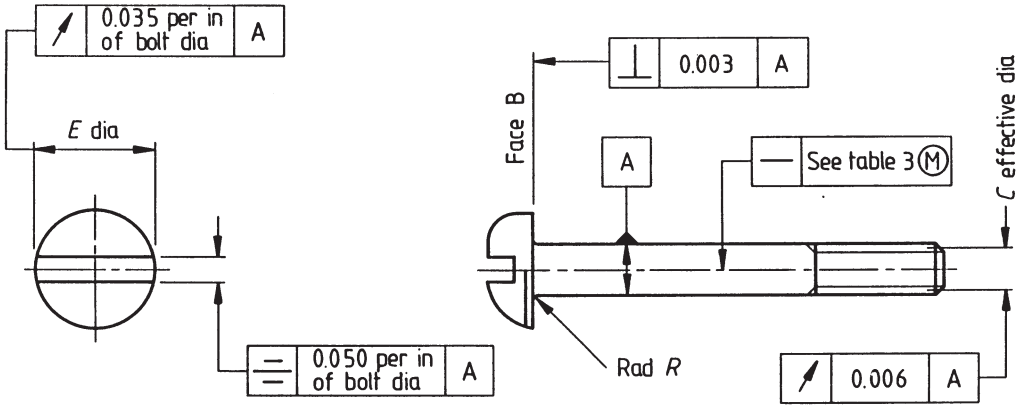
9.5.3 *Assessment of indications*

Where doubt exists as to the nature or depth of any surface defect revealed by magnetic flaw detection, representative samples shall be sectioned and the sections examined under a microscope but, where only the depth of a defect is in doubt, it is permissible for the depth to be estimated by local filing or otherwise machining of the surface until an indication of the defect ceases to be revealed by further magnetic flaw detection.

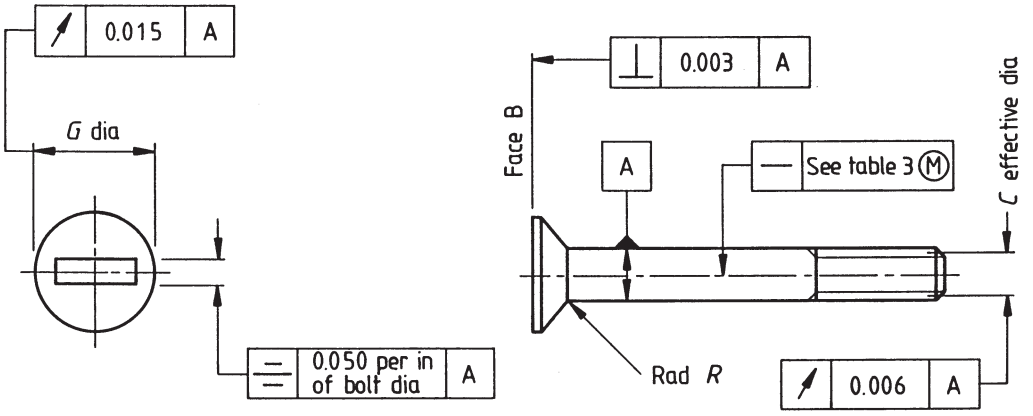
All dimensions in inches. Third angle projection.



Hexagonal head



Pan head and mushroom head



Countersunk head

NOTE Fillet rad. *R* to blend smoothly with face and shank.

Figure 1 — Geometrical tolerances for bolts

Table 3 — Geometrical straightness tolerances for bolt shanks

Nominal size of bolt				Straightness tolerance	
BA	BSF	UNC	UNF	Close tolerance shank bolts	Other than close tolerance shank bolts
	in		in	in	in
6	—	No. 4-40	—	—	0.0030 per inch of bolt length plus a constant of 0.002 in
4	—	No. 6-32	—		
		No. 8-32	—		
2	—	—	No. 10-32	0.0015 per inch of bolt length plus a constant of 0.001 in	0.0030 per inch of bolt length plus a constant of 0.002 in
—	$\frac{1}{4}$	—	$\frac{1}{4}$	0.0012 per inch of bolt length plus a constant of 0.001 in	0.0025 per inch of bolt length plus a constant of 0.002 in
—	$\frac{5}{16}$	—	$\frac{5}{16}$	0.0010 per inch of bolt length plus a constant of 0.001 in	0.0020 per inch of bolt length plus a constant of 0.002 in
—	$\frac{3}{8}$	—	$\frac{3}{8}$	0.0010 per inch of bolt length plus a constant of 0.001 in	0.0020 per inch of bolt length plus a constant of 0.002 in
—	$\frac{7}{16}$	—	$\frac{7}{16}$	0.0007 per inch of bolt length plus a constant of 0.001 in	0.0015 per inch of bolt length plus a constant of 0.002 in
—	$\frac{1}{2}$ and over	—	$\frac{1}{2}$ and over	0.0005 per inch of bolt length plus a constant of 0.001 in	0.0010 per inch of bolt length plus a constant of 0.002 in

All dimensions in inches. Third angle projection.

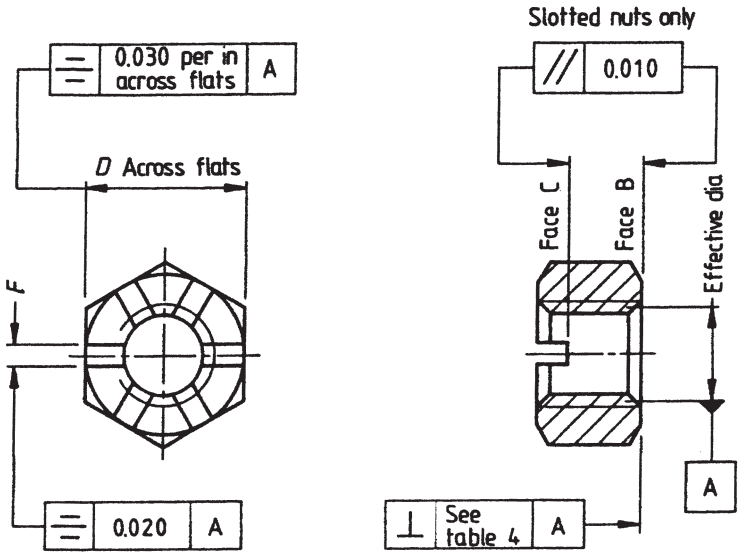


Figure 2 — Geometrical tolerances for nuts

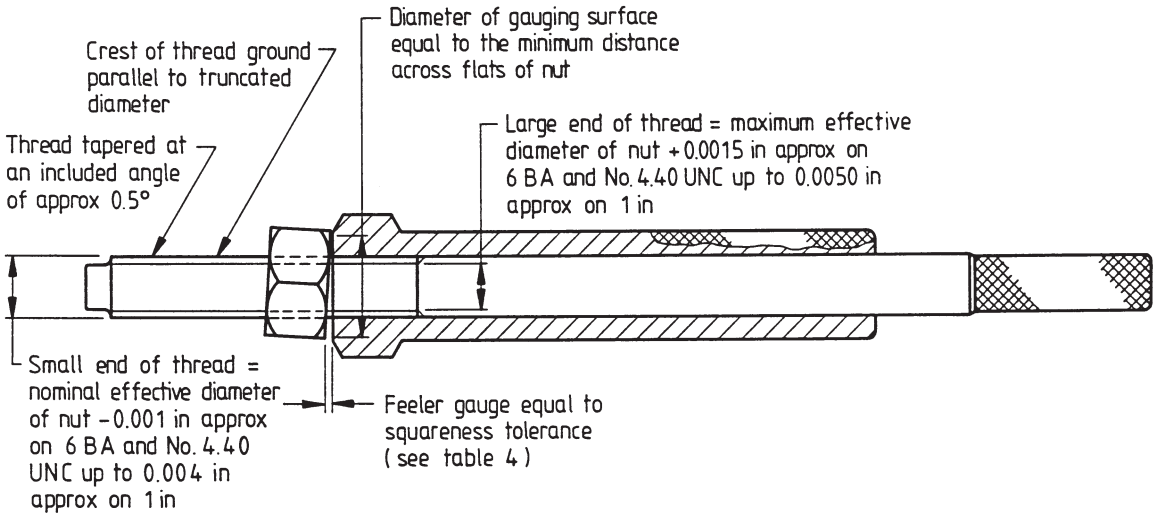


Figure 3 — Nut squareness gauge

Table 4 — Nut sequences tolerances

Nominal size of nut	Squareness tolerance[a]
	in
6 BA and No. 4-40 UNC	0.004
4 BA and No. 6-32 UNC	0.0045
No. 8-32 UNC	0.0045
2 BA and No. 10-32 UNF	0.005
$\frac{1}{4}$ in BSF and UNF	0.006
$\frac{5}{16}$ in BSF and UNF	0.006
$\frac{3}{8}$ in BSF and UNF	0.006
$\frac{7}{16}$ in BSF and UNF	0.007
$\frac{1}{2}$ in BSF and UNF	0.008
$\frac{9}{16}$ in BSF and UNF	0.008
$\frac{5}{8}$ in BSF and UNF	0.009
$\frac{3}{4}$ in BSF and UNF and over	0.009

[a] Calculated from the formula:

For nuts up to and including $\frac{3}{4}$ in squareness tolerance = (maximum size across flats × 0.006) + 0.003 in.

9.5.4 *Standard of acceptance*

Any bolt, nut or bar containing any crack shall be rejected.

The presence of longitudinal magnetic flaw detection indications which, on removal of the detecting ink and examination at ×10 magnification, are not associated with any visible surface defects, shall not be cause for rejection.

If, when examined as described in **9.5.2** and **9.5.3**, any longitudinal magnetic flaw detection indication is found to be associated with a visible surface defect (other than a crack or lap) the depth of the defect shall not exceed the maximum for the appropriate size given in Table 5.

NOTE 1 Laps or seams in the upper surface of the head originating from the forged recess are expected from this examination.

Any bolt, nut or bar showing after magnetic flaw detection, a transverse indication or an indication extending at an angle of more than 10° to the longitudinal axis, shall be rejected.

NOTE 2 Defects revealed by magnetic flaw detection are not necessarily cracks. A surface defect is regarded as being a crack if it consists of a rupture or discontinuity in the material or if it tapers to a sharp angle at the root.

9.5.5 *Aluminium alloy bolts and nuts*

Finished aluminium alloy bolts and nuts shall be anodized in accordance with Defence Standard 03-24. The bolts shall be examined after this treatment, and the presence of stains shall be the cause for rejection. Alternatively a dye penetrant test shall be performed in accordance with BS M 39.

9.5.6 *Thread rolling laps*

After each thread rolling machine setting, the first three bolts shall be examined for laps. Once approval of a machine setting has been given, three samples shall be taken and examined each hour of any continuous run.

The presence of thread rolling laps between the nominal effective diameter and the minor diameter is not acceptable and shall necessitate resetting of the machine.

For steel bolts, the test sample shall be etched in a suitable solution, and subsequently examined at a magnification of ×10.

Table 5 — Maximum depth of defect

Nominal size of bolt or nut	2 BA or No. 10 to $\frac{1}{4}$ in	over $\frac{1}{4}$ in to $\frac{3}{8}$ in	over $\frac{3}{8}$ in to $\frac{1}{2}$ in	over $\frac{1}{2}$ in to 1 in
Maximum depth of defect	0.004 in	0.005 in	0.006 in	0.008 in

10 Additional requirements for cold-forged and hot-forged bolts

10.1 Metallurgical examinations

10.1.1 For cold-forged parts, after each forging machine setting, a minimum of 12 blanks shall be produced under full running conditions. The last 2 blanks shall be taken for macro examination. Any change of material, primary tools or machine setting shall be re-examined.

10.1.2 For hot-forged parts, after each forging machine setting, the first 2 parts produced under full running conditions shall be taken for macro-examination. Where there is any change in material, primary tools or machine setting, a further 2 parts shall be taken for macro-examination.

10.2 Metal flow

10.2.1 When a longitudinal section of the head and not less than 0.25 inches of the shank is etched (using 50 % HCl at 80 °C to 90 °C for long enough to reveal the structure) and examined at ×10 magnification, there shall be no cracks or laps in surface due to the forging operation. The flow shall be largely symmetrical about the centre line, the flow shall be continuous along the underhead into the shank and there shall be not bursts or internal cracks.

10.2.2 If the manufacturing process includes removal of in excess of 0.005 inch from the bearing surface of the head or the shank, then samples of the finished bolt, at a rate of 2 per production batch (in accordance with **9.2.3**) shall be taken and the metal flow examined. No A1 flow A1 lines shall terminate outside of the head to shank fillet.

10.2.3 For hot-forged parts, micro-examination shall show no signs of overheating.

10.3 Heat treatment

10.3.1 Furnaces shall be operated in accordance with BS M 54.

10.3.1.1 Furnace protective atmosphere shall be controlled to [A1] aim for [A1] zero carburization or decarburization.

10.3.1.2 Sufficient samples shall be heat treated with the parts to enable all the tests listed (including provision for retest) to be carried out.

10.3.2 After heat treatment the following tests shall be performed.

10.4 Material property test

10.4.1 Samples shall be hardened and tempered with the parts they represent. Samples shall be selected as follows.

a) For parts in a continuous heat treatment [A1] furnace, [A1] there shall be 1 sample, per wire, cast per diameter, per 8 hours of continuous treatment.

b) For parts subject to batch heat treatment, there shall be 1 sample per wire cast, per diameter, per heat treatment furnace load.

10.4.2 A tensile test shall be performed in accordance with BS A 4, on the test sample or a test piece machined from the sample. The result shall conform to the requirement of the relevant bolt standard.

NOTE The impact/fracture test is not required.

10.4.3 *Retest*

If any test fails to meet the tensile test limits, one or both of the following may be adopted.

a) From the same production batch, two further samples shall be selected. Both samples shall meet the requirement of the bolt standard.

b) The bolts shall be reheat treated and re-tested in accordance with **10.3**, **10.5**, **10.6** and **10.7** as applicable.

No bolt shall be reheat treated more than twice.

10.5 Carburization/Decarburization

10.5.1 *General*

Samples shall be selected as follows.

a) For parts in a continuous heat treatment oven, select 2 parts from every cast represented.

b) For parts subject to batch hardening, select 4 parts per production batch. The parts selected shall be uniformly spread through the furnace volume.

10.5.2 *Test method*

10.5.2.1 The parts shall be examined in accordance with [A1] BS EN ISO 3887, method **4.2** or **4.3**. [A1] [C1] The amount of functional carburization or decarburization due to the heat treatment process shall not exceed 0.002 inches. [C1]

NOTE The effect due to heat treatment may be separated from that already allowed on the wire in accordance with BS S 100 by preparing a longitudinal section to include the cut-off surface.

10.5.2.2 *Retest*

If any sample is unsatisfactory, at least 2 further samples from each production batch shall be assessed. If any of these samples show greater carburization or decarburization than 0.002 inches, then the batches shall be rejected and scrapped.

10.6 Hardness

10.6.1 *General*

Samples of hardened and tempered parts shall be selected as follows A1, before any cold work operations, e.g. thread rolling, have been performed. A1

a) For parts subject to continuous heat treatment: 2 parts per production batch per hour.

b) For parts subject to batch heat treatment: 10 parts covering each wire cast per diameter per heat treatment load.

A1 c) For bolts 5/8 inch diameter and larger: each bolt shall be tested. A1

10.6.2 *Test method*

A1 **10.6.2.1** The hardness test, conducted in accordance with the relevant British Standard shall be made on the heat-treated blanks before coating. The impression shall be made on the head or face end of the thread, the point end of the bolt, or on a cut section. A1

10.6.2.2 *Retest*

Where the results obtained are outside the specified hardness range, the manufacturer shall have the option of reheating and re-testing in accordance with **10.3** or testing 100 % of the batch.

NOTE No parts shall be re-treated more than twice.

10.7 Tensile test of finished parts

A1 **10.7.1** The tensile test shall be made on samples from each manufacturing batch (traceable lot). A1

This test does not apply to bolts with a nominal grip length less than nominal diameter or to bolts or screws with a length of less than 2 1/2 times the nominal diameter.

10.7.2 The sample size for tensile testing shall be selected using the variables plan of BS A 241:2003[3)], Table 5.

10.7.3 The tensile test shall be conducted in accordance with BS A 305 using a jig essentially the same as that specified in BS A 241:2003[3)], Appendix C1.

10.7.4 The results shall be evaluated in accordance with the sampling and acceptance requirement parameters stated in BS A 241, Appendix A1 with the minimum tensile loads as specified in Table 7.

10.7.4.1 Parts not tensile tested shall be hardness tested as specified in **10.6.2.1**.

A1 *Text deleted* A1

10.7.5 *Hardness test*

The hardness test, conducted in accordance with the relevant British Standard, shall be made on the head or the end face of the thread, and the hardness value shall not fall outside the range quoted in Table 6.

A1 Table 6 — Bolt hardness ranges

Tensile strength	Hardness value		
	Vickers (BS EN ISO 6507) HV 30	Brinell (BS EN ISO 6506) HB 10/3 000	Rockwell (BS EN ISO 6508) HRC
880 to 1 080 MPa	270 to 340	255 to 321	25 to 35
1 100 to 1 249 MPa	348 to 390	330 to 370	35 to 40
55 to 65 tonf/sq.in. 124 000 to 146 000 lbf/sq.in.	258 to 330	245 to 314	25 to 35

A1

3) In preparation.

A1 *Text deleted* A1

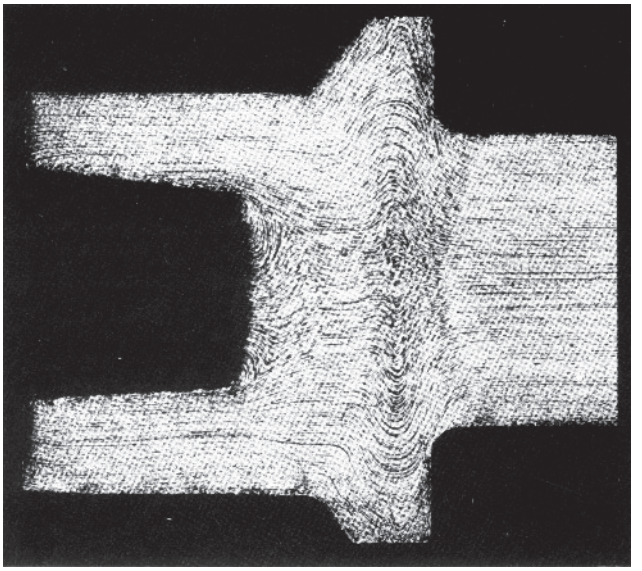


Figure 4 — Minimum acceptable standard of grain flow (after machining if applicable)

Table 7 – Minimum breaking loads

Minimum breaking loads for given tensile strength											
Thread size unified	Tensile strength 123 200 lbf/sq in (849 MPa)		Tensile strength 127 600 lbf/sq in (880 MPa)		Tensile strength 160 000 lbf/sq in (1 100 MPa)		Thread size BA and BSF	Tensile strength 123 200 lbf/sq in (849 MPa)		Tensile strength 127 600 lbf/sq in (880 MPa)	
	Breaking load (minimum)		Breaking load (minimum)		Breaking load (minimum)			Breaking load (minimum)		Breaking load (minimum)	
	lbf	kN	lbf	kN	lbf	kN		lbf	kN	lbf	kN
0.164-32	1 756	(7.81)	1 818	(8.09)	2 280	(10.14)	No. 6 BA	807	(3.59)	835	(3.72)
0.190-32	2 498	(11.11)	2 588	(11.51)	3 245	(14.41)	No. 4 BA	1 356	(6.03)	1 405	(6.25)
1/4 – 28	4 535	(20.17)	4 697	(20.89)	5 890	(26.2)	No. 2 BA	2 365	(10.52)	2 450	(10.9)
5/16 – 24	7 232	(32.17)	7 490	(33.32)	9 393	(41.78)	1/4 – 26 BSF	4 394	(19.55)	4 551	(20.24)
3/8 – 24	10 917	(48.56)	11 307	(50.3)	14 178	(63.07)	5/16 – 22 BSF	6 994	(31.11)	7 244	(32.22)
7/16 – 20	14 762	(65.66)	15 290	(68.01)	19 172	(85.28)	3/8 – 20 BSF	10 347	(46.02)	10 716	(47.67)
1/2 – 20	19 865	(88.36)	20 574	(91.52)	25 799	(114.76)	7/16 – 18 BSF	14 275	(63.5)	14 785	(65.77)
9/16 – 18	25 202	(112.1)	26 102	(116.11)	32 730	(145.59)	1/2 – 16 BSF	18 733	(83.33)	19 402	(86.3)
5/8 – 18	31 753	(141.24)	32 887	(146.29)	41 237	(183.43)	5/8 – 14 BSF	29 961	(133.27)	31 031	(138.03)
3/4 – 16	46 248	(205.72)	47 900	(213.07)	60 062	(267.17)	3/4 – 12 BSF	43 423	(193.16)	44 974	(200.05)
7/8 – 14	63 171	(281)	65 428	(291.04)	82 041	(364.94)	7/8 – 11 BSF	60 037	(267.06)	62 182	(276.6)
1 – 12	82 228	(365.77)	85 165	(378.83)	106 790	(475.03)	1 – 10 BSF	79 075	(351.74)	81 899	(364.3)

NOTE 1 The breaking load values are based on 123 200 lbf/sq in (849 MPa), 127 600 lbf/sq in (880 MPa) and 160 000 lbf/sq in (1 100 MPa) minimum tensile strengths which are appropriate to the BS "A" series bolts and screws.

NOTE 2 For unified threads, the stress areas used for calculation of the tensile load values are calculated using the effective (pitch) diameters and minor diameters specified in BS 1580-1 and BS 1580-2:1962, Table 16, columns 4, 5. For 0.164-32, the tensile load value was calculated using the effective (pitch) diameter and minor diameter in BS 1580-3:1965, Table 51 columns 5, 6 and for 0.190-32 BS 1580-3:1965, Table 52, columns 5, 6.

NOTE 3 For BA threads, the stress areas used for the calculation of the tensile load values are calculated using the effective (pitch) diameters and minor diameters specified in BS 93:1951, Appendix E, Table 7 columns 6, 7.

NOTE 4 For BSF threads, the stress areas used for the calculation of the tensile load values are calculated using the effective (pitch) diameters and minor diameters specified in BS 84:1956, Table 7, columns 6, 7.

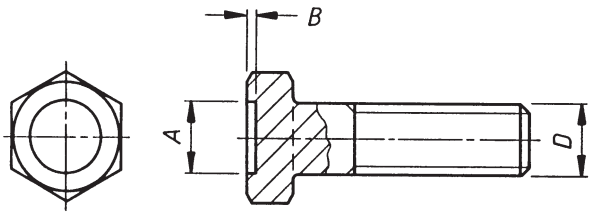
Tensile stress area = $\pi \left(\frac{E+d_3}{4}\right)^2$

E is the basic effective diameter

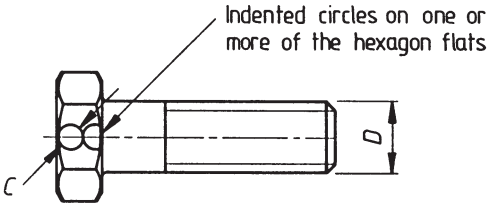
d_3 is the basic minor diameter

Appendix A
Dimensions of unified thread identification features on aircraft bolts and nuts

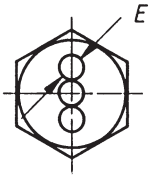
Figure 5 to Figure 10 and Table 8 to Table 11 provide information on features.



(a) Bolt with recess

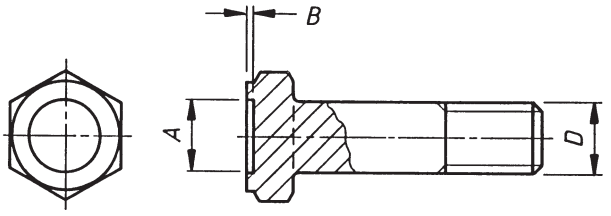


(b) Bolt with indented circles on one or more of the hexagon flats

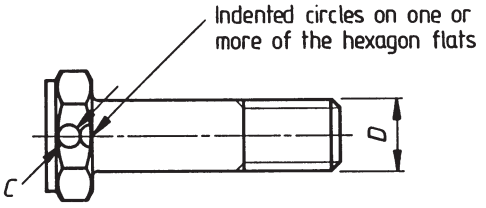


(c) Bolt with indented circles on upper surface of head

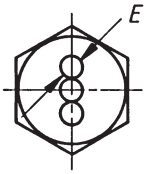
Figure 5 — Ordinary bolt



(a) Bolt with recess

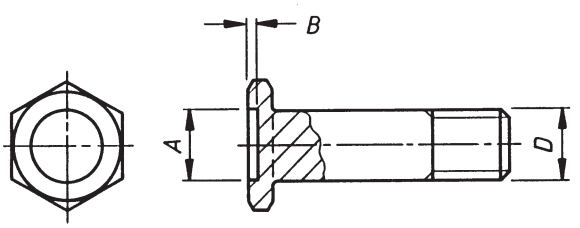


(b) Bolt with indented circles

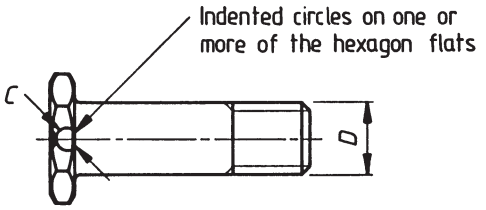


(c) Bolt with indented circles on upper surface of head

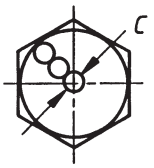
Figure 6 — Bolts with close tolerance shanks



(a) Bolt with recess



(b) Bolt with indented circles on one or more of the hexagon flats



(c) Bolt with indented circles on upper surface of head

Figure 7 — Hexagonal-headed shear bolts

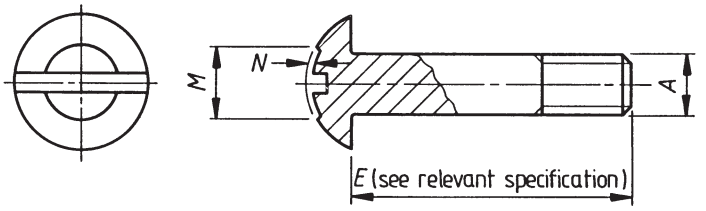


Figure 8 — Mushroom head bolts with recess

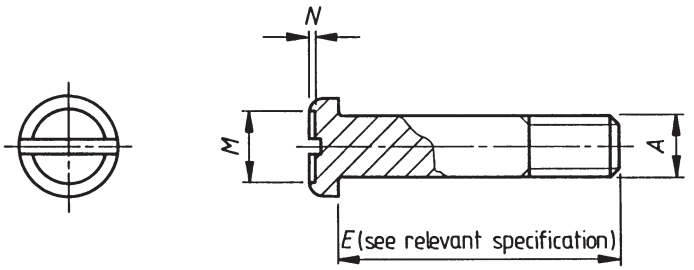
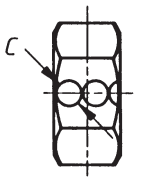


Figure 9 — Pan head bolts with recess



NOTE For convenience an ordinary nut only is illustrated.

Figure 10 — Nut

Table 8 — Alternative identification features for hexagonal-headed bolts other than shear bolts
(see Figure 5 and Figure 6)

Nominal size *D*	Recess				Indented circles	
	Diameter *A*		Depth *B*		Diameter *C*	Diameter *E*
	min.	max.	min.	max.	nom.	nom.
	in	in	in	in	in	in
No. 4-40 UNC	$\frac{3}{32}$	$\frac{1}{8}$	0.005	0.008	—	$\frac{5}{64}$
No. 6-32 UNC	$\frac{7}{64}$	$\frac{9}{64}$	0.005	0.008	—	$\frac{3}{32}$
No. 8-32 UNC	$\frac{9}{64}$	$\frac{11}{64}$	0.005	0.008	$\frac{5}{64}$	$\frac{3}{32}$
No. 10-32 UNF	$\frac{11}{64}$	$\frac{13}{64}$	0.005	0.008	$\frac{5}{64}$	$\frac{3}{32}$
$\frac{1}{4}$ in UNF	$\frac{3}{16}$	$\frac{1}{4}$	0.005	0.008	$\frac{3}{32}$	—
$\frac{5}{16}$ in UNF	$\frac{1}{4}$	$\frac{5}{16}$	0.005	0.008	$\frac{3}{32}$	—
$\frac{3}{8}$ in UNF	$\frac{3}{16}$	$\frac{3}{8}$	0.005	0.008	$\frac{3}{32}$	—
$\frac{7}{16}$ in UNF	$\frac{3}{8}$	$\frac{7}{16}$	0.010	0.013	$\frac{3}{32}$	—
$\frac{1}{2}$ in UNF	$\frac{7}{16}$	$\frac{1}{2}$	0.010	0.013	$\frac{3}{16}$	—
$\frac{9}{16}$ in UNF	$\frac{1}{2}$	$\frac{9}{16}$	0.010	0.013	$\frac{3}{16}$	—
$\frac{5}{8}$ in UNF	$\frac{9}{16}$	$\frac{5}{8}$	0.015	0.018	$\frac{3}{16}$	—
$\frac{3}{4}$ in UNF	$\frac{11}{16}$	$\frac{3}{4}$	0.015	0.018	$\frac{3}{16}$	—
$\frac{7}{8}$ in UNF	$\frac{13}{16}$	$\frac{7}{8}$	0.015	0.018	$\frac{3}{16}$	—
1 in UNF	$\frac{3}{16}$	1	0.015	0.018	$\frac{3}{16}$	—

Table 9 — Alternative identification features for hexagonal-headed shear bolts (see Figure 7)

Nominal size *D*	Recess				Indented circles
	Diameter *A*		Depth *B*		Diameter *C*
	min.	max.	min.	max.	nom.
	in	in	in	in	in
$\frac{1}{4}$ in UNF	$\frac{1}{8}$	$\frac{3}{16}$	0.005	0.008	$\frac{3}{32}$
$\frac{5}{16}$ in UNF	$\frac{3}{16}$	$\frac{1}{4}$	0.005	0.008	$\frac{3}{32}$
$\frac{3}{8}$ in UNF	$\frac{1}{4}$	$\frac{5}{16}$	0.005	0.008	$\frac{3}{32}$
$\frac{7}{16}$ in UNF	$\frac{5}{16}$	$\frac{3}{18}$	0.005	0.008	$\frac{3}{32}$
$\frac{1}{2}$ in UNF	$\frac{3}{8}$	$\frac{7}{16}$	0.010	0.013	$\frac{3}{32}$
$\frac{9}{16}$ in UNF	$\frac{7}{16}$	$\frac{1}{2}$	0.010	0.013	$\frac{3}{32}$
$\frac{5}{8}$ in UNF	$\frac{1}{2}$	$\frac{9}{16}$	0.010	0.013	$\frac{3}{32}$
$\frac{3}{4}$ in UNF	$\frac{9}{16}$	$\frac{5}{8}$	0.015	0.018	$\frac{3}{32}$

Table 10 — Identification features for mushroom head and pan head bolts
(see Figure 8 and Figure 9)

Nominal size *A*	Recess	
	Diameter *M*	Depth *N*
	nom.	max.
	in	in
No. 4-40 UNC	$\frac{1}{8}$	0.010
No. 6-32 UNC	$\frac{9}{64}$	0.010
No. 8-32 UNC	$\frac{11}{64}$	0.010
No. 10-32 UNC	$\frac{13}{64}$	0.010
$\frac{1}{4}$ in UNF	$\frac{9}{32}$	0.015
$\frac{5}{16}$ in UNF	$\frac{3}{8}$	0.015

Table 11 — Identification feature for nuts (see Figure 10)

Nominal size of nut	Indented circles	
	Diameter *C*	
	Ordinary thin slotted and castle nuts	Nuts for shear bolts
	nom.	nom.
	in	in
No. 8-32 UNF	$\frac{5}{64}$	—
No. 10-32 UNF	$\frac{5}{64}$	—
$\frac{1}{4}$ in UNF	$\frac{3}{32}$	$\frac{3}{32}$
$\frac{5}{16}$ in UNF	$\frac{3}{32}$	$\frac{3}{32}$
$\frac{3}{8}$ in UNF	$\frac{3}{32}$	$\frac{3}{32}$
$\frac{7}{16}$ in UNF	$\frac{3}{32}$	$\frac{3}{32}$
$\frac{1}{2}$ in UNF	$\frac{3}{16}$	$\frac{3}{32}$
$\frac{9}{16}$ in UNF	$\frac{3}{16}$	$\frac{3}{32}$
$\frac{5}{8}$ in UNF	$\frac{3}{16}$	$\frac{3}{32}$
$\frac{3}{4}$ in UNF	$\frac{3}{16}$	$\frac{3}{32}$
$\frac{7}{8}$ in UNF	$\frac{3}{16}$	—
1 in UNF	$\frac{3}{16}$	—

Publications referred to

BS 4A 4, *Test pieces and test methods for metallic materials for aircraft — Metric units.*

BS A 231, *Specification for runout and lead threads for rolled threads.*

BS M 39, *Method for penetrant inspection of aerospace materials and components.*

BS 4S 100, *Procedure for inspection and testing of wrought steels (other than sheet, strip and tubes).*

BS 84[4], *Specification for parallel screw threads of Whitworth form.*

BS 93[5], *Specification for British Association (B.A.) screw threads with tolerances for sizes 0 B.A. to 16 B.A.*

A1 *Text deleted* A1

BS 1134, *Assessment of surface texture.*

BS 1580, *Specification for Unified screw threads.*

A1 *Text deleted* A1

BS 5750-2, *Quality systems — Part 2: Specification for production and installation.*

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

BS 6072, *Method for magnetic particle flaw detection.*

A1 BS EN ISO 3887:2003, *Steels — Determination of depth of decarburization.*

BS EN ISO 6506 (all parts), *Metallic materials — Brinell hardness test.*

BS EN ISO 6507 (all parts), *Metallic materials — Vickers hardness test.*

BS EN ISO 6508 (all parts), *Metallic materials — Rockwell hardness test.*

ISO 3161 (BS A 346), *UNJ threads — General requirements and limit dimensions.* A1

Defence Standard 03-19[5], *Electrode deposition of cadmium.*

Defence Standard 03-24[5], *Chromic acid anodizing of aluminium and aluminium alloys.*

[4] Obsolescent.
[5] Available from Ministry of Defence, Directorate of Standardization, Kentigern House, 65 Brown Street, Glasgow G2 8EX.

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