

BS A 401-420:2015



BSI Standards Publication

AEROSPACE SERIES

**Specification for screws, pan
and 100° countersunk head,
hexalobular drive recess
(unified threads below 1/4
inch) in various materials**

bsi.

...making excellence a habit.
AVA Documents™
Document Sharing Hub

Publishing and copyright information

The BSI copyright notice displayed in this document indicates when the document was last issued.

© The British Standards Institution 2015

Published by BSI Standards Limited 2015

ISBN 978 0 580 82769 3

ICS 49.030.20

The following BSI references relate to the work on this document:

Committee reference ACE/12

Draft for comment 15/30281806DC

Publication history

First published October 2015

Amendments issued since publication

Date	Text affected
------	---------------

Contents

1	Scope	1
2	Normative references	1
3	General	2
4	Quality assurance procedure	2
5	Material and manufacture	3
6	Protective finish	3
7	Freedom from defects	3
8	Dimensions	3
9	Head of screws	4
10	Hexalobular drive recess	8
11	Unified thread identifier	10
12	Length of screws	12
13	Screw threads	15
14	Ends of screws	15
15	Length of thread	16
16	Designation	17
17	Identification and marking	17

Annexes

Annex A (informative)	Screw equivalency quick reference guide	19
Annex B (informative)	Conversion tables	20
Annex C (informative)	Measuring inspection criteria for countersunk heads	21
Annex D (informative)	Derivation of design of the countersunk head	24

Bibliography	27
--------------	----

List of figures

Figure 1	Hexalobular recess in 100° countersunk heads	8
Figure 2	Hexalobular recess in pan heads	9
Figure 3	Unified thread identifier option 1 (annular groove)	11
Figure 4	Unified thread identifier option 2 (plain cylindrical extension)	11
Figure 5	Dimensions of countersunk head screws	13
Figure 6	Dimensions of pan head screws	14
Figure 7	Types of end permissible on screws	16
Figure C.1	Method of measuring head protrusion of countersunk head screws	21
Figure C.2	Typical gauge block for 100° countersunk head screws	22
Figure D.1	Formulae for dimensions for countersunk head screws	24
Figure D.2	Absolute max and min head conditions of countersunk head screws	26

List of tables

Table 1	Sampling plan	3
Table 2	British Standard identifier, material and finish of screws	5
Table 3	Dimensions of hexalobular recesses for 100° countersunk heads	9
Table 4	Dimensions of hexalobular recesses for pan heads	10
Table 5	Unified thread identifier option 2	12
Table 6	Dimensions of countersunk head screws	13
Table 7	Dimensions of pan head screws	14
Table 8	Tolerance on length	15
Table 9	Nominal length and part number codes	17
Table A.1	Recess screw comparison to slotted screw equivalent	19
Table B.1	Shank gauge and inch decimal to millimetre equivalents of basic diameters of screws	20

Table C.1 – Dimensions of gauge block for 100° countersunk head screws 23

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 28, 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 October 2015. 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.

Information about this document

This British Standard has been introduced to give a hexalobular drive recess alternative to the traditional slot used in screws in the BSI range A 204, A 206, A 208 and A 217 to A 221 (a quick reference guide is provided in Annex A). This is intended to alleviate the risks of screw driver blade slippage in the vicinity of electronic printed circuit board copper track work and associated wiring.

The method of manufacturing choices are more controlled than those of the slotted BS A 204, etc. range, especially for the austenitic corrosion resistant (CRES) steel option, so to better maintain its strength characteristics, e.g. by cold heading and cold rolling threads. This new standard's title omits the term "machine" as in "machine screw" to reflect this.

This standard also expands the choices by introducing stronger alloy steel, martensitic CRES steel and high temperature/high expansion steel options.

The historic thread size of 2-64 UNF has been maintained. However, very few mating female threaded fasteners such as nuts and helical wire thread inserts, are available commercially; most are 2-56 UNC. Thread size 2-56 UNC has therefore been included as a thread size option.

This standard does not incorporate a mating range of plain hexagon nuts to match the new range of material choices listed above.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

Hazard warnings

CAUTION. Screws conforming to BS A 401 and BS A 411 have cadmium as a plating material, which has been restricted and/or banned in many countries owing to environmental and health concerns. Users should consult local officials if they have questions concerning the use of cadmium-plated parts.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

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 dimensions, materials, protective finishes and part numbers for 100° countersunk head and pan head screws with unified threads for non-structural general aerospace use.

2 Normative references

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

ASD-STAN TR 3775, *Aerospace series – Bolts and pins – materials*

BS 1134, *Assessment of surface texture – Guidance and general information*

BS 1473, *Specification for wrought aluminium and aluminium alloys for general engineering purposes – rivet, bolt and screw stock*

BS 1580-3, *Unified screw threads – Screw threads with diameters below 1/4 in – Part 3: Requirements*

BS 1872, *Specification for electroplated coatings of tin*

BS 6338, *Specification for chromate conversion coatings on electroplated zinc and cadmium coatings*

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

BS L 102, *Specification for bars and extruded sections of aluminium-copper-magnesium-silicon-manganese alloy (solution treated and aged at room temperature) (not exceeding 200 mm diameter or minor sectional dimension) (Cu 4.4, Mg 0.5, Si 0.7, Mn 0.8)*

BS L 168, *Specification for bars and extruded sections of aluminium-copper-magnesium-silicon-manganese alloy (solution treated and artificially aged) (not exceeding 200 mm diameter or minor sectional dimension) (Cu 4.4, Mg 0.5, Si 0.7, Mn 0.8)*

BS S 80, *High chromium-nickel corrosion resisting steel forging stock, bars, forgings and parts (880 to 1 080 MPa: limiting ruling section 100 mm)*

BS S 129, *Specification for 18/9 chromium-nickel corrosion-resisting steel (titanium stabilized) billets, bars, forgings and parts (540 MPa: limiting ruling section 150 mm)*

BS S 130, *Specification for 18/9 chromium-nickel corrosion-resisting steel (niobium stabilized) billets, bars, forgings and parts (540 MPa: limiting ruling section 150 mm)*

BS S 142, *Specification for 1% chromium-molybdenum steel billets, bars, forgings and parts (900–1 100 MPa: limiting ruling section 40 mm)*

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 154, *Specification – 2½% nickel-chromium-molybdenum steel billets, bars, forgings and parts (880–1 080 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*

BS EN 755-2, *Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Mechanical properties*

BS EN 2100, *Aluminium alloy AL-P2014A-T4511 – Extruded bars and sections a or $D \leq 200$ mm*

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

BS EN 2284, *Specification for sulfuric acid anodizing of aluminium and wrought aluminium alloys*

BS EN 2398, *Aerospace series – Heat resisting steel FE-PA2601 (X6NiCrTiMoV26-15) – $R_m \geq 900$ MPa – Bars for machined bolts – $D \leq 25$ mm*

BS EN 2399, *Aerospace series – Heat resisting steel FE-PA2601 (X4NiCrTiMoV26-15) – $R_m \geq 900$ MPa – Bars for forged bolts – $D \leq 25$ mm*

BS EN 2516, *Passivation of corrosion resisting steels and decontamination of nickel based alloys*

BS EN 3911, *Aerospace series – Six lobe recess – Geometrical definition*

BS EN 4826, *Aerospace series – Zinc-nickel (12-16% Ni) plating of steels with specified tensile strength $\leq 1\,450$ MPa, copper alloys, nickel alloys and aluminium alloys for parts and fasteners*

BS EN 12163, *Copper and copper alloys – Rod for general purposes*

BS EN 12164, *Copper and copper alloys – Rod for free machining purposes*

BS EN 12166, *Copper and copper alloys – Wire for general purposes*

BS EN ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel – Bolts, screws and studs with specified property classes – Coarse thread and fine pitch thread*

SAE AMS 03-19, *Electro-deposition of cadmium*

SAE AMS 03-25, *Sulfuric acid anodizing of aluminium and aluminium alloys*

SAE AMS 2417, *Aerospace material specification, plating, zinc-nickel alloy*

3 General

The screws shall conform to the relevant requirements of BS A 100 in respect of manufacture, screw threads, identification and marking.

NOTE Unless otherwise stated, the measurement and scientific values shown are expressed in imperial British units with metric SI conversions in parentheses () as needs be.

4 Quality assurance procedure

A quality assurance procedure shall be carried out in accordance with BS A 100, with the exception of samples for dimensional and non-destructive inspection which shall be taken from each batch in accordance with the levels given in Table 1 of this standard.

Table 1 Sampling plan

Acceptable quality level (AQL)	Inspection level 11	Inspection level S-1
1%	Thread size	Underhead radius Drive recess dimensions
2.5%	Burrs and plating (visual)	Head concentricity Drive recess form and position
4%	Nominal length Other dimensions	Head height (pan only) Head protrusion (dimension <i>P</i>) (countersunk only)

5 Material and manufacture

5.1 The screws shall be manufactured from the materials listed in Table 2.

5.2 The screws shall be manufactured by one of the following methods to suit the material type and shall meet the final mechanical properties as listed after any post manufacture heat treatment.

- Machined from bright drawn bars. Not applicable to pan head screws made from the materials listed in b) below.
- Cold headed from wire or bright drawn bars. This is the minimum requirement for pan head screws made from aluminium, brass, austenitic CRES steel and low alloy steel.
- Hot forged and machined to suit. Applicable to any suitable material listed.

6 Protective finish

The screws shall be coated with the protective treatment for the appropriate material as specified in Table 2.

7 Freedom from defects

The screws shall be free from harmful defects, such as thread rolling laps between the nominal effective diameter and the minor diameter or any cracks.

NOTE Screws may be rejected at any time for faults in or revealed by manufacture, even if they have been made from material passed previously for chemical composition and mechanical properties.

8 Dimensions

With the exception of the thread, the screws shall conform to the dimensions and tolerances given in this standard, prior to applying any protective finish.

NOTE 1 Unless otherwise stated, the values given are in inches. For a guide to the thread sizes converted to decimal inch and metric mm, refer to Annex B.

NOTE 2 The dimensions and tolerances can be found in Figure 1 to Figure 7 inclusive and their associated tables, Table 3 to Table 9 inclusive.

NOTE 3 Any dry film lubricant applied as specified in Table 2 might take parts oversize on all features including the thread; this is acceptable.

9 Head of screws

Screw heads shall be concentric with the shank within the dimensional limits shown in Figure 5 and Figure 6.

Drive recesses shall be within the dimensional limits shown in Figure 1 and Figure 2 and shall be positioned central to the head's outside diameter. The recesses shall be clean and free from burrs upon visual inspection.

Table 2 British Standard identifier, material and finish of screws (1 of 3)

British Standard identifier	Type of head	Material description/specification ^{A)}	Mechanical properties		Protective finish ^{D)}
			Tensile strength ^{C)} tons/inch ² (MPa) min	0.2% proof stress tons/inch ² (MPa) min	
A401	100° Countersunk	Carbon-manganese (mild) steel in accordance with BS EN ISO 898-1, Property class 4.6	25 (385)	Not stated in material spec	Cadmium coated and passivated ^{E)} in accordance with SAE AMS 03-19 and BS 6338, Class 2c or BS EN 2133, coating Class-C
	Pan				
A402	100° Countersunk				Zinc-nickel coated and passivated in accordance with BS EN 4826, A3/B3 ^{F)} or SAE AMS 2417 Type-2 Grade-B
	Pan				
A403	100° Countersunk	Alloy steel in accordance with BS S 142, BS S 147, BS S 148, BS S 154 or BS S 158 or as listed in ASD-STAN TR 3775 Table-1 Strength Class 900 ^{B)}	58 (895)	45 (695)	Zinc-nickel coated and passivated in accordance with BS EN 4826, A3/B3 ^{F)} or SAE AMS 2417 Type-2 Grade-B
	Pan				
A404	100° Countersunk	Corrosion resisting steel (austenitic) in accordance with BS S 129 or BS S 130	35 (540)	13.5 (210)	None
	Pan				
A405	100° Countersunk	Corrosion resisting steel (martensitic) in accordance with BS S 80	57 (880)	47 (725)	Passivate in accordance with BS EN 2516, coating Class-C2 ^{H)}
	Pan				