

Specification for

Machine screws and machine screw nuts —

(B.S.W. and B.S.F. threads)

UDC 621.882.082.3

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This British Standard, having been approved by the Mechanical Engineering Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 30 June 1958

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First published May 1932
First revision June 1958

The following BSI references relate to the work on this standard:
Committee reference MEE/60
Draft for comment
CW(MEE) 7993

ISBN 0 580 35309 5

Amendments issued since publication

Amd. No.	Date of issue	Comments
5730	January 1966	
1561	September 1974	
5905	August 1966	

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Foreword

This standard makes reference to the following British Standards:

BS 57, *B.A. screws, bolts, nuts and plain washers.*

BS 84, *Parallel screw threads of Whitworth form.*

BS 1473, *Wrought aluminium and aluminium alloys. Rivet, bolt and screw stock for forging.*

BS 1475, *Wrought aluminium and aluminium alloys. Wire.*

BS 1476, *Wrought aluminium and aluminium alloys. Bars, rods and sections.*

BS 2827, *Machine screw nuts, pressed type, (B.A. and Whitworth form threads).*

BS 4183:1967, *Metric screws and machine screw nuts metric sizes.*

This British Standard for machine screws and machine screw nuts with B.S.W. or B.S.F. threads was prepared under the authority of the Mechanical Engineering Industry Standards Committee, and was first issued in 1932. It originally contained dimensions for bright countersunk, round and cheese head screws together with several clauses specifying general requirements which were in accordance with practice at that time.

When the standard came up for review in the immediate post war period it was recognized that substantial revision was needed to bring it up to date. Work on this revision had just been put in hand when developments occurred in the field of screw thread unification which made it necessary to defer completion of this standard and proceed with the more urgent work of drafting standards for fasteners having unified screw threads and general dimensions which would make them interchangeable with equivalent American products.

In preparing BS 1981, "*Unified machine screws and machine screw nuts*" the opportunity was taken to include a number of general features relating to current practice with a view to incorporating them in the revision of BS 450 when work on that standard was resumed. The question may be asked whether it was necessary to proceed with the revision of BS 450 once the standard for unified machine screws was available; the continuing use of such screws with B.S.W. and B.S.F. threads during the transition period precluded the withdrawal of BS 450, and it was clearly undesirable that two standards for comparable products, i.e. BS 1981 and BS 450, should exist side by side but contain general requirements which differed from each other. The Committee accordingly felt that it was right to continue with the preparation of an up-to-date version of the latter standard.

The scope of the standard has been extended to include all the various types of heads in common use in both slotted and recessed forms, and the general requirements are in most cases similar to those in BS 1981. Development is continually taking place, however, in methods of manufacture, and further advances in established practice have been recognized in drafting the text of this standard.

It will be noted that dimensions for several sizes of screws below $\frac{1}{4}$ in. and details of hexagon ordinary nuts and lock nuts in sizes from $\frac{1}{16}$ in. to $\frac{7}{32}$ in. inclusive have been given in an appendix. It has long been the practice to discourage the use of these fasteners with B.S.W. or B.S.F. threads, and to recommend the substitution of the nearest equivalents from the B.A. range. Although their use is still strongly deprecated, however, the number of enquiries relating to these fasteners received both by the Institution and by the manufacturers suggested that it would be advisable to provide information in this standard and thus eliminate the production of numbers of these screws and nuts possibly differing from each other only in some small particular.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 40 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

The provisions of this British Standard are applicable to both ferrous and non-ferrous screws and nuts having B.S.W. or B.S.F. threads. General dimensions and requirements are given for countersunk, raised countersunk, round, pan, cheese and mushroom head screws with slotted heads, and countersunk, raised countersunk, round, pan, raised cheese and mushroom head screws with recessed heads.

General dimensions for a restricted range of non-standard sizes of some of the above types of screws, together with dimensions of hexagon head screws and hexagon precision nuts in sizes below $\frac{1}{4}$ in. are given in an appendix. Other appendices relate to a suitable head flushness gauge for countersunk head screws, a method of checking recess penetration with standard gauge points, the formulae from which the dimensions are derived, and tables of standard sizes.

NOTE 1 Round head screws appeared in the 1932 edition of BS 450 and they are therefore included in this revised standard. It is considered, however, that pan head screws provide for most of the applications in which round head screws are normally used and it is recommended that they be regarded as "preferred" since their shape enables them to offer better slot engagement.

NOTE 2 Machine screw nuts, pressed type (B.A. and Whitworth form threads) are covered by BS 2827.

2 Material

The material from which the screws and nuts are manufactured shall have a tensile strength of not less than the following:

Steel	25 tons/sq. in.
Brass	20 tons/sq. in.
Aluminium alloy	20 tons/sq. in.

These minimum tensile strengths may be taken as being applicable to the finished products. (See Note 1.)

The failing load of a nut on assembly depends not only upon the tensile strength of the material but also upon the thickness of the nut and the type of thread.

If the purchaser requires the screws and nuts to be manufactured from steel or brass of a higher tensile strength, or of another material, he shall specify the tensile strength of the material.

Screws to this standard are not normally subjected to tensile test, and where this is required the purchaser shall state so in his enquiry and order.

NOTE The choice of aluminium alloy should normally be left to the manufacturer, but some suitable alloys satisfying the requirements are given below.

Any alloy currently covered by British Standards 1473, 1475 or 1476, with a tensile strength of not less than 20 tons/sq. in. is also suitable.

For screws and nuts turned from wire:

BS 1475:1955, "*Wrought aluminium and aluminium alloys. Wire.*"

HG14 T

HG15 W or WP.

For screws and nuts turned from bar:

BS 1476:1955, "*Wrought aluminium and aluminium alloys. Bars, rods and sections.*"

HE11 WP

HE14 T

HE15 W or WP

For screws up to and including $\frac{3}{8}$ in. diameter cold-headed from wire:

BS 1473:1955, "*Wrought aluminium and aluminium alloys. Rivet, bolt and screw stock for forging*"

NB6 — $\frac{1}{2}$ H

HB15 WP

3 Terminology

For the purposes of this standard the generic term "screws" has been adopted as applying to the products whether threaded up to the head or having an unthreaded portion of shank.

4 Dimensions

- a) *Screws*. The dimensions and tolerances for screws shall be as specified in Table 1 to Table 9 inclusive, and Table 11 to Table 14 inclusive, and Clauses 6 to 10 inclusive.
- b) *Nuts*. The dimensions and tolerances for nuts shall be as specified in Table 10 and Clause 8.

5 Heads of screws

The screw heads shall be concentric with the shank. The slots and recesses shall be clean and free from burrs and, on visual inspection, shall appear to be closely coincident with the centre line of the head.

The depth of slot (Dimension J) shall be measured from the top of the head to the point at which the slot breaks through.

NOTE Slotted head screws turned from bars can be supplied with a smaller radius under the head if specially ordered.

6 Length of screws

- a) *Countersunk head*. The nominal length shall be the distance from the upper surface of the head to the extreme end of the shank, including any chamfer or radius.
- b) *Raised-countersunk head*. The nominal length shall be the distance from the upper surface of the head (excluding the raised portion) to the extreme end of the shank, including any chamfer or radius.
- c) *Round, pan, cheese, raised-cheese, mushroom and hexagon head*. The nominal length shall be the distance from the underside of the head to the extreme end of the shank, including any chamfer or radius.
- d) *Tolerance on length*. The permissible tolerance on the nominal length of screws is as follows:

Diameter	Nominal length	Tolerance on length
Below $\frac{1}{4}$ in.	Up to and including $\frac{1}{2}$ in. Over $\frac{1}{2}$ in.	+ 0 – 0.020 in. + 0 – $\frac{1}{32}$ in.
$\frac{1}{4}$ in. and over	Up to and including 1 in. Over 1 in. up to and including 2 in. Over 2 in.	+ 0 – $\frac{1}{32}$ in. + 0 – $\frac{1}{16}$ in. + 0 – $\frac{3}{32}$ in.

NOTE Attention is drawn to the fact that the tolerance on length is expressed in a negative direction.

7 Ends of screws

- a) *Rolled threads*. When screws are made with rolled threads the “lead” formed by the thread rolling operation is normally to be regarded as providing the necessary chamfer and no other machining is necessary. Header points conforming to the dimensions given in Figure 1 and Table 1 may however be supplied if specially ordered.
- b) *Cut threads*. The ends of screws with cut threads shall normally be finished with a chamfer conforming to the dimensions in Figure 1. At the option of the manufacturer the ends of screws smaller than $\frac{1}{4}$ in. diameter may be finished with a radius approximately equal to $1\frac{1}{4}$ times the nominal diameter of the shank.
- c) *Special points*. Any type of end other than those covered in Clauses 7 a) and 7 b) are regarded as “special” and should be avoided whenever possible. However, when cone points are particularly required they should be ordered to the dimensions given in Figure 1.

NOTE For convenience one type of end only is illustrated in the figures at the head of Table 2 to Table 9 inclusive. The alternative types of end permissible are shown in Figure 1.

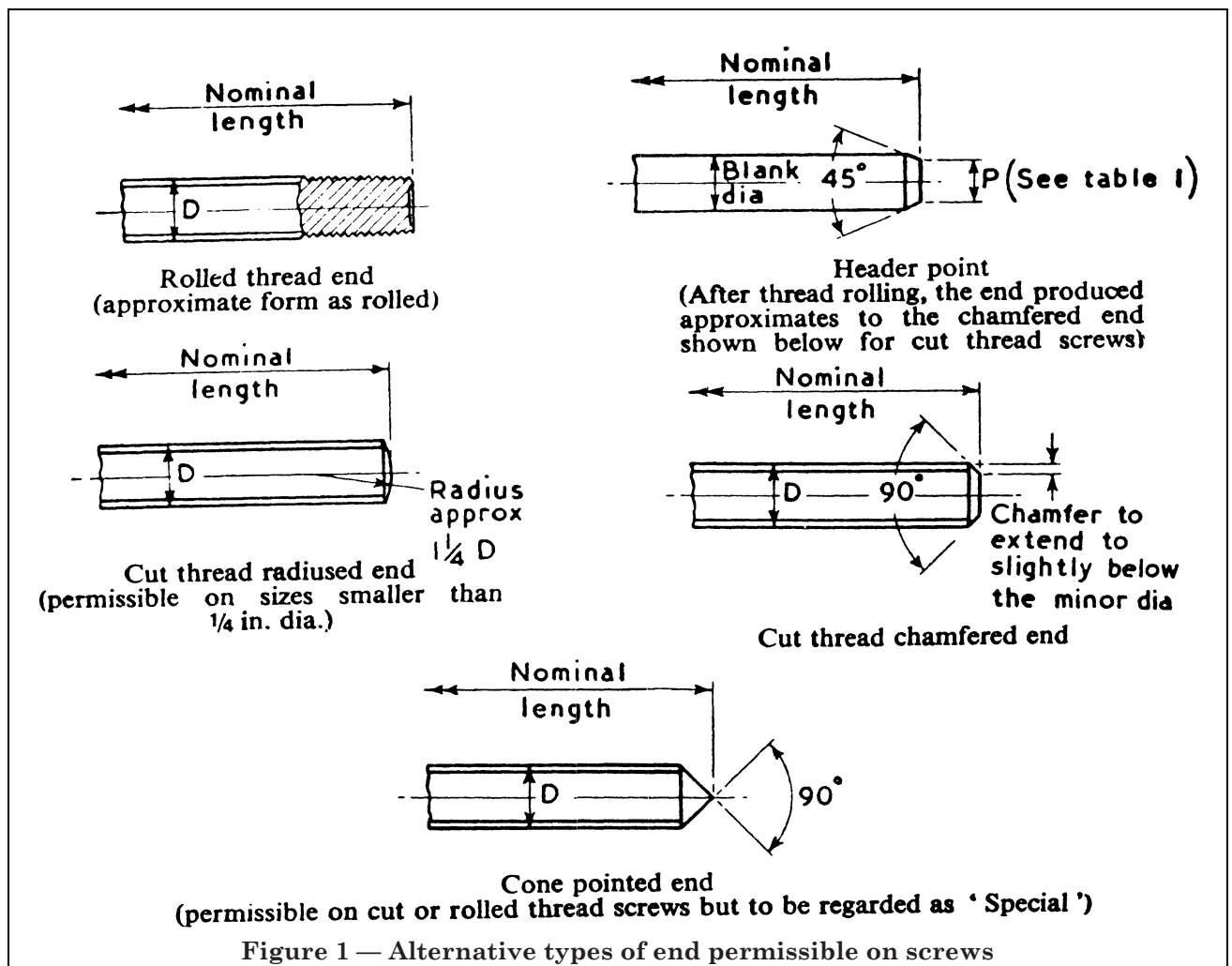


Table 1 — Dimensions of header points

1	2	3	4	5	6
Nominal size of screw D	Diameter of header point P		Nominal size of screw D	Diameter of header point P	
	max.	min.		max.	min.
	in.	in.		in.	in.
$\frac{1}{8}$ in. — 40 B.S.W.	0.083	0.074	$\frac{3}{16}$ in. — 32 B.S.F.	0.133	0.121
$\frac{5}{32}$ in. — 32 Whit.	0.104	0.094	$\frac{7}{32}$ in. — 28 B.S.F.	0.156	0.143
$\frac{3}{16}$ in. — 24 B.S.W.	0.121	0.109	$\frac{1}{4}$ in. — 26 B.S.F.	0.182	0.168
$\frac{7}{32}$ in. — 24 Whit.	0.150	0.137	$\frac{5}{16}$ in. — 22 B.S.F.	0.231	0.215
$\frac{1}{4}$ in. — 20 B.S.W.	0.168	0.154	$\frac{3}{8}$ in. — 20 B.S.F.	0.283	0.265
$\frac{5}{16}$ in. — 18 B.S.W.	0.219	0.203	$\frac{7}{16}$ in. — 18 B.S.F.	0.333	0.313
$\frac{3}{8}$ in. — 16 B.S.W.	0.268	0.250	$\frac{1}{2}$ in. — 16 B.S.F.	0.382	0.360
$\frac{7}{16}$ in. — 14 B.S.W.	0.315	0.295	$\frac{9}{16}$ in. — 16 B.S.F.	0.439	0.415
$\frac{1}{2}$ in. — 12 B.S.W.	0.358	0.336	$\frac{5}{8}$ in. — 14 B.S.F.	0.486	0.460
$\frac{9}{16}$ in. — 12 B.S.W.	0.415	0.391	$\frac{3}{4}$ in. — 12 B.S.F.	0.587	0.557
$\frac{5}{8}$ in. — 11 B.S.W.	0.463	0.437			
$\frac{3}{4}$ in. — 10 B.S.W.	0.567	0.537			

8 Screw threads

- a) *General*. The screw threads shall be British Standard Whitworth (B.S.W.) or British Standard Fine (B.S.F.) in accordance with BS 84, “*Parallel screw threads of Whitworth form*”, as specified by the purchaser.
- b) *Screws*. The screw threads may be either cut or rolled, at the option of the manufacturer, and shall, unless otherwise specified, conform to the limits and tolerances for Free Class bolts specified in BS 84.
- c) *Nuts*. Unless otherwise specified, the screw threads shall conform to the limits and tolerances for Normal Class nuts specified in BS 84.

9 Length of thread on screws

Screws 2 in. long and under shall be threaded as far as possible up to the head. The length of unthreaded shank under the head shall not exceed twice the pitch and is defined as the distance from the leading face of a nut which has been screwed as far as possible on to the screw by hand to:

- a) The junction of the basic major diameter and the countersunk portion of head on countersunk and raised countersunk heads, and
- b) the underside of the head on other types of heads.

The nut shall have screw threads conforming to BS 84, “*Normal Class*” limits and shall not be countersunk. Screws over 2 in. long shall have a minimum length of thread of $1\frac{3}{4}$ in.

10 Diameter of unthreaded shank on screws

The diameter of the unthreaded portion of the shank on screws shall not exceed the basic major diameter of the screw thread and shall not be less than the minimum effective diameter of the screw thread.

Where it is essential that the diameter of the unthreaded portion of the shank shall not be below the minimum major diameter of the thread this should be stated by the purchaser.

NOTE The diameter of the unthreaded portion of shank is closely associated with the method of manufacture; it will generally be nearer the maximum major diameter of the thread for turned screws and nearer the minimum effective diameter for those produced by cold heading.

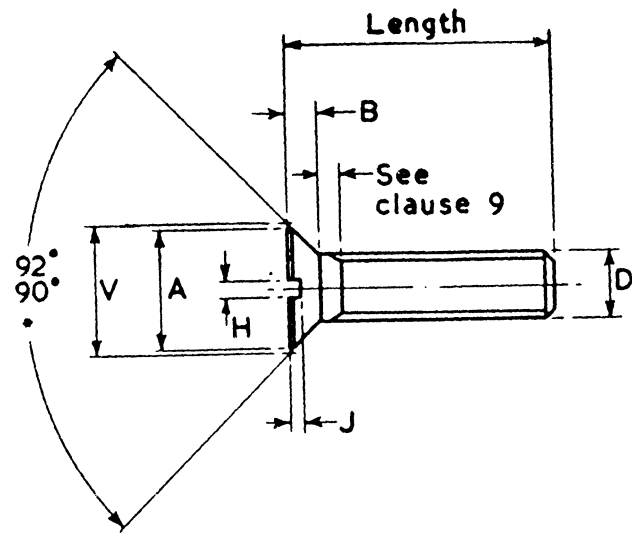


Figure 2 — Screws 2 in. long and under

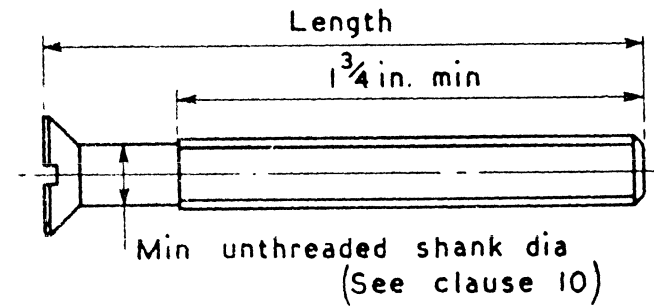
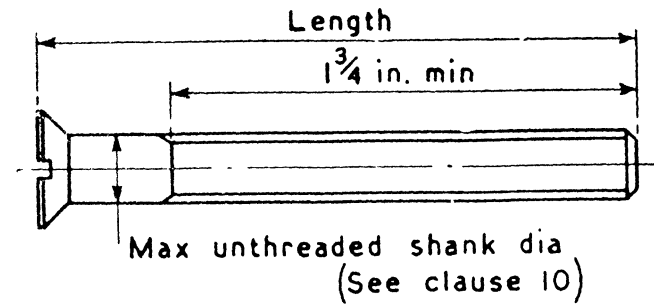


Figure 3 — Screws over 2 in. long

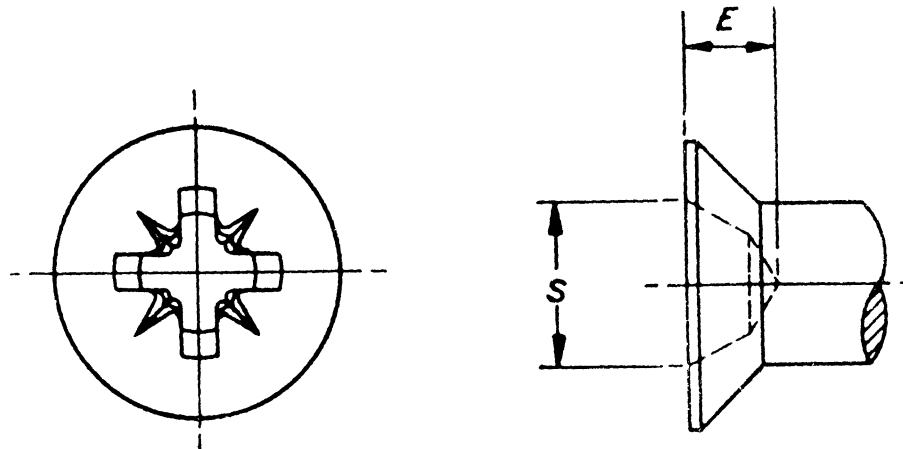


Figure 4 — Enlarged views of recessed head

Table 2 — Slotted and recessed 90° countersunk head screws

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
General									Slot			Recess					
Nominal size of screw	Basic diameter D	Number of threads per inch		Diameter of head		Depth of head B ^c	Flushness tolerance ^d	Width		Depth J	Dempth		Penetration ^g		Diameter S ^e	Recess and driver point No.	
				V ^b	A			H			E		g				
		B.S.W.	B.S.F.		max.	min.	max.	max.	max.	min.	nom.	max.	min.	max.	min.		nom.
in.	in.			in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
¹ / ₈	0.125 0	40	—	0.237	0.219	0.201	0.056	0.009	0.039	0.032	0.027	0.068	0.052	0.058	0.042	0.099	1
³ / ₁₆	0.187 5	24	32 ^f	0.356	0.328	0.307	0.084	0.011	0.050	0.042	0.041	0.106	0.088	0.091	0.073	0.166	2
⁷ / ₃₂	0.218 8	—	28 ^f	0.415	0.383	0.360	0.098	0.012	0.055	0.046	0.048	—	—	—	—	—	2
¹ / ₄	0.250 0	20	26	0.475	0.438	0.412	0.113	0.013	0.061	0.051	0.055	0.146	0.128	0.125	0.107	0.250	3
⁵ / ₁₆	0.312 5	18	22	0.594	0.547	0.518	0.141	0.015	0.071	0.061	0.069	0.168	0.150	0.145	0.127	0.309	4
³ / ₈	0.375 0	16	20	0.712	0.656	0.624	0.169	0.017	0.082	0.072	0.083	0.216	0.198	0.193	0.175	0.357	4
⁷ / ₁₆	0.437 5	14	18	0.831	0.766	0.729	0.197	0.019	0.093	0.082	0.097	0.245	0.227	0.222	0.204	0.386	4
¹ / ₂	0.500 0	12	16	0.950	0.875	0.835	0.225	0.021	0.104	0.092	0.111	0.276	0.258	0.253	0.235	0.417	4
⁹ / ₁₆	0.562 5	12 ^f	16 ^f	1.069	0.984	0.941	0.253	0.022	0.115	0.103	0.125	—	—	—	—	—	—
⁵ / ₈	0.625 0	11	14	1.187	1.094	1.046	0.281	0.025	0.126	0.113	0.138	—	—	—	—	—	—
³ / ₄	0.750 0	10	12	1.425	1.312	1.257	0.338	0.029	0.148	0.134	0.166	—	—	—	—	—	—

^a Countersinks to suit the screws should have a maximum angle of 90° with a negative tolerance.

^b The dimensions for “V” are the theoretical diameters of head to sharp corners and are given for design purposes only.

^c The maximum depth of head “B” on a nominal size shank is given for the convenience of users only.

^d The flushness tolerances represent the maximum amount the upper surface of the head may fall below the surface of an appropriate gauge, a suitable form of which is shown in Appendix B.

^e The diameter “S” is measured at the points of intersection between the sides of the recess and the upper surface of the head.

^f Sizes marked thus are non-preferred and should be avoided whenever possible.

^g These dimensions refer to the penetration of standard gauge points used with special penetration gauges (See Appendix D)

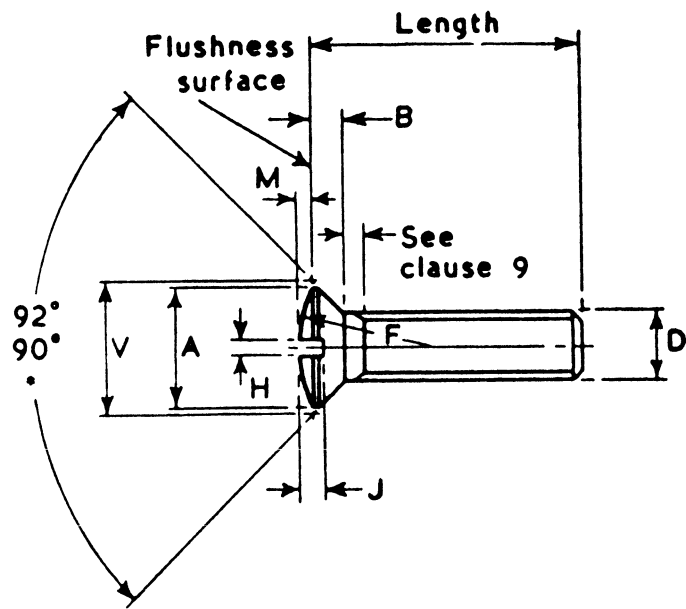


Figure 5 — Screws 2 in. long and under

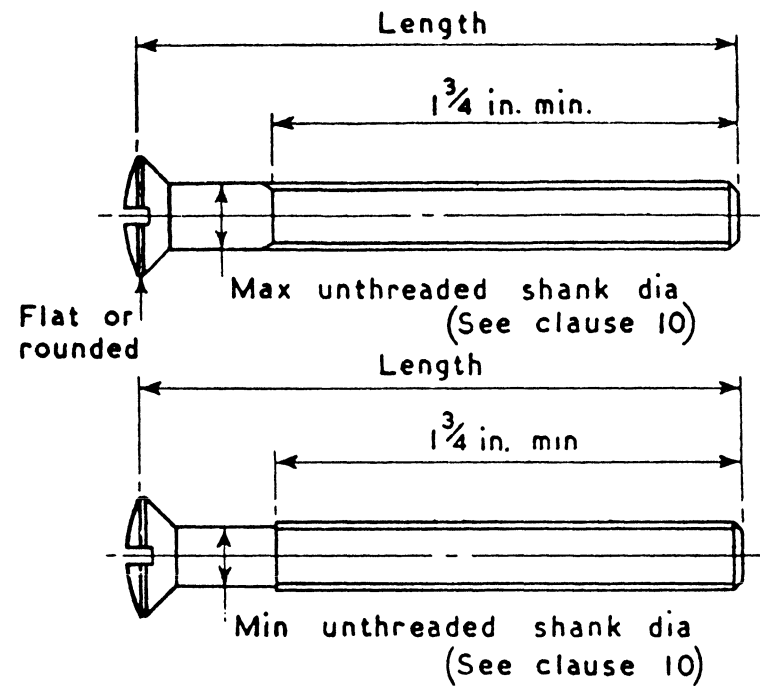


Figure 6 — Screws over 2 in. long

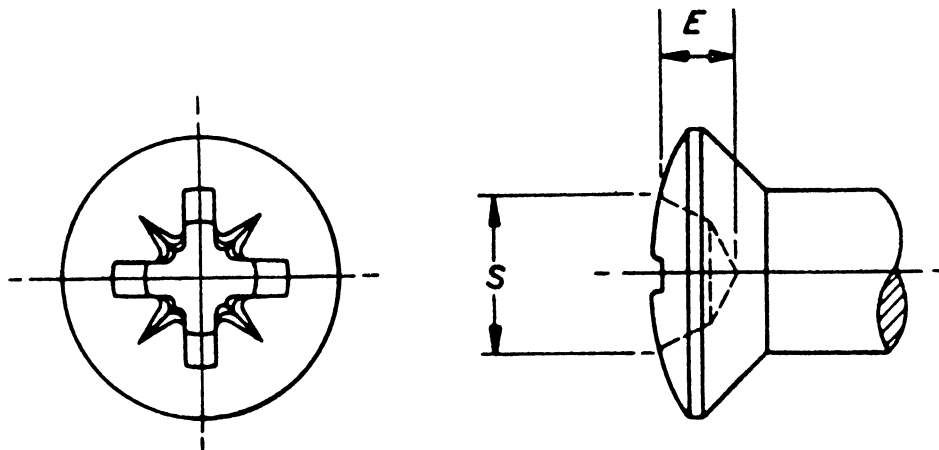


Figure 7 — Enlarged views of recessed head

Table 3 — Slotted and recessed 90° raised-countersunk head screws

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
General										Slot			Recess					
Nominal size of screw	Basic diameter D	Number of threads per inch		Diameter of head		Depth of head	Height of raised portion M	Radius of head	Width		Depth	Depth		Penetration		Diameter	Recess and driver point No.	
				V ^b	A													H ^c
		B.S.W.	B.S.F.		max.	min.	max.	nom.	nom.	max.	min.	nom.	max.	min.	max.	min.		
in.	in.			in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	
1/8	0.125 0	40	—	0.237	0.219	0.201	0.056	0.026	0.248	0.039	0.032	0.047	0.092	0.076	0.081	0.065	0.123	1
3/16	0.187 5	24	32 ^f	0.356	0.328	0.307	0.084	0.040	0.352	0.050	0.042	0.071	0.137	0.119	0.122	0.103	0.197	2
7/32	0.218 8	—	28 ^f	0.415	0.383	0.360	0.098	0.044	0.437	0.055	0.046	0.083	—	—	—	—	—	2
1/4	0.250 0	20	26	0.475	0.438	0.412	0.113	0.051	0.500	0.061	0.051	0.095	0.169	0.151	0.148	0.130	0.275	3
5/16	0.312 5	18	22	0.594	0.547	0.518	0.141	0.068	0.625	0.071	0.061	0.120	0.199	0.181	0.172	0.154	0.341	4
3/8	0.375 0	16	20	0.712	0.656	0.624	0.169	0.080	0.731	0.082	0.072	0.144	0.254	0.236	0.227	0.209	0.394	4
^a Countersinks to suit the screws should have a maximum angle of 90° with a negative tolerance.																		
^b The dimensions for “V” are the theoretical diameters of head to sharp corners and are given for design purposes only.																		
^c The maximum depth of head B' on a nominal size shank is given for the convenience of users only. The top of the land (flushness surface) may be visually inspected with the gauge used for checking the flushness tolerance on countersunk head screws (see Appendix B).																		
^d These dimensions refer to the penetration of standard gauge points used with special penetration gauges (see Appendix D).																		
^e The diameter “S” is measured at the points of intersection between the sides of the recess and the upper surface of the head.																		
^f Sizes marked thus are non-preferred and should be avoided whenever possible.																		

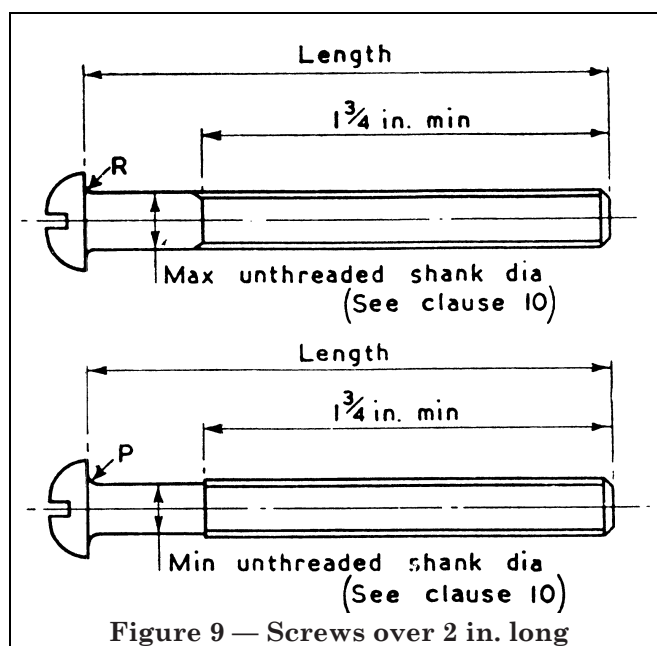
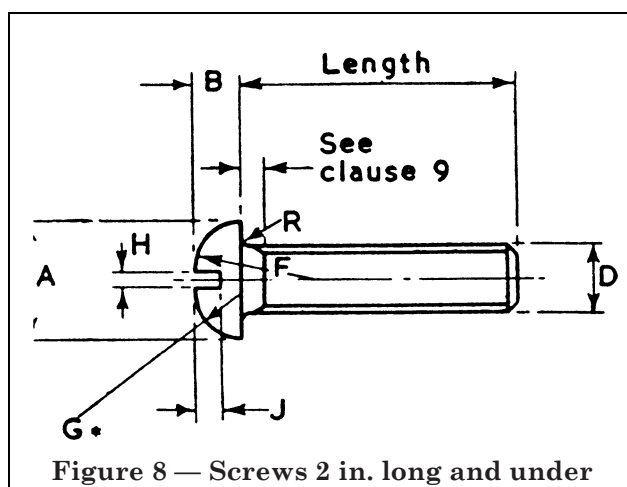


Table 4 — Slotted round head screws

1	2	3	4	5	6	7	8	9	10	11	12	13	14
General						Slotted head							
Nom. size of screw	Basic dia. D	Number of threads per inch		Radius under head		Dia. of head A		Depth of head B		Radius of head F	Slot		
				R	P						Width H		Depth J
		B.S.W.	B.S.F.	max.	max.	max.	min.	max.	min.	nom.	max.	min.	nom.
in.	in.			in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1/8	0.125 0	40	—	0.010	0.020	0.219	0.206	0.087	0.082	0.219	0.039	0.032	0.048
3/16	0.187 5	24	32 ^b	0.015	0.025	0.328	0.312 ^c	0.131	0.124	0.328	0.050	0.042	0.072
7/32	0.218 8	—	28 ^b	0.015	0.025	0.383	0.365	0.153	0.145	0.383	0.055	0.046	0.084
1/4	0.250 0	20	26	0.031	0.040	0.438	0.417	0.175	0.165	0.438	0.061	0.051	0.096
5/16	0.312 5	18	22	0.031	0.045	0.547	0.524	0.219	0.207	0.547	0.071	0.061	0.120
3/8	0.375 0	16	20	0.031	0.045	0.656	0.629	0.262	0.249	0.656	0.082	0.072	0.144
7/16	0.437 5	14	18	0.031	0.050	0.766	0.735	0.306	0.291	0.766	0.093	0.082	0.168
1/2	0.500 0	12	16	0.031	0.050	0.875	0.840	0.350	0.333	0.875	0.104	0.092	0.192
9/16	0.562 5	12 ^b	16 ^b	0.031	0.050	0.984	0.946	0.394	0.375	0.984	0.115	0.103	0.217
5/8	0.625 0	11	14	0.031	0.055	1.094	1.051	0.437	0.417	1.094	0.126	0.113	0.240
3/4	0.750 0	10	12	0.031	0.060	1.312	1.262	0.525	0.500	1.312	0.148	0.134	0.288

^a The shape of the head shall closely approximate to a half ellipse. Radius G (struck off the under-side of the head) must pass through Diameter A and touch Radius F.

^b Sizes marked thus are non-preferred and should be avoided whenever possible.

^c To permit the use of 5/16 in. bar, the minimum head diameter may, by arrangement between purchaser and manufacturer, be 0.309 in.