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BRITISH STANDARD

BS 1769:1951

Incorporating Amendments Nos. 1, 2, 3, 4, 5, 6 and 7

OBSOLESCENT
MAY 1985

Specification for

Unified black hexagon Bolts, screws, nuts — (UNC & UNF threads) — Heavy series

UDC 621.882.1.082.3

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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:—

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Air Ministry
Associated Offices Technical Committee
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British Chemical Plant Manufacturers' Association
British Compressed Air Society
British Electrical and Allied Manufacturers' Association*
British Engineers' Association*
British Internal Combustion Engine Manufacturers' Association*
British Iron and Steel Federation*
British Railways, The Railway Executive*
Crown Agents for the Colonies*
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Institution of Heating and Ventilating Engineers
Institution of Mechanical Engineers
Institution of Mechanical Engineers (Automobile Division)
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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 standard:—

Agricultural Engineers' Association
Black Bolt and Nut Association of Great Britain
Boilermakers' and Iron and Steel Shipbuilders' Society
Bright Bolt and Nut Manufacturers' Association
Bright Steel Bar Association
British Constructional Steelwork Association
British Cycle and Motor Cycle Manufacturers' and Traders' Union Ltd.
British Steel Wire Industries Association
Cold Headed Heat-treated Bolt Association
Council of British Manufacturers of Petroleum Equipment
General Post Office
Institution of Engineers and Shipbuilders in Scotland
Institution of Naval Architects
Metal Thread Screw Manufacturers' Association (Rolled Screw Section)
Metal Thread Screw Manufacturers' Association (Turned Screw Section)
National Coal Board
National Physical Laboratory
North East Coast Institution of Engineers and Shipbuilders
Oil Companies Materials Committee
Railway Carriage and Wagon Building Association
Society of British Aircraft Constructors Ltd.
Society of Motor Manufacturers and Traders Ltd.
Washer Manufacturers' Association

Amendments issued since publication

Amd. No.	Date	Comments
2141	March 1955	
2788	May 1957	
3620	January 1960	
4334	October 1961	
6002	December 1966	
692	February 1971	
1645	January 1975	Indicated by a sideline in the margin

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
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Foreword

This standard makes reference to the following British Standards:—

BS 919, *Screw thread gauge tolerances.*

BS 969, *Tolerances for plain limit gauges.*

BS 1580, *United Screw threads.*

This British Standard has been prepared under the authority of the Mechanical Engineering Industry Standards Committee in response to a request from the Inter-Services Engineering Standards Co-ordinating Committee.

The British Standard for Unified screw threads, BS 1580, having been completed and published in July, 1949, the Inter-Services Engineering Standards Co-ordinating Committee put forward a request for steps to be taken to secure similar agreement on the widths across flats and general dimensions of bolts, screws and nuts having Unified threads.

This request was considered by joint meetings of all Technical Committees of the British Standards Institution dealing with bolts and nuts, and proposals were submitted to Canada and the United States of America to serve as bases for discussion.

In due course, an invitation to attend a joint conference was received from the United States, and a United Kingdom delegation comprising representatives from the Services and from industry was appointed and attended a conference at which representatives from American and Canadian services, industries and standards bodies were present in New York in June, 1950.

It was agreed at the conference that there should be two series, a normal and a heavy series, based essentially on a selection from existing American standards. It was recognized that interchangeability depended on agreement on the widths across flats of the hexagons and provided this could be secured, it was considered permissible for each country to follow its own practice in regard to such points of detail as were not essential to interchangeability.

The report of the United Kingdom delegation was considered at a joint meeting of all the bolt and nut committees in September, 1950, and its recommendations were accepted, following which, draft standards were prepared and circulated widely throughout Government departments and industrial organizations; at the same time, the bolt and nut committees of the American standards bodies were preparing a revision of the American Standard which represented a considerable simplification of previous practice.

Finally, at a conference held at the British Standards Institution, London, in April, 1951, attended by delegates from the United Kingdom, the United States and Canada, agreement was reached on the basic dimensions, for the normal and heavy series and overall limits were established with the provision that individual countries might, if they so desired, apply smaller tolerances within those limits.

The Heavy Series bolts, screws and nuts to which this standard relates have hexagon sizes which are larger in proportion to the nominal diameter of thread than those in the Normal Series. The tolerances are comparatively wide, as is usual in the case of black bolts and nuts, but it is recognized that bolts and nuts of these dimensions may be required with a higher grade of finish for certain applications, and requirements are accordingly included in respect of bolts faced under the head and machined on the shank and machined nuts.

Normal Series bolts, screws and nuts from ¼ in. to 1 in. inclusive are dealt with in a companion standard BS 1768, "*Unified Precision bolts, screws and nuts — Normal Series*" and are made to closer tolerances in a variety of steels selected to provide a choice of closely controlled mechanical properties in the finished bolts and nuts.

NOTE The requirements for washers in this standard have been superseded by the publication of BS 3410, "*Metal washers for general engineering purposes*", to which reference should now be made.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 10 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.

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1 Scope

This British Standard relates to the Heavy Series of Unified black hexagon bolts, screws and nuts having Unified screw threads in a range of nominal sizes from ½ in. to 2 in. inclusive.

NOTE It is considered that the range of nominal sizes included in this standard is adequate for most of the applications for which this series is likely to be employed, but for the convenience of users requiring larger sizes, the formulae from which the proportions for bolt heads and nuts are derived are given in Appendix A.

2 Material

The steel used for the manufacture of bolts, screws and nuts shall be such that the products possess mechanical properties as follows:

Minimum tensile strength	Minimum elongation
26 tonf/in^2	17 %[a]
or 28 tonf/in^2	15 %[b]

[a] Corresponding value for $4 \times \sqrt{A} = 20$ %
[b] Corresponding value for $4 \times \sqrt{A} = 17$ %

In each case the minimum elongation is based on a gauge length of $5.65 \sqrt{\text{cross sectional area}}$.

In the case of hot forged bolts made to either of the above mechanical property groups the steel used shall not contain more than 0.06 percent each of sulphur and phosphorus.

The choice of material to provide either of the mechanical property groups referred to above will normally be at the option of the manufacturer, except where the purchaser specifically states which of the two he requires. Where the bolts, screws or nuts are required with mechanical properties different from those above the purchaser should specify the properties required in the enquiry or order.

3 Finish

Unified black hexagon bolts, screws, nuts and washers shall be neatly and cleanly made.

4 Dimensions

The dimensions and tolerances of Unified black hexagon bolts, screws, and nuts, Heavy Series, shall be in accordance with Table 1 to Table 3 inclusive, and Clauses **5** to **11**.

5 Length of bolts and screws

a) The nominal length of the bolts and screws shall be the distance from the underside of the head to the further end of the shank, the length of the machined point, if any, being regarded as part of the nominal length.

b) The permissible tolerance on the nominal length shall be as follows:—

Nominal length	Diameter	Tolerance on length
All lengths	Below 1 in. 1 in. and over	+ ⅛ in. – 0 + $^3/_{16}$ in. – 0

6 Ends of bolts and screws

The ends of bolts and screws may, at the option of the manufacturer, be finished with either a flat chamfer or a radius approximately equal to 1¼ times the nominal diameter of shank. When bolts and screws are made with rolled threads the lead formed at the end of the bolt or screw by the thread rolling operation may be regarded as providing the necessary chamfer to the end, no other machining operation being necessary.

7 Screw threads

a) *General.* For bolts and screws as forged or faced under the head, and for nuts as forged, the screw threads shall be Unified Coarse (UNC) in accordance with BS 1580, "*Unified screw threads*", as specified by the purchaser.

For bolts and screws faced under the head and machined on the shank and for machined nuts the screw threads shall be Unified Coarse (UNC), Unified Fine (UNF) in accordance with BS 1580, "*Unified screw threads*", as specified by the purchaser.

b) *Bolts and screws.* The screw threads may be either cut or rolled, at the option of the manufacturer, and shall conform to the limits and tolerances for Class 2A specified in BS 1580, "*Unified screw threads*."

c) *Nuts.* The screw threads shall conform to the limits and tolerances for Class 2B specified in BS 1580, "*Unified screw threads*."

8 Length of thread

a) *Bolts.* The length of thread on bolts shall be the distance from the end of the bolt (including any chamfer or radius) to the leading face of a nut which has been screwed as far as possible on to the bolt by hand and shall be in accordance with the following dimensions:—

Length of bolt	Length of thread
Up to and including 6 in.	2D + ¼ in.
Above 6 in.	2D + ½ in.

Bolts that are too short for minimum thread length shall be threaded as screws.

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b) *Screws.* Screws shall be threaded to permit of a nut being screwed by hand to within a distance from the underside of the head equal to twice the pitch.

c) The permissible tolerance on the length of thread for bolts of all lengths shall not exceed plus $^{3}/_{16}$ in. or 2½ threads, whichever is the greater.

9 Chamfering

a) *Bolts and screws.* Bolt heads and screw heads shall have a chamfer of approximately 30° on their upper faces. The lower or bearing face shall be machined only if specified on the order.

b) *Ordinary nuts.* Ordinary nuts shall have a chamfer of approximately 30° on one face and nuts up to and including 1½ in. nominal size may, at the option of the manufacturer, be similarly chamfered on both faces.

The bearing face of the nuts shall be machined only if specified on the order.

c) *Lock nuts.* Lock nuts shall have a chamfer of approximately 30° on one or both faces, at the option of the manufacturer.

Both faces of the nuts shall be machined only if specified on the order

d) *Slotted nuts.* Slotted nuts shall have a chamfer of approximately 30° on their upper faces, and nuts up to and including 1½ in. nominal size may, at the option of the manufacturer, be similarly chamfered on both faces.

The bearing faces of the nuts shall be machined only if specified on the order.

NOTE The option referred to in sub-clauses b, c and d above shall apply unless the purchaser in his enquiry and order specifically states that he requires the nuts to be "full bearing" or "double-chamfered".

Attention is drawn to the fact that these alternative methods of finishing the lower face of nuts are associated both with the nominal size and the particular method of manufacture. A request by the purchaser for a specific type of finish limits the manufacturing processes available, and it is therefore recommended that the purchaser avoids making a request for a specific type of finish unless circumstances fully justify it.

10 Machined nuts — squareness of thread to face

When the bearing face of the nut is machined the axis of the thread of the nut shall be square to the face of the nut within the tolerances given below.

The nut shall be screwed by hand on to a gauge having a truncated taper thread until the thread of the nut is tight on the thread of the gauge. A sleeve sliding on a parallel extension of the gauge, and which has a face of diameter equal to the minimum distance across flats of the nut and exactly at 90° to the axis of the gauge shall be brought into contact with the leading face of the nut. With the sleeve in this position it shall not be possible for a feeler gauge of thickness equal to the "squareness tolerance" to enter anywhere between the leading face of the nut and the face of the sleeve.
(See Figure 8.)

Tolerance on squareness of face of nuts.

Nominal diameter	Squareness tolerance
in.	in.
½	0.015
⅝	0.016
¾	0.019
⅞	0.023
1	0.023
1⅛	0.027
1¼	0.027
1⅜	0.030
1½	0.030
1¾	0.030
2	0.035

11 Diameter of shank of bolts

a) The maximum diameter of the unthreaded portion of the shank of bolts shall be as follows:—

Nominal diameter	Maximum diameter
in.	in.
½	0.530
⅝	0.675
¾	0.800
⅞	0.938
1	1.063
1⅛	1.188
1¼	1.313
1⅜	1.469
1½	1.594
1¾	1.844
2	2.094

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The shank diameter shall be checked by means of a plain ring gauge having a maximum thickness equal to the nominal diameter of the bolt, a minimum fillet radius in the bore equal to the maximum radius under the bolt head and an internal diameter equal to the maximum shank diameter as specified above. The bolt shall enter the ring gauge up to the head.

b) The unthreaded shank on bolts shall be machined only if stated by the purchaser in his order. When the shank is machined the following limits shall apply:—

Nominal size	Diameter of shank	
	Maximum	Minimum
in.	in.	in.
½	0.500 0	0.494 0
⅝	0.625 0	0.619 0
¾	0.750 0	0.744 0
⅞	0.875 0	0.869 0
1	1.000 0	0.994 0
1⅛	1.125 0	1.117 0
1¼	1.250 0	1.242 0
1⅜	1.375 0	1.367 0
1½	1.500 0	1.492 0
1¾	1.750 0	1.742 0
2	2.000 0	1.990 0

12 Marking

Bolts shall be identified as "Unified" by the incorporation of a circular recess in the upper surface of the head. Full details are given in Appendix B.

NOTE 1 The dimensions given in Appendix B are for the guidance of the manufacturer and shall not be regarded as part of the requirements of the standard.

NOTE 2 The identification of Unified bolts by the method specified above is necessary to cover the transition period during which this standard is becoming established; but at some future date, to be agreed later, marking will be discontinued.

NOTE 3 No provision is made in this standard for the marking of nuts. When an identification feature is considered desirable by the manufacturer or user, marking should take the form of an indented groove. Details will be found in Annex G of BS 1768, "*Unified Precision Hexagon bolts, screws and nuts (UNC and UNF threads) normal series.*"

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Table 1 — Unified hexagon head bolts and screws — heavy series (Third angle projection)

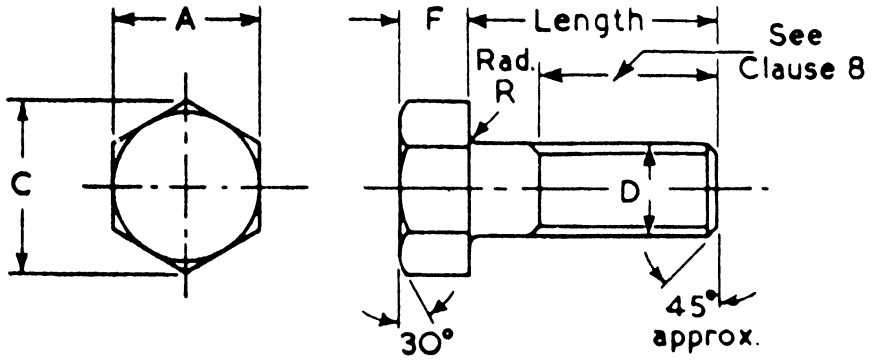

Figure 1 — Hexagon head bolt

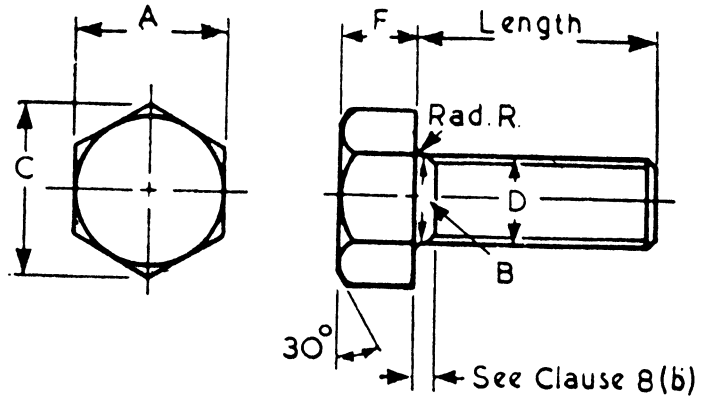

Figure 2 — Hexagon head screw

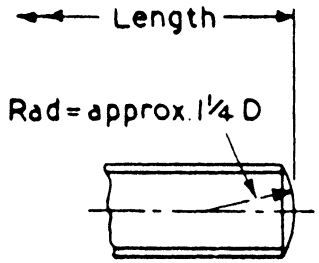

Figure 3 — Rounded end

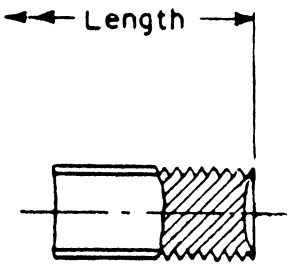

Figure 4 — Rolled thread end

Alternative types of end permissible on bolts and screws

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1	2	3	4	5	6	7	8	9	10	11
Nominal size D	No. of threads per inch		Width across flats A		Width across corners C	Thickness of head F				Radius under head R
						As forged		Faced		
	UNC	UNF	Max.	Min.	Max.	Max.	Min.	Max.	Min.	Max.
in.			in.	in.	in.	in	in	in	in	in.
½	13	20	0.875 0	0.855 0	1.01	0.426	0.386	0.426	0.386	1/32
⅝	11	18	1.062 5	1.037 5	1.23	0.522	0.478	0.522	0.478	1/16
¾	10	16	1.250 0	1.225 0	1.44	0.618	0.570	0.618	0.570	1/16
⅞	9	14	1.437 5	1.407 5	1.66	0.714	0.662	0.714	0.662	1/16
1	8	12	1.625 0	1.595 0	1.88	0.778	0.722	0.778	0.722	1/16
1⅛	7	12	1.812 5	1.782 5	2.09	0.874	0.814	0.874	0.814	⅛
1¼	7	12	2.000 0	1.955 0	2.31	0.970	0.906	0.970	0.906	⅛
1⅜[a]	6	12	2.187 5	2.142 5	2.53	1.065	0.997	1.065	0.997	⅛
1½	6	12	2.375 0	2.330 0	2.74	1.161	1.089	1.161	1.089	⅛
1¾	5	—	2.750 0	2.690 0	3.18	1.352	1.272	1.352	1.272	⅛
2	4½	—	3.125 0	3.065 0	3.61	1.482	1.394	1.482	1.394	⅛

[a] To be dispensed with wherever possible.

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Table 2 — Unified hexagon ordinary nuts and lock nuts — heavy series (Third angle projection)

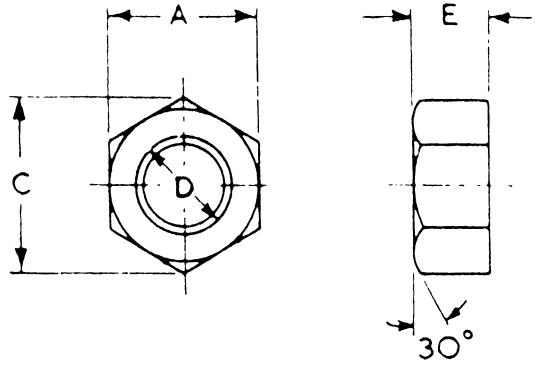

Figure 5 — Hexagon ordinary nut, full bearing

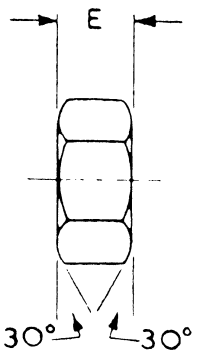

Figure 6 — Double chamfered

Alternative type permissible for sizes up to and including 1½ in. [see Clause **9** b)].

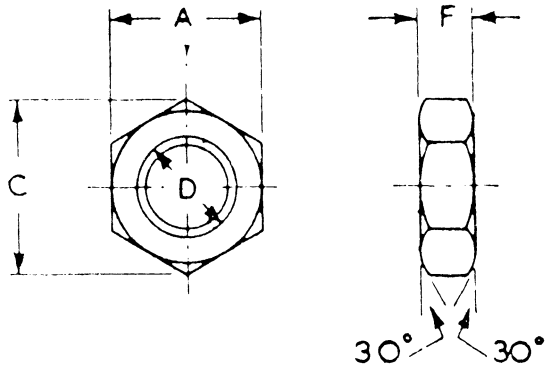

Figure 7 — Hexagon lock nut

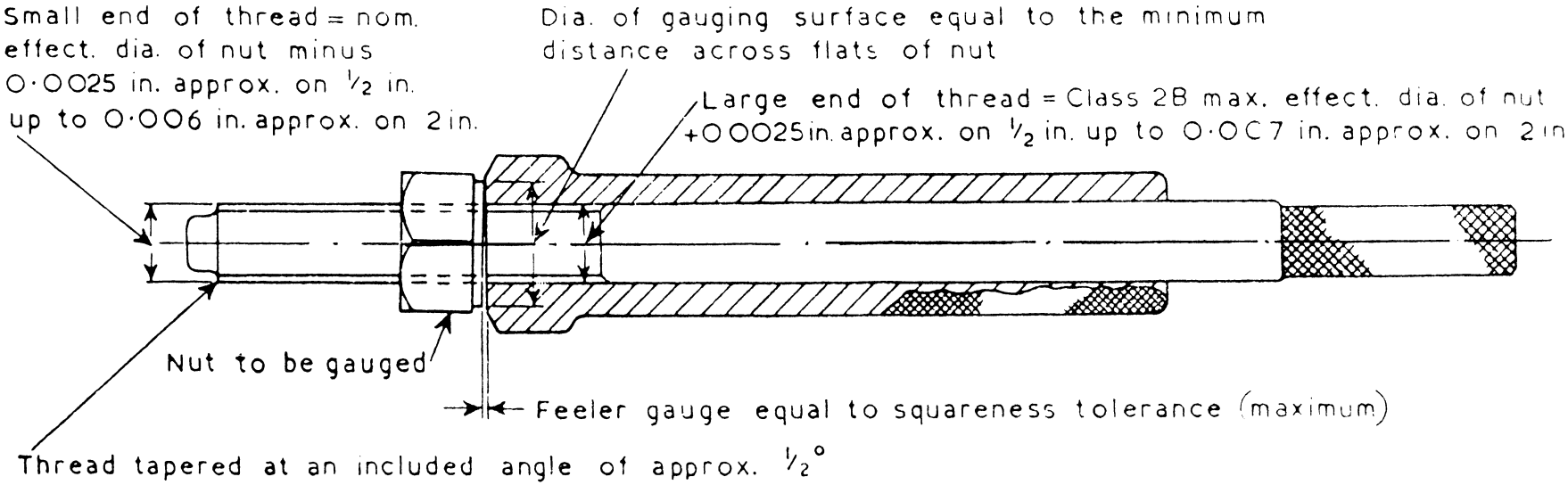

Figure 8 — Squareness tolerance gauge (see Clause **10**)

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1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nominal size D	No. of threads per inch		Width across flats A		Width across corners C	Thickness of ordinary nuts E				Thickness of lock nuts F			
						As forged		Faced one side		As forged		Faced both sides	
	UNC	UNF	Max.	Min.	Max.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
in.			in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
½	13	20	0.875 0	0.855 0	1.01	0.520	0.480	0.504	0.464	0.332	0.292	0.317	0.277
⅝	11	18	1.062 5	1.037 5	1.23	0.647	0.603	0.631	0.587	0.397	0.353	0.381	0.337
¾	10	16	1.250 0	1.225 0	1.44	0.774	0.726	0.758	0.710	0.462	0.414	0.446	0.398
⅞	9	14	1.437 5	1.407 5	1.66	0.901	0.849	0.885	0.833	0.526	0.474	0.510	0.458
1	8	12	1.625 0	1.595 0	1.88	1.028	0.972	1.012	0.956	0.590	0.534	0.575	0.519
1⅛	7	12	1.812 5	1.782 5	2.09	1.155	1.095	1.139	1.079	0.655	0.595	0.639	0.579
1¼	7	12	2.000 0	1.955 0	2.31	1.282	1.218	1.251	1.187	0.782	0.718	0.751	0.687
1⅜[a]	6	12	2.187 5	2.142 5	2.53	1.409	1.341	1.378	1.310	0.846	0.778	0.815	0.747
1½	6	12	2.375 0	2.330 0	2.74	1.536	1.464	1.505	1.433	0.911	0.839	0.880	0.808
1¾	5	—	2.750 0	2.690 0	3.18	1.790	1.710	1.759	1.679	1.040	0.960	1.009	0.929
2	4½	—	3.125 0	3.065 0	3.61	2.044	1.956	2.013	1.925	1.169	1.081	1.138	1.050

[a] To be dispensed with wherever possible.

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Table 3 — Unified hexagon slotted nuts — heavy series (Bearing face machined)
(Third angle projection)

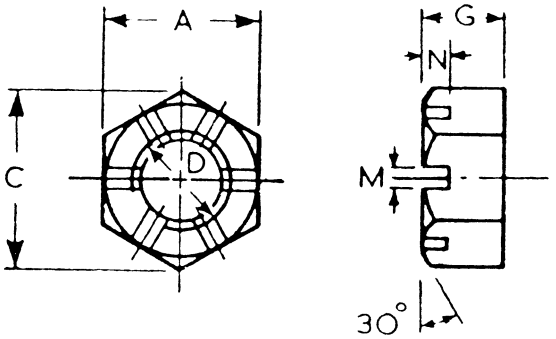

Figure 9 — Hexagon slotted nut, full bearing

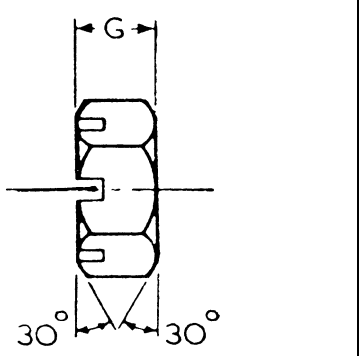

Figure 10 — Double chamfered

Alternative types of hexagon slotted nuts. See Clause **9** d) and Note.

1	2	3	4	5	6	7	8	9	10
Nominal size D	No. of threads per inch		Width across flats A		Width across corners C	Thickness G		Slot	
	UNC	UNF	Max.	Min.	Max.	Max.	Min	Width M	Depth N
in.			in.	in.	in.	in.	in.	in.	in.
½	13	20	0.875 0	0.855 0	1.01	0.504	0.464	5/32	5/32
⅝	11	18	1.062 5	1.037 5	1.23	0.631	0.587	3/16	7/32
¾	10	16	1.250 0	1.225 0	1.44	0.758	0.710	3/16	¼
⅞	9	14	1.437 5	1.407 5	1.66	0.885	0.833	3/16	¼
1	8	12	1.625 0	1.595 0	1.88	1.012	0.956	¼	9/32
1⅛	7	12	1.812 5	1.782 5	2.09	1.139	1.079	¼	11/32
1¼	7	12	2.000 0	1.955 0	2.31	1.251	1.187	5/16	⅜
1⅜[a]	6	12	2.187 5	2.142 5	2.53	1.378	1.310	5/16	⅜
1½	6	12	2.375 0	2.330 0	2.74	1.505	1.433	⅜	7/16
1¾	5	—	2.750 0	2.690 0	3.18	1.759	1.679	7/16	½
2	4½	—	3.125 0	3.065 0	3.61	2.013	1.925	7/16	9/16

[a] To be dispensed with wherever possible.

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Appendix A Formulae

NOTE The basic dimensions given in this standard arc in accordance with those for the equivalent bolts and nuts in the American Standard, but in certain instances smaller tolerances have been applied. The proportions for bolt and screw heads and nuts in intermediate sizes and sizes larger than 2 in. should be derived from the formulae extracted from the American Standard and given in the following table. Tolerances should not exceed those derived from the formulae.

Bolt and screw heads	Width across flats		Height of head			Width across corners (max.)
	Basic[a]	Tolerance minus	Nominal		Tolerance plus or minus	
			Nominal size D	Height of head		
	in.	in.	in.	in.	in.	in.
Faced	1½ D + ⅛	0.050D	½ to ⅞ 1 to 1⅞ 2 to 3	¾ D + $^{1}/_{32}$ ¾ D ¾ D + $^{1}/_{32}$	0.016D + 0.012 0.016D + 0.012 0.016D + 0.012	1.154 7 × Maximum width across flats

Nuts	Width across flats		Thickness			Width across corners (max.)
	Basic[a]	Tolerance minus	Nominal		Tolerance plus or minus	
			Nominal size D	Thickness		
	in.	in.	in.	in.	in.	in.
Ordinary						
As forged	1½D + ⅛	0.050D	All sizes	D	As for bolts. Sec above	
Faced, plain and slotted	1½D + ⅛	0.050D	¼ to 1⅛ 1¼ to 2 2¼ to 3 3¼ to 4	D – $^{1}/_{64}$ D – $^{1}/_{32}$ D – $^{3}/_{64}$ D – $^{1}/_{16}$	0.016D + 0.012 0.016D + 0.012 0.016D + 0.012 0.016D + 0.012	1.154 7 × Maximum width across flats
Lock						
As forged	1½D + ⅛	0.050D	¼ to 1⅛ 1¼ to 2¼ 2½ to 4	½D + $^{1}/_{16}$ ½D + ⅛ ½D + ¼	As for bolts. See above	
Faced	1½D + ⅛	0.050D	¼ to 1⅛ 1¼ to 2 2¼ 2⅛ to 3 3¼ to 4	½D + $^{3}/_{64}$ ½D + $^{3}/_{32}$ ½D + $^{5}/_{84}$ ½D + $1^{3}/_{64}$ ½D + $^{3}/_{16}$	0.016D + 0.012 0.016D + 0.012 0.016D + 0.012 0.016D + 0.012 0.016D + 0.012	

[a] The use of bolts having nominal diameters to an odd $^{1}/_{16}$ in. is deprecated, but in cases where it is unavoidable the above formula should be applied and the dimensions across flats adjusted to the nearest $^{1}/_{16}$ in. above.

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Appendix B Details of identification marking for unified hexagon bolts (see Clause **12**)

NOTE All dimensions given are for the guidance of the manufacturer and shall not be regarded as part of the requirements of the standard.

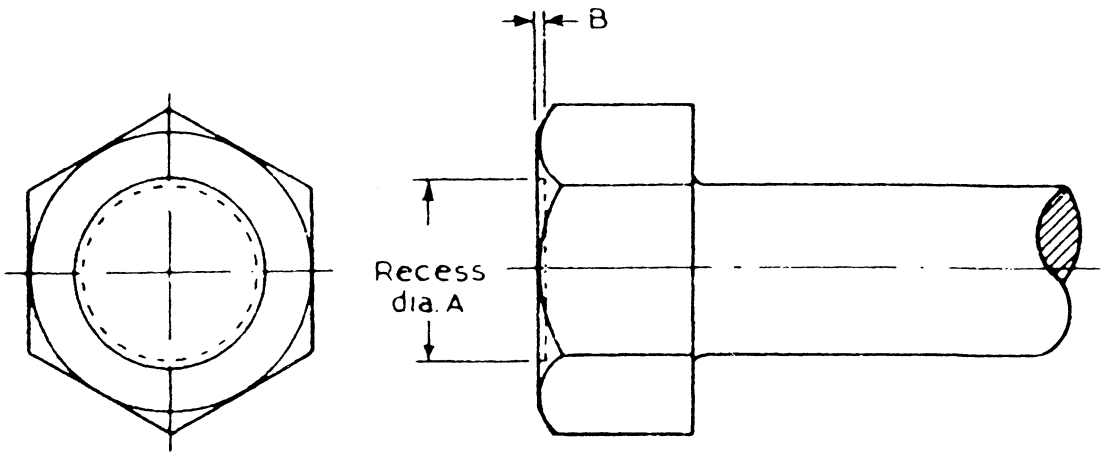

Figure 12 — Recessed bolt head

1	2	3	4	5
Nominal size D	**Recess**			
	Diameter A		**Depth B**	
	Max.	**Min.**	**Max.**	**Min.**
in.	in.	in.	in.	in.
½	$^{9}/_{16}$	½	0.020	0.010
⅝	$^{11}/_{16}$	⅝	0.025	0.015
¾	$^{13}/_{16}$	¾	0.025	0.015
⅞	$^{15}/_{16}$	⅞	0.025	0.015
1	$1^{1}/_{16}$	1	0.025	0.015
1⅛	$1^{3}/_{16}$	1⅛	0.030	0.020
1¼	$1^{5}/_{16}$	1¼	0.030	0.020
1⅜[a]	$1^{7}/_{16}$	1⅜	0.030	0.020
1½	$1^{9}/_{16}$	1½	0.030	0.020
1¾	$1^{13}/_{16}$	1¾	0.030	0.020
2	$2^{1}/_{16}$	2	0.030	0.020

[a] To be dispensed with wherever possible.

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