

BRITISH STANDARD 2A. 100:1968

**GENERAL REQUIREMENTS
FOR BOLTS AND NUTS
OF TENSILE STRENGTH
NOT EXCEEDING
180 000 lbf/in² (125 hbar)**

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BRITISH STANDARD : AEROSPACE SERIES

SPECIFICATION FOR

GENERAL REQUIREMENTS FOR BOLTS AND
NUTS OF TENSILE STRENGTH NOT EXCEEDING
180 000 lbf/in² (125 hbar)

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FOREWORD

This revision of British Standard A.100 has been prepared primarily to improve the quality of the inspection of aerospace bolts and nuts. Account has been taken of experience in the application of the requirements of the 1960 issue of the standard, and of the need to bring these requirements up to date in relation to specifications for aerospace bolts and nuts recently published or in course of publication.

This revision does not affect the interchangeability of items manufactured to their own individual bolt or nut standard, and it should not be regarded as precluding the use of bolts or nuts complying with A.100:1960.

This British Standard is intended for use in conjunction with those 'A' series British Standards in which conformity to 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 standard makes reference to the following:

British Standards:

British Standard A.4 Test pieces and test methods for metallic materials for aircraft.

British Standard S.100 Inspection and testing procedure for steel.

BS 84 Parallel screw threads of Whitworth form.

BS 93 British Association (B.A.) screw threads with tolerances for sizes 0 B.A. to 16 B.A.

BS 240 Method for Brinell hardness test. Part 1. Testing of metals.

BS 308 Engineering drawing practice.

BS 427 Method for Vickers hardness test. Part 1. Testing of metals.

BS 891 Method for Rockwell hardness test. Part 1. Testing of metals.

BS 1134 Centre-line-average height method for the assessment of surface texture.

BS 1580 Unified screw threads.

Ministry of Technology Specification:*

D.T.D. 904 Cadmium plating.

Ministry of Defence Specifications:*

DEF-131 Sampling procedures and tables for inspection by attributes.

DEF-151 Processes for the anodic oxidation of aluminium and aluminium alloy parts.

DEF-2331 Temporary rust preventive.

* Obtainable from Her Majesty's Stationery Office.

NOTE. The values in British units are to be regarded as the standard. A table is given in Appendix C to provide a ready means of calculating the approximate millimetre equivalents of the inch dimensions. More accurate conversions should be based on the tables in BS 350, 'Conversion factors and tables'.

SPECIFICATION

1. GENERAL

1.1 SCOPE

This British Standard specifies the general requirements for aerospace bolts and nuts of tensile strength not exceeding 180 000 lbf/in² (125 hbar).

1.2 MATERIAL

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

1.2.2 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.

1.3 MANUFACTURE

1.3.1 When more than one method of manufacture is permitted by the relevant standard, the manufacturer shall declare on the release note the method by which the bolts have been made, i.e. machined from bar, cold-forged, hot-forged.

1.3.2 Cold-forged or hot-forged steel bolts shall be manufactured by a process to fulfil the requirements of Section 3.

1.3.3 Screw threads

1.3.3.1 All Unified Class 3A threads shall be rolled after heat treatment having had the lead end chamfered prior to thread rolling.

NOTE. The lead after thread rolling will not be a true chamfer.

1.3.3.2 All other threads may either be cut or rolled at the option of the bolt manufacturer. 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.

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

(2) 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.

1.3.4 Cold-forged aluminium alloy bolts shall be manufactured by a process to fulfil the requirements of Section 4.

1.4 DIMENSIONS

All bolts and nuts shall conform to the dimensions and tolerances specified in the relevant standard.

1.5 RUN-OUT OF SCREW THREADS ON BOLTS

Unified Class 3A threads shall have a thread run-out conforming to Appendix B.

1.6 SCREW THREAD FORM AND CLASS OF FIT

1.6.1 When B.A. threads are specified for bolts they shall conform to BS 93, close class.

1.6.1.1 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 at least 0.001 in smaller than the maximum limits for 'close class' bolts specified in BS 93.

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.



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1.6.2 When B.A. threads are specified for nuts they shall conform to BS 93.

1.6.3 When B.S.F. threads are specified for bolts they shall conform to BS 84, medium class.

1.6.3.1 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 $\frac{7}{8}$ in B.S.F. and larger shall be at least 0.002 in smaller than the maximum limits for 'medium class' bolts specified in BS 84.

In order to avoid any undue restriction of the tolerance allowed for screwing, the major, effective and minor diameters may be 0.002 in smaller than the minimum limits for 'medium class' bolts specified in BS 84.

1.6.4 When B.S.F. threads are specified for nuts they shall conform to BS 84, normal class.

1.6.5 Unless otherwise specified, Unified threads for bolts shall conform to BS 1580, Class 2A.

1.6.6 Unless otherwise specified, Unified threads for nuts shall conform to BS 1580, Class 2B.

1.7 ANTI-CORROSION TREATMENT

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 appropriate process specification listed below:

Anodizing: DEF-151 Type 2 (chromic acid process).

Cadmium plating: D.T.D. 904.

Temporary rust preventive: DEF-2331.

1.8 IDENTIFICATION MARKING

1.8.1 Hexagonal-headed bolts (including shear bolts)

1.8.1.1 Bolts of 2 B.A. and No. 10 nominal sizes and larger shall have the complete part number (e.g. A102-3-D) applied to the upper face of the head.

1.8.1.2 Bolts with Unified threads shall have the appropriate 'Unified' identification applied as indicated in Appendix A to this standard.

1.8.1.3 Each individual package of bolts shall have the complete part number and inspection stamp clearly shown on each label.

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

1.8.2 Bolts with other than hexagon heads

1.8.2.1 Pan and mushroom head bolts with Unified threads shall have the appropriate 'Unified' identification applied as indicated in Appendix A to this standard.

1.8.2.2 Pan, mushroom and countersunk head bolts of 2 B.A. and No. 10 nominal sizes and larger shall have the length identification only, as given in the appropriate bolt standard, marked on the head, unless otherwise stated.

1.8.2.3 Each individual package of bolts shall have the complete part number and inspection stamp clearly shown on each label.

1.8.3 Hexagon nuts (including shear nuts)

1.8.3.1 Nuts of $\frac{7}{8}$ in nominal diameter and larger shall have the number of the relevant British Standard (e.g. A103) applied on one or more of the hexagonal surfaces.

1.8.3.2 Nuts of No. 10 nominal size and larger with left-hand threads shall have the letter 'L' applied on one of the hexagonal surfaces.

1.8.3.3 Nuts with Unified threads of No. 8 UNC nominal size and larger shall be marked with the 'Unified' identification as shown in Appendix A to this standard.

1.8.3.4 Each individual package of nuts shall have the complete part number and inspection stamp clearly shown on each label.

1.8.4 Method of marking. Marking shall be integrally forged or by controlled pressure die stamping. Characters shall be not less than 0.025 inch in height.

NOTE. To enable existing stocks of forging tools to be used up, the identification marking shown in the present relevant standards may, until further notice, be applied instead of the above, at the option of the manufacturer.

2. INSPECTION PROCEDURE

2.1 GENERAL

2.1.1 Inspecting Authority. For bolts and nuts subject to British civil or military airworthiness requirements, the Inspecting Authorities are the Air Registration Board (through a design authority approved by the Board) and the Ministry of Technology respectively.

2.1.2 Inspection. Inspection shall satisfy the requirements of the appropriate authority by the use of the sampling procedures specified in 2.2.2 on the finished products, except that, by agreement with the local Inspecting Authority, properly controlled and recorded interstage inspection may be substituted.

2.1.3 Materials and anti-corrosion treatments. The manufacturer shall provide evidence to the Inspecting Authority that all materials and anti-corrosion treatments comply with the relevant specifications, and shall also show that the identity of all materials has been maintained throughout all stages of manufacture.

2.1.4 Records. The manufacturer shall establish a batch record chart (or card) to the satisfaction of the Inspecting Authority. The record shall show the batch quantity and the serial numbers of certificates covering approval of all materials. The results of all inspections and tests made in accordance with this standard shall be recorded and correlated with the batch numbers, and the batch record chart (or card) shall show the serial numbers of those records to the satisfaction of the Inspecting Authority.

2.2 ACCEPTANCE OF PRODUCTION BATCHES

2.2.1 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 such as in the opinion of the Inspecting Authority might be expected to result in a significant variation in the quality of the finished product.

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2.2.2 Sampling. Except where 100% inspection is specified, random samples shall be taken from each batch in accordance with 2.2.3 for dimensional and non-destructive inspection, and with 3.3.1 for destructive inspection.

2.2.3 Samples for non-destructive inspection. Samples for dimensional and non-destructive inspection shall be taken from each batch in accordance with Defence Specification DEF-131, at the inspection levels shown in Table 1. The acceptance or rejection shall depend upon the acceptable quality levels (AQLs) applied to the characteristics as shown in Table 1.

2.3 DIMENSIONS AND GAUGING

2.3.1 All dimensions shall be controlled by a system of gauging. The type and quality of all gauges, projection apparatus (including diagrams) and inspecting techniques shall be to the satisfaction of the Inspecting Authority. In case of dispute fixed limit gauges shall be used for checking the dimensions of screw threads.

2.3.2 Each gauge and projection diagram shall be marked with its reference number (serial number) and, in the case of non-adjustable gauges, the gauging dimensions. Each gauge shall further be certified initially and thereafter the standard accuracy of each gauge shall be maintained by regular certification either at an approved gauge test house or if agreed with the Inspecting Authority at the manufacturer's own test room. The accuracy of each projection diagram shall be to the satisfaction of the Inspecting Authority.

2.3.3 A record card shall be maintained for each gauge showing the initial dimensions of each gauging element, the frequency of the maintenance checks and the gauge dimensions resulting therefrom to the satisfaction of the Inspecting Authority.

2.4 SURFACE TEXTURE

Surface texture shall be as specified in Table 2 and 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) Burr and plating (visual) Identification (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

	Feature	Roughness height rating, maximum (CLA to BS 1134)
Bolts	Shank, head bearing face and fillet radius	Close tolerance shank: 32
		Other than close tolerance shank: 63
	Thread flank and root radius	Rolled thread: 32
		Cut thread: 63
	Other surfaces	125
Nuts	Bearing faces	125 (circular lay)
	Other surfaces	125

2.5 GEOMETRICAL TOLERANCES*

2.5.1 The geometrical features of bolts shall comply with the tolerances shown in Fig. 1 and Table 3. (Sampling in accordance with 2.2.3.)

2.5.2 The geometrical features of nuts shall comply with the tolerances shown in Fig. 2. (Sampling in accordance with 2.2.3.)

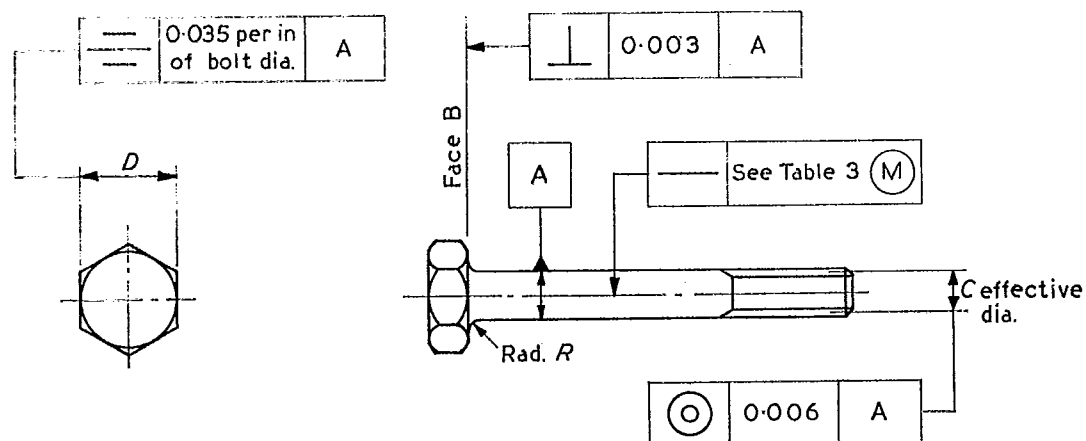
2.5.3 The squareness between the nut bearing faces and the screw thread shall comply with the tolerances in Table 4 when checked with a squareness gauge of the type

indicated in Fig. 3, which shall be approved by the Inspecting Authority. (Sampling in accordance with 2.2.3.)

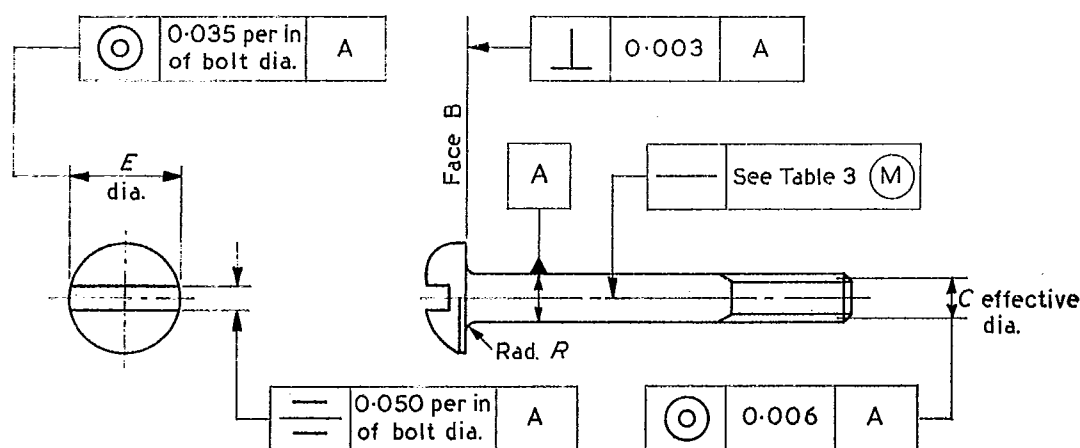
The nuts shall be screwed by hand on to a tapered truncated screw gauge until the thread of the nut is tight on the thread of the screw gauge. A sliding sleeve, having a face diameter equal to the minimum distance across flats of the nut, and a face at 90° to the axis of the screw gauge, shall then be 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 shown in Table 4 to enter between the leading face of the nut and the face of the sleeve (see Fig. 3).

*Symbols in accordance with draft ISO recommendations; see BS 308, 'Engineering drawing practice', Appendix B.

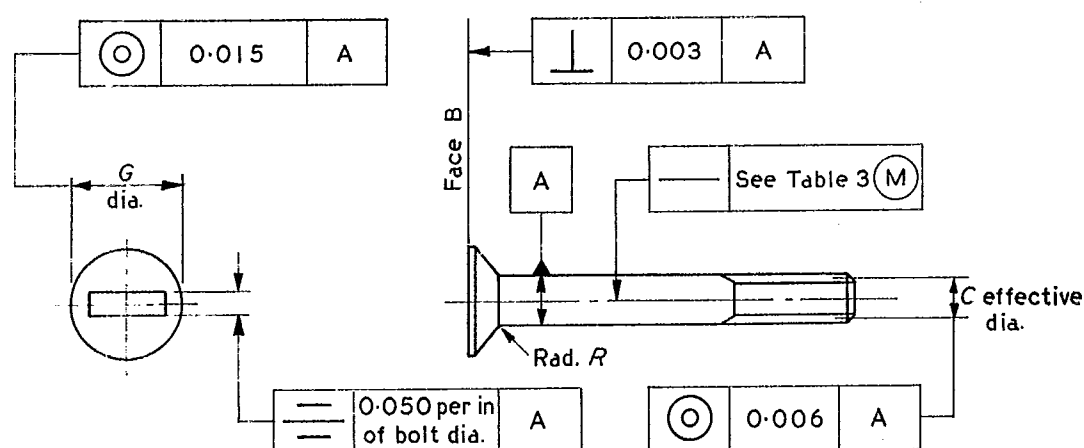
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Hexagonal head



Pan head and mushroom head



Countersunk head

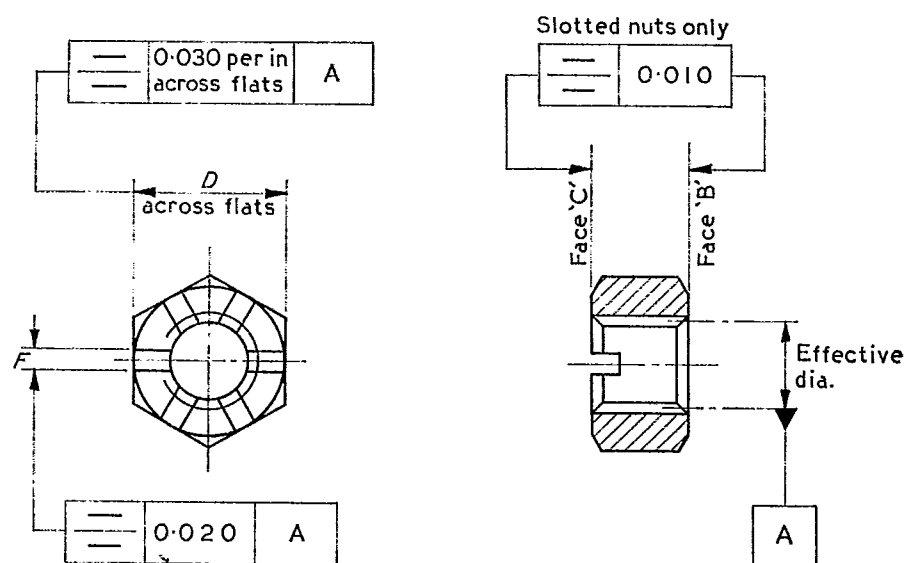
NOTE. Fillet rad. R to blend smoothly with face and shank.

All dimensions in inches. Third angle projection.

Fig. 1. Geometrical tolerances for bolts

TABLE 3. GEOMETRICAL STRAIGHTNESS TOLERANCES FOR BOLT SHANKS

Nominal size of bolt				Straightness tolerance	
B.A.	B.S.F.	UNC	UNF	Close tolerance shank bolts	Other than close tolerance shank bolts
6 4	in — —	No. 4-40 No. 6-32 No. 8-32	in — —	in —	in 0.0030 per inch of bolt length plus a constant of 0.002 in
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.

Fig. 2. Geometrical tolerances for nuts