

**BS 4A 116:2012**

*Incorporating Corrigendum No. 1*



**BSI Standards Publication**

# **Steel pan head bolts (Unified threads), cadmium plated, for aircraft**

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### Summary of pages

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

## Foreword

### Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 March 2012. It was prepared by Technical Committee ACE/12, *Aerospace fasteners and fastening systems*. A list of organizations represented on this committee can be obtained on request to its secretary.

### Supersession

This British Standard supersedes BS 3A 116:1962, which is withdrawn.

### Information about this document

This new edition of this British Standard incorporates technical changes only. It does not represent a full review or revision of the standard, which will be undertaken in due course.

**CAUTION. BS A 116 bolts have cadmium as a plating material which has been restricted and/or banned for use in many countries owing to environmental and health concerns; they should not be used in new product designs. Local officials should be consulted about any concerns on using cadmium-plated parts.**

### Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

### Contractual and legal considerations

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.**

## 1 Scope

This British Standard specifies the materials, dimensions, finish and inspection requirements for steel pan head bolts with Unified threads, cadmium plated, for aircraft.

*NOTE 1 The values in British units are to be regarded as the standard. Table A.1 provides 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.*

*NOTE 2 In place of the customary, but incorrect, use of the ton as a unit of force, the unit called a ton force (abbreviation tonf) is used in this British Standard. It is the force which, when acting on a body of mass one ton, gives an acceleration equal to that of standard gravity.*

## 2 Normative references

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

BS 4A 100:2003, *Specification for general requirements for bolts and free running nuts of tensile strength not exceeding 1 249 MPa*

BS EN 2133, *Cadmium plating of steels with specified tensile strength  $\leq 1\,450$  MPa, copper, copper alloys and nickel alloys*

BS S 95, *Specification for 1½ per cent nickel-chromium-molybdenum steel (90/110 kgf/mm)*

BS S 102, *Specification for carbon-molybdenum steel (bar for the manufacture of forged bolts only)*

BS S 105, *Specification for carbon steel (bar for the manufacture of forged bolts only)*

BS S 114, *Manganese-Molybdenum Steel (55/65 tonf/sq in: limiting ruling section 2½ inches)*

BS S 116, *Specification for aircraft material. '40' Carbon Steel Bright Bars for Machining (55-65 tonf/sq in: limiting ruling section ¾ inch) (Primarily Intended for the Manufacture of Machined Bolts)*

BS S 117, *Specification for aircraft material. 1 per cent chromium steel (55/65 tonf/sq in: limiting ruling section 1⅛ inch)*

BS S 147, *Specification for 0.5% nickel-chromium-molybdenum steel bars for the manufacture of forged bolts and forged nuts*

BS S 148, *Specification for low nickel-chromium steel (bar for the manufacture of forged bolts only)*

BS S 149, *Specification for 1.75% nickel-chromium-molybdenum steel bars for the manufacture of forged bolts and forged nuts*

BS S 154, *Specification. 2½% nickel-chromium-molybdenum steel billets, bars, forgings and parts (880-1080 MPa: limiting ruling section 150 mm)*

BS S 158, *Specification for 1% chromium-molybdenum steel bars for the manufacture of forged bolts and forged nuts*

Def Stan 03-19, *Electro-deposition of cadmium*

### 3 General requirements

The bolts shall conform to the relevant requirements of BS 4A 100:2003 in respect of manufacture, screw threads, anti-corrosion treatment, identification and marking.

### 4 Material and manufacture

The bolts shall be manufactured by one of the following methods:

- a) Machined from bright drawn alloy steel bars that conform to one of the following:

- 1) BS S 95
- 2) BS S 114
- 3) BS S 116
- 4) BS S 117; or
- 5) BS S 154.

*NOTE* Material conforming to BS S 96 may be used until stocks are exhausted.

- b) Forged from alloy steel that conforms to one of the following:

- 1) BS S 102;
- 2) BS S 105;
- 3) BS S 147;
- 4) BS S 148;
- 5) BS S 149; or
- 6) BS S 158.

*NOTE* Material conforming to BS S 103 may be used until stocks are exhausted.

- c) In the finally head-treated condition, the mechanical properties of the material used for forged bolts shall be as follows:

0.1 per cent proof stress	not less than 43 tonf/in <sup>2</sup> (664 MPa)
Tensile strength	not less than 55 tonf/in <sup>2</sup> (850 MPa) not more than 65 tonf/in <sup>2</sup> (1003 MPa)
Elongation on 5.65√ area	not less than 18%
Izod impact value	not less than 40 ft lbf (54 J)

### 5 Dimensions

All finished bolts, after the application of the protective finish, shall conform to the dimensions and tolerances given in Table 1, Table 2, Figure 1 and Figure 2.

The clamping length of the bolt shall conform to the dimensions and tolerances given in Table 2, and shall be such that, when a standard nut without countersink or ring gauge without countersink has been screwed on as far as possible by hand, its leading face is within the distance  $M$  from the underside of the bolt head. The runout of thread shall not exceed twice the pitch.

The nominal length of the bolt shall be the minimum bearing length,  $L$ , which is determined by the minimum clamping length,  $M$ , less two thread pitches.

## 6 Screw threads

The bolts shall have Unified threads of the form and class of fit specified in the relevant requirements of BS 4A 100:2003. After coating, the bolt threads shall not exceed the basic size (maximum material condition) for the thread size and class of fit.

## 7 Protective finish

All bolts shall be coated with cadmium in accordance with Def Stan 03-19 or BS EN 2133.

## 8 Identification and marking

Bolts shall have the appropriate Unified thread identification applied in accordance with BS 4A 100:2003, 8.2.2. The British Standard identifier and part number (in accordance with Table 2) shall not be applied on the bolts, but shall be clearly marked on the labels of parcels of bolts together with the batch identification code. For example, A116-20C is a bolt with thread size 8-32 UNC and bearing length 2.0 inches.

## 9 Inspection procedure

The bolts shall be inspected in accordance with BS 4A 100:2003.

Figure 1 Basic dimensions

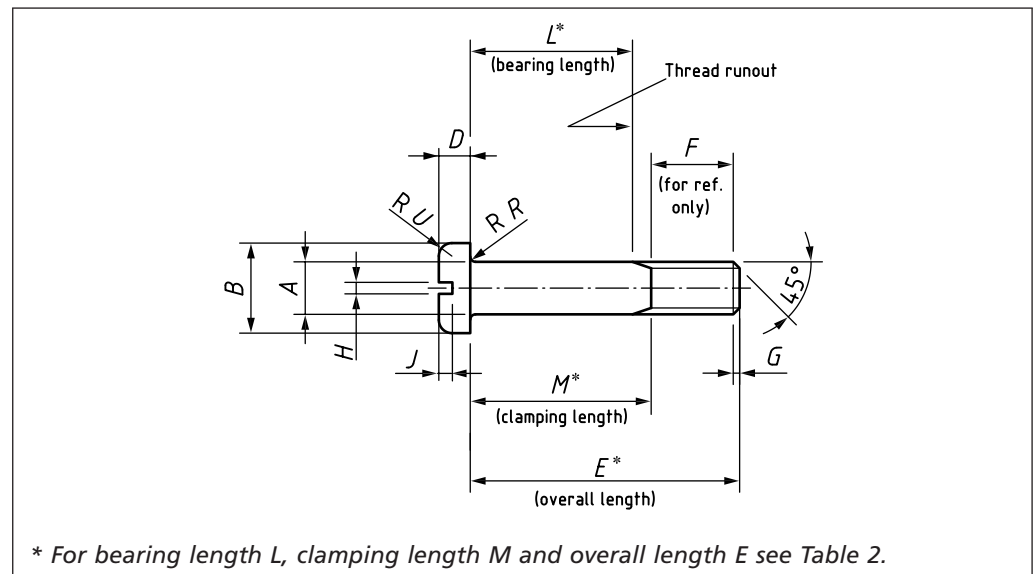


Table 1 Dimensions

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																						
																		Nominal thread size		Diameter of plain portion of shank		Thread runout (2 x pitch)		Length of threaded portion of shank $F_t$		Diameter of head		Thickness of head		Radius of head		Radius under bolt head		Depth of chamfer		Slot			
Decimal nominal thread size		max.	min.	max.	min. ref.	max.	min.	max.	min.	nom.	max.	min.	max.	min.	min.	max.	nom.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.							
																																	A		B		D		U
0.112-40 UNC (4)	4-40 UNC	0.1115	0.1085	0.050	0.300	0.194	0.184	0.068	0.058	0.042	0.015	0.005	0.020	0.015	0.031	0.039	0.035																						
0.138-32 UNC (6)	6-32 UNC	0.1375	0.1345	0.063	0.277	0.252	0.242	0.082	0.072	0.046	0.015	0.005	0.030	0.020	0.039	0.048	0.043																						
0.164-32 UNC (8)	8-32 UNC	0.1635	0.1605	0.063	0.327	0.283	0.273	0.096	0.085	0.052	0.020	0.010	0.030	0.020	0.045	0.054	0.051																						
0.190-32 UNF (10)	10-32 UNF	0.1895	0.1865	0.063	0.377	0.319	0.309	0.110	0.099	0.061	0.020	0.010	0.030	0.020	0.050	0.060	0.060																						
0.250-28 UNF (E)	1/4-28 UNF	0.2495	0.2465	0.071	0.459	0.440	0.420	0.144	0.130	0.087	0.030	0.015	0.040	0.030	0.064	0.075	0.078																						
0.3125-24 UNF (G)	5/16-24 UNF	0.3120	0.3090	0.083	0.497	0.547	0.527	0.178	0.162	0.099	0.030	0.015	0.040	0.030	0.072	0.084	0.095																						

† This dimension is an absolute minimum associated with maximum length,  $M$ , and minimum length,  $E$ . It is not intended for use for manufacturing or inspection purposes.

‡ To be measured from the top of the head to the point at which the slot breaks through.



Figure 2 Bearing length, clamping length and overall length dimensions

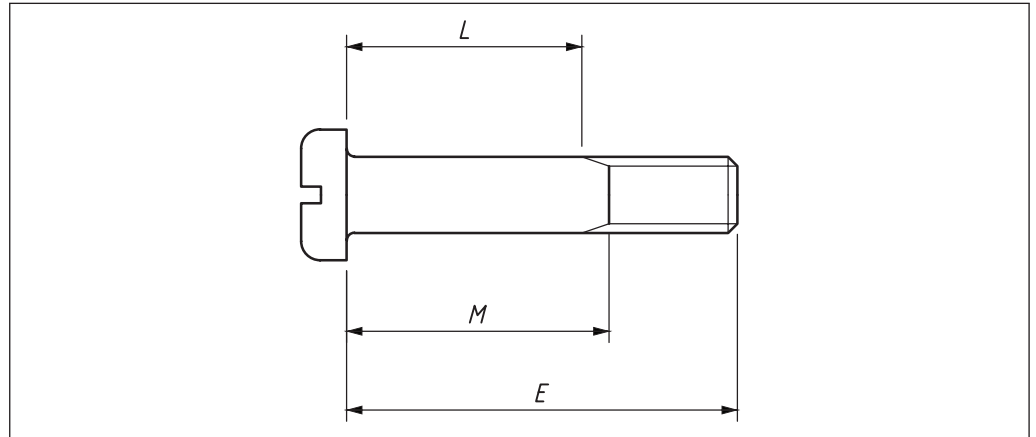


Table 2 Bearing length *L*, clamping length *M* and overall length *E*

No. 4-40 UNC			No. 6-32 UNC			No. 8-32 UNC			No. 10-32 UNF		
Part No.	*L min.	M +0 -0.03	E +0.04 -0	Part No.	*L min.	M +0 -0.03	E +0.04 -0	Part No.	*L min.	M +0 -0.03	E +0.04 -0
1/2 A	in	in	in	1/2 B	in	in	in	1/2 D	in	in	in
1A	0.05	0.130	0.45	1B	0.05	0.143	0.45	1C	0.05	0.143	0.50
2A	0.1	0.180	0.50	2B	0.1	0.193	0.50	2C	0.1	0.193	0.55
3A	0.2	0.280	0.60	3B	0.2	0.293	0.60	3C	0.2	0.293	0.65
4A	0.3	0.380	0.70	4B	0.3	0.393	0.70	4C	0.3	0.393	0.75
5A	0.4	0.480	0.80	5B	0.4	0.493	0.80	5C	0.4	0.493	0.85
6A	0.5	0.580	0.90	6B	0.5	0.593	0.90	6C	0.5	0.593	0.95
7A	0.6	0.680	1.00	7B	0.6	0.693	1.00	7C	0.6	0.693	1.05
8A	0.7	0.780	1.10	8B	0.7	0.793	1.10	8C	0.7	0.793	1.15
9A	0.8	0.880	1.20	9B	0.8	0.893	1.20	9C	0.8	0.893	1.25
10A	0.9	0.980	1.30	10B	0.9	0.993	1.30	10C	0.9	0.993	1.35
11A	1.0	1.080	1.40	11B	1.0	1.093	1.40	11C	1.0	1.093	1.45
12A	1.1	1.180	1.50	12B	1.1	1.193	1.50	12C	1.1	1.193	1.55
13A	1.2	1.280	1.60	13B	1.2	1.293	1.60	13C	1.2	1.293	1.65
14A	1.3	1.380	1.70	14B	1.3	1.393	1.70	14C	1.3	1.393	1.75
15A	1.4	1.480	1.80	15B	1.4	1.493	1.80	15C	1.4	1.493	1.85
16A	1.5	1.580	1.90	16B	1.5	1.593	1.90	16C	1.5	1.593	1.95
17A	1.6	1.680	2.00	17B	1.6	1.693	2.00	17C	1.6	1.693	2.05
18A	1.7	1.780	2.10	18B	1.7	1.793	2.10	18C	1.7	1.793	2.15
19A	1.8	1.880	2.20	19B	1.8	1.893	2.20	19C	1.8	1.893	2.25
20A	1.9	1.980	2.30	20B	1.9	1.993	2.30	20C	1.9	1.993	2.35
21A	2.0	2.080	2.40	21B	2.0	2.093	2.40	21C	2.0	2.093	2.45
22A	2.1	2.180	2.50	22B	2.1	2.193	2.50	22C	2.1	2.193	2.55
23A	2.2	2.280	2.60	23B	2.2	2.293	2.60	23C	2.2	2.293	2.65
24A	2.3	2.380	2.70	24B	2.3	2.393	2.70	24C	2.3	2.393	2.75
25A	2.4	2.480	2.80	25B	2.4	2.493	2.80	25C	2.4	2.493	2.85
26A	2.5	2.580	2.90	26B	2.5	2.593	2.90	26C	2.5	2.593	2.95
27A	2.6	2.680	3.00	27B	2.6	2.693	3.00	27C	2.6	2.693	3.05
	2.7	2.780	3.10		2.7	2.793	3.10		2.7	2.793	3.15

Table 2 Bearing length *L*, clamping length *M* and overall length *E*

No. 4-40 UNC			No. 6-32 UNC			No. 8-32 UNC			No. 10-32 UNF		
Part No.	*L min.	M +0 -0.03	E +0.04 -0	Part No.	*L min.	M +0 -0.03	E +0.04 -0	Part No.	*L min.	M +0 -0.03	E +0.04 -0
28A	2.8	2.880	3.20	28B	2.8	2.893	3.20	28C	2.8	2.893	3.25
29A	2.9	2.980	3.30	29B	2.9	2.993	3.30	29C	2.9	2.993	3.35
30A	3.0	3.080	3.40	30B	3.0	3.093	3.40	30C	3.0	3.093	3.45
31A	3.1	3.180	3.50	31B	3.1	3.193	3.50	31C	3.1	3.193	3.55
32A	3.2	3.280	3.60	32B	3.2	3.293	3.60	32C	3.2	3.293	3.65
33A	3.3	3.380	3.70	33B	3.3	3.393	3.70	33C	3.3	3.393	3.75
34A	3.4	3.480	3.80	34B	3.4	3.493	3.80	34C	3.4	3.493	3.85
35A	3.5	3.580	3.90	35B	3.5	3.593	3.90	35C	3.5	3.593	3.95
36A	3.6	3.680	4.00	36B	3.6	3.693	4.00	36C	3.6	3.693	4.05
37A	3.7	3.780	4.10	37B	3.7	3.793	4.10	37C	3.7	3.793	4.15
38A	3.8	3.880	4.20	38B	3.8	3.893	4.20	38C	3.8	3.893	4.25
<sup>5</sup> / <sub>16</sub> in UNF											
Part No.	*L min.	M +0 -0.03	E +0.04 -0	Part No.	*L min.	M +0 -0.03	E +0.04 -0	Part No.	*L min.	M +0 -0.03	E +0.04 -0
1/2 E	in	in	in	1/2 G	in	in	in	1/2 G	in	in	in
1E	0.05	0.151	0.65	1G	0.05	0.163	0.70	1G	0.05	0.163	0.70
2E	0.1	0.201	0.70	2G	0.1	0.213	0.80	2G	0.1	0.213	0.75
3E	0.2	0.301	0.80	3G	0.2	0.313	0.90	3G	0.2	0.313	0.85
4E	0.3	0.401	0.90	4G	0.3	0.413	1.00	4G	0.3	0.413	0.95
5E	0.4	0.501	1.00	5G	0.4	0.513	1.10	5G	0.4	0.513	1.05
6E	0.5	0.601	1.10	6G	0.5	0.613	1.20	6G	0.5	0.613	1.15
7E	0.6	0.701	1.20	7G	0.6	0.713	1.30	7G	0.6	0.713	1.25
8E	0.7	0.801	1.30	8G	0.7	0.813	1.40	8G	0.7	0.813	1.35
9E	0.8	0.901	1.40	9G	0.8	0.913	1.50	9G	0.8	0.913	1.45
10E	0.9	1.001	1.50	10G	0.9	1.013	1.60	10G	0.9	1.013	1.55
	1.0	1.101	1.60		1.0	1.113			1.0	1.113	1.65

Table 2 Bearing length  $L$ , clamping length  $M$  and overall length  $E$ 

$\frac{1}{4}$ in UNF		$\frac{5}{16}$ in UNF					
Part No.	* $L$ min.	$M$ +0 - 0.03	$E$ +0.04 - 0	Part No.	* $L$ min.	$M$ +0 - 0.03	$E$ +0.04 - 0
	in	in	in		in	in	in
11E	1.1	1.201	1.70	11G	1.1	1.213	1.75
12E	1.2	1.301	1.80	12G	1.2	1.313	1.85
13E	1.3	1.401	1.90	13G	1.3	1.413	1.95
14E	1.4	1.501	2.00	14G	1.4	1.513	2.05
15E	1.5	1.601	2.10	15G	1.5	1.613	2.15
16E	1.6	1.701	2.20	16G	1.6	1.713	2.25
17E	1.7	1.801	2.30	17G	1.7	1.813	2.35
18E	1.8	1.901	2.40	18G	1.8	1.913	2.45
19E	1.9	2.001	2.50	19G	1.9	2.013	2.55
20E	2.0	2.101	2.60	20G	2.0	2.113	2.65
21E	2.1	2.201	2.70	21G	2.1	2.213	2.75
22E	2.2	2.301	2.80	22G	2.2	2.313	2.85
23E	2.3	2.401	2.90	23G	2.3	2.413	2.95
24E	2.4	2.501	3.00	24G	2.4	2.513	3.05
25E	2.5	2.601	3.10	25G	2.5	2.613	3.15
26E	2.6	2.701	3.20	26G	2.6	2.713	3.25
27E	2.7	2.801	3.30	27G	2.7	2.813	3.35
28E	2.8	2.901	3.40	28G	2.8	2.913	3.45
29E	2.9	3.001	3.50	29G	2.9	3.013	3.55
30E	3.0	3.101	3.60	30G	3.0	3.113	3.65
31E	3.1	3.201	3.70	31G	3.1	3.213	3.75
32E	3.2	3.301	3.80	32G	3.2	3.313	3.85
33E	3.3	3.401	3.90	33G	3.3	3.413	3.95
34E	3.4	3.501	4.00	34G	3.4	3.513	4.05
35E	3.5	3.601	4.10	35G	3.5	3.613	4.15

Table 2 Bearing length  $L$ , clamping length  $M$  and overall length  $E$ 

$\frac{1}{4}$ in UNF			$\frac{5}{16}$ in UNF				
Part No.	* $L$ min.	$M$ + 0 - 0.03	$E$ + 0.04 - 0	Part No.	* $L$ min.	$M$ + 0 - 0.03	$E$ + 0.04 - 0
36E	in 3.6	in 3.701	in 4.20		in 3.6	in 3.713	in 4.25
37E	3.7	3.801	4.30	36G	3.7	3.813	4.35
38E	3.8	3.901	4.40	37G	3.8	3.913	4.45
				38G			

*NOTE Bolts below the horizontal heavy line might not be readily available in large quantities because of limitations in manufacture by forging.*

\* See Clause 4, item c).

Annex A  
(informative)

## Table for conversion of inches to approximate millimetre equivalents

Table A.1 Table for conversion of inches to approximate millimetre equivalents

in	mm
$\frac{1}{4}$	6.4
$\frac{5}{16}$	7.9
$\frac{3}{8}$	9.5
$\frac{7}{16}$	11.1
$\frac{1}{2}$	12.7
$\frac{9}{16}$	14.3
$\frac{5}{8}$	15.9
$\frac{3}{4}$	19.1
$\frac{7}{8}$	22.2
4	101.6
5	127.0
6	152.4
7	177.8
8	203.2
9	228.6
10	254.0

## Bibliography

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 350 *Conversion factors for units*

BS S 96, *Specification for aircraft material 2½ per cent nickel-chromium-molybdenum steel*

BS S 103, *Low nickel chromium steel (wire for the manufacture of bolts)*







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