

Specification for

Machine screws and machine screw nuts — metric series

UDC 621.882:389.151

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW



Document Sharing Hub

Co-operating organizations

The Mechanical Engineering Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Associated Offices' Technical Committee	Institution of Civil Engineers
Association of Consulting Engineers	Institution of Gas Engineers
Association of Mining Electrical and Mechanical Engineers	Institution of Heating and Ventilating Engineers
Board of Trade	Institution of Mechanical Engineers
British Chemical Plant Manufacturers' Association	Institution of Mechanical Engineers (Automobile Division)
British Compressed Air Society	Institution of Production Engineers*
British Electrical and Allied Manufacturers' Association*	Locomotive and Allied Manufacturers' Association of Great Britain*
British Gear Manufacturers' Association	London Transport Board
British Internal Combustion Engine Manufacturers' Association	Machine Tool Trades Association*
British Iron and Steel Federation*	Ministry of Defence
British Mechanical Engineering Federation	Ministry of Labour (H.M. Factory Inspectorate)
British Pump Manufacturers Association	Ministry of Power
Crown Agents for Oversea Governments and Administrations	Ministry of Public Building and Works
Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales*	Ministry of Technology — National Engineering Laboratory*
Engineering Equipment Users' Association	Ministry of Transport
Gas Council*	National Coal Board*
Institute of Marine Engineers	National Physical Laboratory (Ministry of Technology)
	Radio Industry Council
	Royal Institute of British Architects

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

Association of Hydraulic Equipment Manufacturers	Ministry of Defence, Navy Department
British Railway Board	Post Office
British Constructional Steelwork Association	Precision Bolt and Nut Institute
British Cycle and Motor Cycle Industries Association Ltd.	Rolled Thread Screw Association
Council of British Manufacturers of Petroleum Equipment	Scientific Instrument Manufacturers' Association
Electronic Engineering Association	Society of Motor Manufacturers and Traders Ltd.
Fasteners and Turned Parts Institute	Telecommunication Engineering & Manufacturing Association
Institute of Iron and Steel Wire Manufacturers	Individual manufacturers

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 19 July 1967

© BSI 02-2000

The following BSI references relate to the work on this standard:
Committee references MEE/60, MEE/60/2
Draft for comment 67/1778

ISBN 0 580 34578 5

Amendments issued since publication

Amd. No.	Date of issue	Comments
572	August 1970	
1742	May 1975	
8550	May 1995	Indicated by a sideline in the margin

Contents

	Page
Co-operating organizations	Inside front cover
Foreword	ii
1 Scope	1
2 Terminology	1
3 Material	1
4 Coating of screws and nuts	2
5 General dimensions	2
6 Heads of screws	2
7 Screw threads	2
8 Nominal length of screws	2
9 Length of thread on screws	3
10 Diameter of unthreaded shank on screws	3
11 Radius under the head of screws	4
12 Ends of screws	4
13 Designation	4
14 Inspection	5
Appendix A Recess penetration gauging	23
Appendix B Dimensions of 90° countersunk head screws	29
Appendix C Standard sizes of machine screws. Metric series	30
Appendix D BSI policy statement on screw threads and the metric system	33
Appendix E Manufacturers' recommended range of sizes	34
Figure 1 — Alternative types of end permissible on screws	5
Figure 2 — Recess penetration gauge	24
Figure 3 — Gauge body	25
Figure 4 — Gauge point enlarged	26
Figure 5 — Connecting piece	28
Table 1 — Machine screws. Metric series	1
Table 2 — Slotted countersunk head machine screws. Metric series	6
Table 2A — Recessed countersunk head machine screws. Metric series	8
Table 3 — Slotted raised countersunk head machine screws. Metric series	10
Table 3A — Recessed raised countersunk head machine screws. Metric series	12
Table 4 — Slotted and recessed pan head machine screws. Metric series	14
Table 4A — Recessed pan head machine screws. Metric series	16
Table 5 — Slotted cheese head machine screws. Metric series	18
Table 6 — Concentricity tolerances	20
Table 7 — Nominal lengths and tolerances on length for machine screws	21
Table 8 — Machine screw nuts, pressed type, square and hexagon	22
Table 9 — Dimensions of gauge point	27
Table 10 — Standard sizes for countersunk and raised countersunk head machine screws. Metric series	30
Table 11 — Standard sizes for pan head machine screws. Metric series	31

	Page
Table 12 — Standard sizes for cheese head machine screws. Metric series	32
Table 13 — Pan head machine screws, slotted and recessed, mild steel, unplated	34
Table 14 — Countersunk machine screws, slotted and recessed, mild steel, unplated	34
Table 15 — Pan head machine screws, slotted and recessed, brass	35
Table 16 — Countersunk machine screws, slotted and recessed, brass	35

Foreword

This standard makes reference to the following British Standards:

BS 3382, *Electroplated coatings on threaded components*.

BS 3643, *ISO metric screw threads. Part 1. Thread data and standard thread series. Part 2. Limits and tolerances for coarse pitch series threads*.

BS 3692, *ISO metric precision hexagon bolts, screws and nuts*.

This British Standard has been prepared under the authority of the Mechanical Engineering Industry Standards Committee as a result of the decision taken in November, 1965 to adopt the ISO metric thread system in the United Kingdom.¹⁾

At the sixth plenary meeting of Technical Committee ISO/TC 2, held in New Delhi in November 1964, provisional agreement was reached with respect to a draft ISO proposal, "Slotted cheese head screws — metric series". This proposal was subsequently submitted to member countries, for postal approval, as ISO Draft Recommendation No. 949 in May 1966.

In New Delhi Working Group 5 was set up, with France, Germany, India, the Netherlands, Sweden, Switzerland, the United Kingdom and the U.S.A. as participating members and Germany as the Secretariat, to prepare proposals for other types of slotted head machine screws.

A meeting of Working Group 5 was held in Cologne in May 1966, at which it was agreed to rationalize usage upon the following head shapes for slotted machine screws:

- 1) Cheese head.
- 2) Pan head.
- 3) Countersunk head.
- 4) Raised countersunk head.

The agreements reached at Cologne were consequently translated into revised proposals and these proposals were generally adopted, with certain amendments, at the seventh plenary meeting of Technical Committee ISO/TC 2 held at Budapest in October 1966.

Although work has yet to be initiated on the subject of recessed headed screws, it was thought likely at Cologne, that the head shapes devised for slotted screws would be suitable for recessed headed screws, with the exception of the pan head shape, which would require an increased head height to accommodate the recess.

The standard is based primarily on the proposals agreed at Budapest and on the following Draft Recommendations, prepared by Technical Committee ISO/TC 2, "Bolts, nuts and accessories":

ISO Recommendation R 898/1, *Mechanical properties of fasteners — Part 1: Bolts, screws and studs*.

ISO Recommendation R 1580, *Slotted pan head screws — Metric series*.

ISO Recommendation R 888, *Nominal lengths for bolts screws and studs — Thread lengths for general purpose bolts*.

ISO Recommendation R 885, *Bolts and screws — Radii under the head for general purpose bolts and screws — Metric series*.

It is to be emphasized that although the Draft Recommendations listed above have yet to be finally ratified, they have been provisionally agreed and are being progressively incorporated in the national standards of ISO member countries.

¹⁾ See Appendix D.

It is intended that this standard should eventually supersede and replace BS 57, "*B.A. screws, bolts and nuts*", BS 2827, "*Machine screw nuts, pressed type (B.A. and Whitworth form threads)*" and BS 450, "*Machine screws and machine screw nuts (B.S.W. and B.S.F. threads)*" and form a parallel standard to BS 1981, "*Unified machine screws and machine screw nuts*" and BS 3155, "*American machine screws and nuts in sizes below ¼ inch diameter*".

NOTE Although the mechanical requirements specified in this standard are in metric technical units (i.e. kgf/mm²) in accordance with present ISO agreements (ISO R 898/1), comparable SI units have been included in anticipation of future international agreement in this respect. 1 kgf = 9.806 65 newtons. For further information about SI units see BS 350, "*Conversion factors and tables*", and PD 5686, "*The use of SI units*".

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.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 35 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.

Obsolescent (by Amendment No. 3).

The need for screws and nuts covered by this British Standard has been reviewed and it has been decided that in the interests of rationalization they should be regarded as obsolescent. Their use for new designs is not therefore recommended. The standard will be withdrawn in due course.

Even though this standard has largely been superseded by a series of BS EN standards, of which BS EN ISO 1580:1994 and BS EN ISO 7045:1994 are typical examples, it has not been withdrawn but declared obsolescent as it is recognized that it should remain available for the servicing of existing designs which are expected to have a long working life.

1 Scope

1.1 The provisions of this British Standard are applicable to machine screws and machine screw nuts having ISO metric threads.

1.2 Dimensions and tolerances are given for machine screws in the following ranges:

Table 1 — Machine screws. Metric series

Machine screw type	Head style	Diameter range
Slotted head screws	Countersunk head Raised countersunk head Cheese head	M1 (1 mm) to M20 (20 mm)
	Pan head	M2.5 (2.5 mm) to M10 (10 mm)
Recessed head screws	Countersunk head Raised countersunk head	M2.5 (2.5 mm) to M12 (12 mm)
	Pan head	M2.5 (2.5 mm) to M10 (10 mm)

1.3 Dimensions and tolerances are also given for square and hexagon machine screw nuts, pressed type, within the diameter range M1.6 (1.6 mm) to M10 (10 mm).

NOTE Details of precision hexagon nuts are given in BS 3692, “ISO metric precision hexagon bolts, screws and nuts”.

1.4 Mechanical properties are specified for steel, brass and aluminium alloy machine screws and machine screw nuts.

1.5 Appendices are included relating to the method of checking recess penetration with standard gauge points for machine screws, the dimensioning of 90° countersunk heads, standard sizes and the BSI policy statement on screw threads and the metric system.

2 Terminology

2.1 For the purposes of this British 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.

2.2 The designations of the various types of screw and nut are in accordance with those commonly used in British practice.

3 Material

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

Steel,	40 kgf/mm ² (392 N/mm ²)
Brass,	32 kgf/mm ² (314 N/mm ²)
Aluminium alloy,	32 kgf/mm ² (314 N/mm ²)

NOTE See Foreword for explanation of units given in brackets.

3.2 These minimum tensile strengths may be taken as applicable to the finished products.

3.3 Steel machine screws shall conform to the requirements for strength grade designation 4.8, extracted from ISO Recommendation R 898/1²⁾.

The strength grade designation system for machine screws consists of two figures, the first is 1/10 of the minimum tensile strength in kgf/mm², the second is 1/10 of the ratio between the yield stress and the minimum tensile strength expressed as a percentage; as illustrated below:

1/10 minimum tensile strength of 40 kgf/mm² gives the symbol “4”.

$$\text{1/10 ratio } \frac{\text{yield stress}}{\text{minimum tensile strength}} \% = \frac{1}{10} \times \frac{32}{40} \times \frac{100}{1} = “8”.$$

∴ Strength grade designation = “4.8”.

Multiplication of these two figures gives the minimum yield stress in kgf/mm².

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

3.4 If the purchaser requires steel screws and nuts to be manufactured from material of a higher tensile strength, or from another material, this shall be subject to agreement between the purchaser and the supplier.

4 Coating of screws and nuts

If the purchaser requires the screws or nuts to be coated, he shall state the coating required in his enquiry and order. It is recommended that the coating should comply with the appropriate part of BS 3382³⁾.

5 General dimensions

5.1 Screws. The general dimensions and tolerances for screws shall be as given in Table 2 to Table 5 inclusive and Clause 6 to Clause 12 inclusive.

5.2 Nuts. The general dimensions and tolerances for nuts shall be as given in Table 8 and Clause 7.

6 Heads of screws

6.1 The screw heads shall be concentric with the shank within tolerance grade IT 13 using the head diameter as datum. See Table 6.

6.2 The slots and recesses shall be clean and free from burrs and shall be concentric with the head within tolerance grade IT 13 using the head diameter as datum. See Table 6.

6.3 The depth of slot (dimension *t*) shall be measured from the top of the head to the point at which the slot breaks through.

6.4 The depth of the recess shall be such that when measured using the method and gauge described in Appendix A the penetration of the gauge into the recess conforms to the penetration values given in Table 2A, Table 3A and Table 4A.

7 Screw threads

7.1 General. The screw threads shall be ISO metric coarse pitch series threads in accordance with BS 3643-1⁴⁾.

7.2 Screws. The external threads shall conform to tolerance Class 6g limits (medium fit) as given in BS 3643-2⁴⁾.

7.3 Nuts. The internal threads shall conform to tolerance class 6H limits (medium fit) as given in BS 3643-2⁴⁾.

8 Nominal length of screws

8.1 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, radius, or cone point.

²⁾ ISO 898/1 “Mechanical properties of fasteners”, Part 1, “Bolts, screws and studs”.

³⁾ BS 3382, “Electroplated coatings on threaded components”.

⁴⁾ BS 3643, “ISO metric screw threads”, Part 1, “Thread data and standard thread series”, Part 2, “Limits and tolerances for coarse pitch series threads”.

8.2 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, radius, or cone point.

8.3 Pan and cheese head. The nominal length shall be the distance from the underside of the head to the extreme end of the shank, including any chamfer, radius, or cone point.

8.4 Nominal lengths and tolerances on length. The standard nominal lengths and tolerances are given in Table 7.

NOTE For details of the diameters of screws associated with these standard lengths, which are most likely to be stocked, see Appendix C. The manufacturers' recommended range of sizes is given in Appendix E.

9 Length of thread on screws

9.1 The length of thread shall be the distance from the end of the screw (including any chamfer, radius, or cone point) to the leading face of a nut without countersink which has been screwed as far as possible onto the screw by hand.

9.2 The minimum thread length shall be as given below:

Nominal thread dia. d	M1	M1.2	(M1.4)	M1.6	M2	(M2.2)	M2.5	M3	(M3.5)	M4
Thread length b (min.)	^a	^a	^a	15	16	17	18	19	20	22
Nominal thread dia. d	(M4.5)	M5	M6	M8	M10	M12	(M14)	M16	(M18)	M20
Thread length b (min.)	24	25	28	34	40	46	52	58	64	70

NOTE Nominal thread diameters shown in brackets are non-preferred.

^a Only threaded up to the head.

9.3 Screws of nominal thread diameter M1, M1.2 and M1.4 and screws of larger diameters which are too short for the above thread lengths shall be threaded as far as possible up to the head. In these cases the length of unthreaded shank under the head shall not exceed $1\frac{1}{2}$ pitches for lengths up to twice the diameter and 2 pitches for longer lengths, and is defined as the distance from the leading face of a nut which has been screwed as far as possible onto the screw by hand to:

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

10 Diameter of unthreaded shank of screws

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

10.2 Where it is essential that the diameter of the unthreaded portion of the shank shall not be less than 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 major diameter of the thread for turned screws and nearer the effective diameter for those produced by cold heading.

11 Radius under the head of screws

11.1 Pan and cheese head screws. The radius under the head of the screws shall run smoothly into the face of the head and shank without any step or discontinuity.

NOTE A true radius is not essential providing that the curve is smooth and lies wholly within the maximum radius, determined from the maximum transitional diameter, and the minimum radius specified (see Columns 10 and 11 of Table 4 and Table 5).

11.2 Countersunk head screws. Any radius under the head of the screws shall run smoothly into the conical bearing surface of the head and the shank without any step or discontinuity. The values specified in Column 6 of Table 2 and Table 3 shall be regarded as the maximum where the shank diameter is equal to the major diameter of the thread and the minimum where the shank diameter is approximately equal to the effective diameter of the thread.

12 Ends of screws

12.1 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.

12.2 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 M6 (6 mm diameter) may be finished with a radius approximately equal to $1\frac{1}{4}$ times the nominal diameter of the shank.

12.3 Special points. Types of end not specified in 12.1 and 12.2 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 5 inclusive. The alternative types of end permissible are shown in Figure 1.

13 Designation

13.1 Information required. When designating standard machine screws or machine screw nuts in an enquiry or order the following information shall be given:

- 1) The material.
- 2) Whether screw or nut.
- 3) The style of head and whether slotted or recessed.
- 4) The diameter and, in the case of screws, the length.
- 5) The type of end (if special point is required).
- 6) The number of this British Standard, i.e. BS 4183.
- 7) Details of the plating required, if any.

13.2 Examples

- 1) Steel⁵⁾ slotted countersunk head screws M5 × 16 to BS 4183 zinc plated to BS 3382-2⁶⁾.
- 2) Brass square nut M10 to BS 4183.

⁵⁾ Screws of strength grade 4.8 will normally be supplied unless otherwise specified.

⁶⁾ BS 3382, “Electroplated coatings on threaded components”, Part 2, “Zinc on steel components”.

14 Inspection

The manufacturer shall take the necessary steps to ensure that the requirements of this standard are fulfilled.

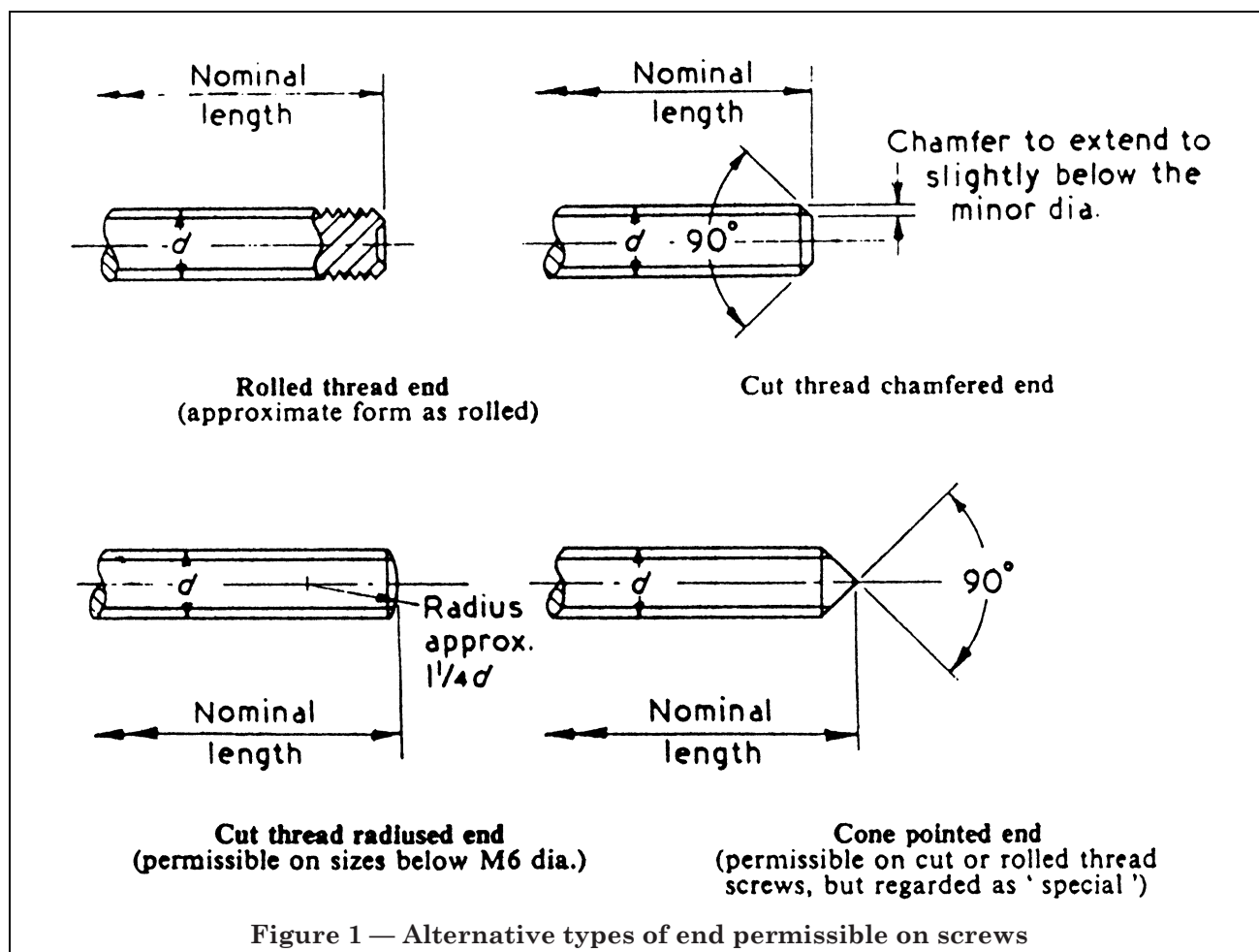


Table 2 — Slotted countersunk head machine screws. Metric series

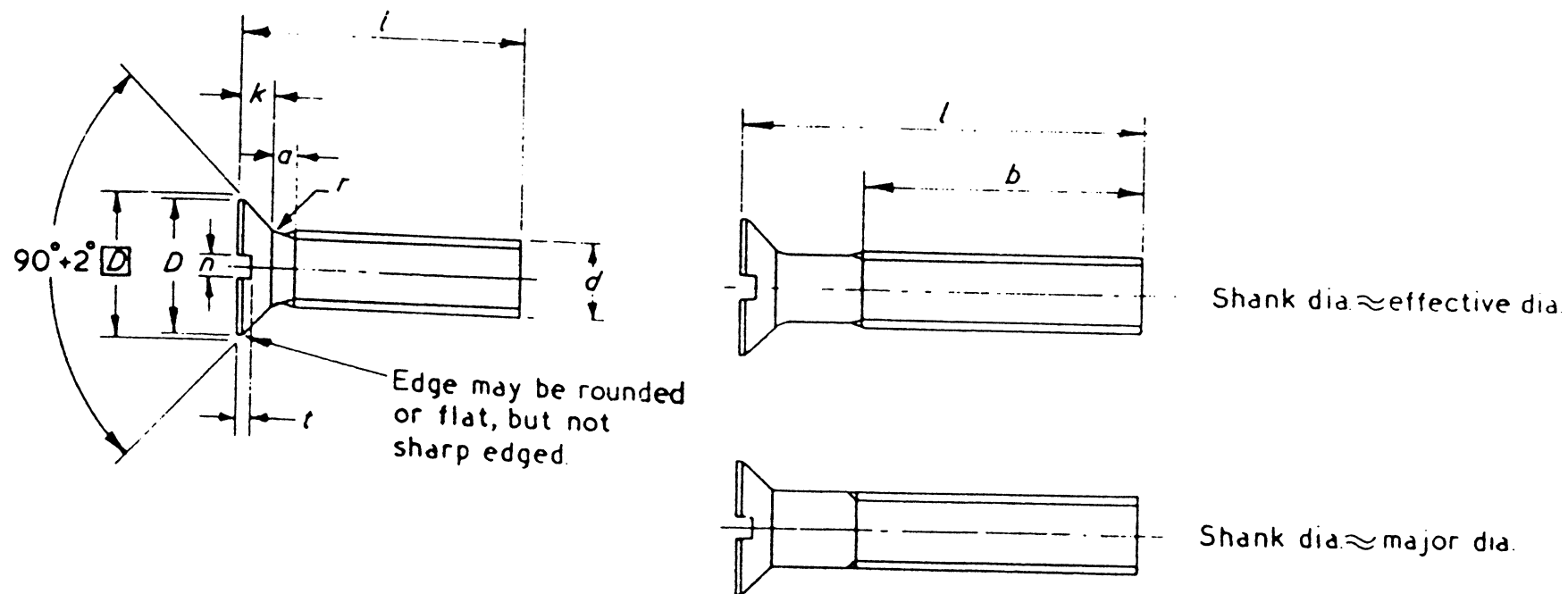


Table 2 — Slotted countersunk head machine screws. Metric series

Dimensions in millimetres

1	2	3	4	5	6	7	8	9	10	11	12	13
General									Slotted heads			
<i>d</i>	<i>D</i>		<i>k</i>		<i>r</i>	<i>b</i>	<i>a</i>		<i>n</i>		<i>t</i>	
Nominal size and thread diameter	Head diameter		Head height		Radius	Thread length	Thread run-out	Flushness tolerance ^a	Width of slot		Depth of slot	
	Max.	Min.	Max.	Min.	^c	Min.	Max. ^d (2 <i>p</i>)	Max.	Max.	Min.	Max. (0.3 <i>d</i>)	Min. (0.2 <i>d</i>)
M1	2.20	1.76	0.60	0.48	0.1	^b	0.50	—	0.45	0.31	0.30	0.20
M1.2	2.64	2.14	0.72	0.60	0.1	^b	0.50	—	0.50	0.36	0.36	0.24
(M1.4)	3.08	2.52	0.84	0.72	0.1	^b	0.60	—	0.50	0.36	0.42	0.28
M1.6	3.52	2.86	0.96	0.84	0.1	15.0	0.70	—	0.60	0.46	0.48	0.32
M2.0	4.40	3.50	1.20	1.08	0.1	16.0	0.80	—	0.70	0.56	0.60	0.40
(M2.2)	4.84	3.88	1.32	1.20	0.1	17.0	0.90	—	0.80	0.66	0.66	0.44
M2.5	5.50	4.45	1.50	1.38	0.1	18.0	0.90	0.10	0.80	0.66	0.75	0.50
M3	6.30	5.25	1.65	1.50	0.1	19.0	1.00	0.12	1.00	0.86	0.90	0.60
(M3.5)	7.35	6.12	1.93	1.75	0.2	20.0	1.20	0.13	1.00	0.86	1.05	0.70
M4	8.40	7.04	2.20	2.00	0.2	22.0	1.40	0.15	1.20	1.06	1.20	0.80
(M4.5)	9.00	7.85	2.25	2.03	0.2	24.0	1.50	0.17	1.20	1.06	1.35	0.90
M5	10.00	8.75	2.50	2.25	0.2	25.0	1.60	0.19	1.51	1.26	1.50	1.00
M6	12.00	10.50	3.00	2.70	0.25	28.0	2.00	0.23	1.91	1.66	1.80	1.20
M8	16.00	14.00	4.00	3.60	0.4	34.0	2.50	0.29	2.31	2.06	2.40	1.60
M10	20.00	17.50	5.00	4.50	0.4	40.0	3.00	0.37	2.81	2.56	3.00	2.00
M12	24.00	21.00	6.00	5.40	0.6	46.0	3.50	0.44	3.31	3.06	3.60	2.40
(M14)	28.00	24.50	7.00	6.30	0.6	52.0	4.00	0.52	3.31	3.06	4.20	2.80
M16	32.00	28.00	8.00	7.20	0.6	58.0	4.00	0.60	4.37	4.07	4.80	3.20
(M18)	36.00	31.50	9.00	8.10	0.6	64.0	5.00	0.67	4.37	4.07	5.40	3.60
M20	40.00	35.00	10.00	9.00	0.8	70.0	5.00	0.75	5.37	5.07	6.00	4.00

NOTE Nominal thread diameters shown in brackets are non-preferred.

^a See Appendix B.^b Threaded up to head only.^c See 11.2.^d See 9.3.