

ISO metric black hexagon bolts, screws and nuts — Specification

ICS 21.060.10; 21.060.20

Committees responsible for this British Standard

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Foreword

This new edition of BS 4190 has been prepared by Sub-Committee FME/9/6, General purpose fasteners and accessories, on behalf of Technical Committee FME/9, Bolts, nuts and accessories. It supersedes BS 4190:1967, which is withdrawn. This new edition embodies the text of amendment No. 1 (AMD 1778), amendment No. 2 (AMD 2690) and amendment No. 3 (AMD 8226).

The need for bolts, screws and nuts covered by this British Standard has been reviewed and it has been decided, in the interests of safety, to delete BS 4190:1967 Tables 14 and 18 (mechanical properties for bolts and screws) and to produce a new edition. In this edition, BS EN ISO 898-1 has been referred to as it reflects current thinking and practice of the mechanical properties for such products. This edition cross-refers to tables for mechanical properties of bolts, and brings the specification into line with BS EN ISO 898-1.

Annex A and Annex B are normative. Annex C is informative.

It has been assumed in the drafting of this British Standard that the execution of its provisions is entrusted to appropriately qualified and experienced people, for whose guidance it has been prepared.

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 24, an inside back cover and a back cover.

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1 Scope

This British Standard gives the general dimensions and tolerances of black hexagon bolts, screws and nuts with ISO metric threads, in diameters from 5 mm to 68 mm inclusive. Mechanical properties are included for steel bolts, screws and ordinary plain nuts, which may be produced by hot or cold forging at the option of the manufacturer. Dimensional requirements are included for bolts, screws and nuts finished black all over and for those which have partially machined finishes.

NOTE 1 The term “black” does not necessarily relate to the appearance of the products, since these may be of bright appearance or black in the finished state. The term implies the comparatively wider tolerances to which these products are usually made.

NOTE 2 Nuts with an effective height of less than $0.6d$ or a width across flats or outside diameter of less than $1.45d$, or both, are excluded from the mechanical requirements specified in this standard.

NOTE 3 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, further information is provided in Annex C.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to or revisions of any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 1916-1:1953, *Limits and fits for engineering — Part 1: Limits and tolerances.*

BS 3643-1:1981, *ISO metric screw threads — Part 1: Principles and basic data.*

BS 3643-2:1981, *ISO metric screw threads — Part 2: Limits and tolerances for coarse pitch series threads.*

BS 3692:2001, *ISO metric precision hexagon bolts, screws and nuts — Specification.*

BS 7345:1990 (ISO R 888), *Nominal lengths for bolts, screws and studs — Thread lengths for general purpose bolts.*

BS 7371-6:1998, *Coatings on metal fasteners — Part 6: Specification for hot dipped galvanized coatings.*

BS EN ISO 4042:2000, *Fasteners — Electroplated coatings.*

BS EN 10002-1:1990, *Tensile testing of metallic materials — Part 1: Method of test at ambient temperature.*

BS EN 10109-1:1996, *Metallic materials — Hardness test — Part 1: Rockwell test (scales A, B, C, D, E, F, G, H, K) and Rockwell superficial test (scales 15 N, 30 N, 45 N, 15 T, 30 T and 45 T).*

BS EN 10109-2:1996, *Metallic materials — Hardness test — Part 2: Verification of Rockwell hardness testing machines (scales A, B, C, D, E, F, G, H, K, N, T).*

BS EN 10109-3:1996, *Metallic materials — Hardness test — Part 3: Calibration of standardized blocks to be used for Rockwell hardness testing machines (scales A, B, C, D, E, F, G, H, K, N, T).*

BS EN 20286-1:1993, *ISO system of limits and fits — ISO system of limits and fits — Part 1: Specification for uses of tolerances, deviations and fits.*

BS EN 20286-2:1993, *ISO system of limits and fits — ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts.*

BS EN 20898-2:1994, *Mechanical properties of fasteners — Nuts with specified proof load values — Coarse thread.*

BS EN ISO 1234:1998, *Split pins.*

BS EN ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs.*

BS EN ISO 6506-1:1999, *Metallic materials — Brinell hardness test — Part 1: Test method.*

BS EN ISO 6506-2:1999, *Metallic materials — Brinell hardness test — Part 2: Verification of Brinell hardness testing machines.*

BS EN ISO 6506-3:1999, *Metallic materials — Brinell hardness test — Part 3: Calibration of reference blocks.*

BS EN ISO 6507-1:1998, *Metallic materials — Vickers hardness test — Part 1: Test method.*

BS EN ISO 6507-2:1998, *Metallic materials — Vickers hardness test — Part 2: Verification of testing machines.*

BS EN ISO 6507-3:1998, *Metallic materials — Vickers hardness test — Part 3: Calibration of reference blocks.*

3 Finish

The bolts, screws and nuts shall be cleanly finished, sound and free from defects.

NOTE 1 Table 1 gives the alternative categories of product finishes dealt with in this standard.

Table 1 — Product categories

Non-machined products (finished black all over)	Partially machined products
Black bolts	Bolts faced under head only Bolts faced under head and turned on shank
Black screws	Screws faced under head only
Black nuts	Nuts faced under head only Thin nuts (faced both sides)

NOTE 2 If the purchaser requires the bolts, screws or nuts to be coated, he should state the type of coating required in his enquiry and order. Where possible, reference should be made to the appropriate British Standard (e.g. BS 7371-6:1998 or BS EN ISO 4042:2000).

4 General dimensions

The general dimensions and tolerances of bolts, screws and nuts shall be in accordance with Table 2, Table 3, Table 4, Table 5, Table 6, Table 10, Table 11, Table 12 and Table 13 and clauses 5 to 10 inclusive.

5 Length of bolts and screws

5.1 The nominal length of the bolts and screws shall be the distance from the underside of the head to the extreme end of the shank, including any chamfer or radius.

NOTE The standard nominal lengths are given in Table 13.

5.2 The permissible tolerance on the nominal length shall be as given in Table 2.

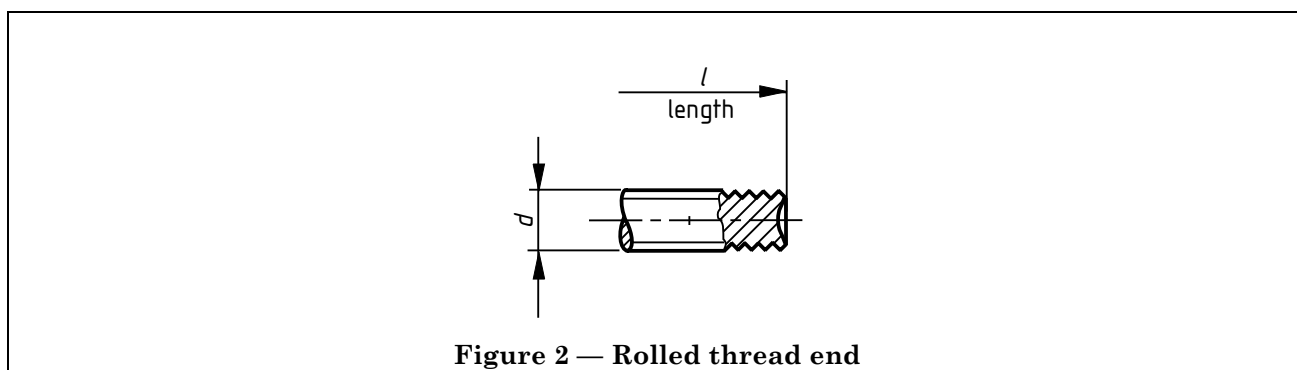
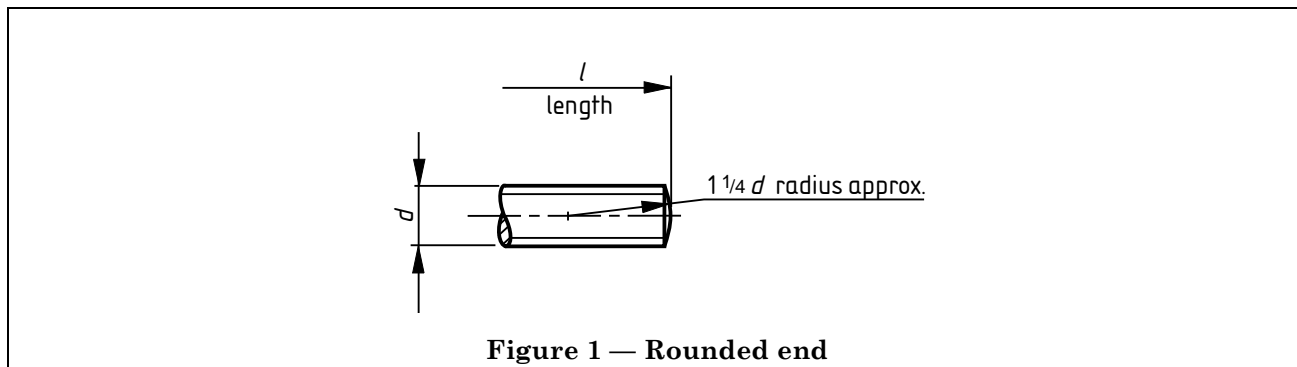
Table 2 — Tolerance on nominal length

Length		Bolts faced under head only or black bolts and screws	Screws faced under head only or bolts faced under head and turned on shank
Over	Up to and including		
10	18	±0.90	±0.55
18	30	±1.05	±0.65
30	50	±1.25	±0.80
50	80	±1.50	±0.95
80	120	±1.75	±1.10
120	180	±2.0	±1.25
180	250	±2.30	±1.45
250	315	±2.60	±1.60
315	400	±2.85	±1.80
400	500	±3.15	±2.00

Dimensions in millimetres

6 Ends of bolts and screws

The ends of bolts and screws may, at the option of the manufacturer, be finished with either a 45° chamfer to a depth slightly exceeding the depth of the thread or with a radius approximately equal to $1\frac{1}{4}$ times the nominal diameter of the shank. When bolts 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 with no other machining operation being necessary, and the end shall be reasonably square with the centre line of the shank. (See Figure 1 and Figure 2.)



7 Screw threads

7.1 General

The form of thread, diameters and associated pitches of standard ISO metric bolts, screws and nuts shall be in accordance with BS 3643-1.

NOTE Only coarse pitch series threads are specified in this standard.

7.2 Tolerances

The tolerances on the screw threads shall be in accordance with BS 3643-2, as detailed in Table 3.

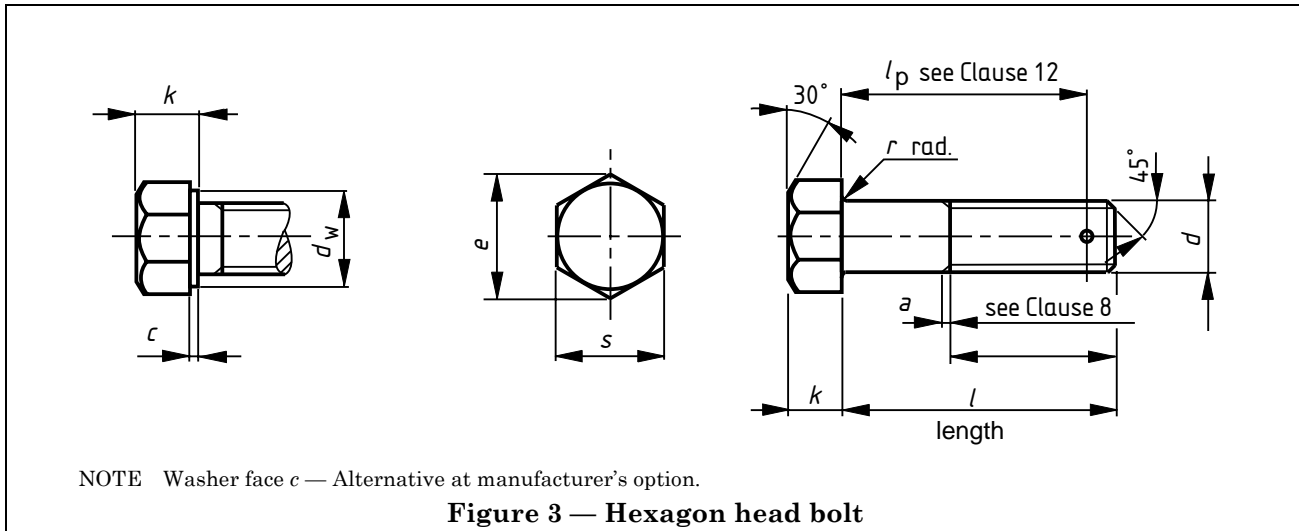
Table 3 — Thread tolerance classes

Product	Tolerance class
Black bolts Black screws Bolts faced under head only	8g
Screws faced under head only Bolts faced under head and turned on shank	6g
Nuts (black or faced)	7H

8 Length of thread

8.1 Bolts

8.1.1 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 screw ring gauge that has been screwed as far as possible on to the bolt by hand. (See Figure 3.)



8.1.2 The standard thread lengths shall be based on the formulae set out in Table 4 in accordance with BS 7375.

Table 4 — Thread lengths

Nominal length of bolt <i>l</i>	Length of thread <i>b</i>
Up to and including 125 mm	$2d + 6$ mm
Over 125 mm up to and including 200 mm	$2d + 12$ mm
Over 200 mm	$2d + 25$ mm

8.1.3 The length of thread runout shall not exceed the values given in Table 5 except where 8.1.4 applies.

Table 5 — Thread runout (bolts) and underhead distance (screws)

Dimensions in millimetres

Nominal size and thread diameter <i>d</i>	Thread runout on bolts <i>a</i> max.	Distance of ring gauge from underside of head on screws max.
M5	2	3
M6	2.5	4
M8	3	4.5
M10	3.5	5
M12	4	6
M16	5	7.5
M20	6	9
(M22)	6	9
M24	7	11
(M27)	7	11
M30	8	12
(M33)	8	12
M36	10	15
(M39)	10	15
M42	11	16
(M45)	11	16
M48	12	18
(M52)	12	18
M56	19	20
(M60)	19	20
M64	21	22
(M68)	21	22

NOTE Sizes in brackets are non-preferred.

8.1.4 In order to provide for structural applications, particularly shear connections where the thread is not allowed in the shear plane, bolts in the diameter range M12 to M30 inclusive up to 125 mm nominal length may alternatively have a shorter thread length, equal to $1\frac{1}{2}d$, only if the purchaser, in his enquiry and order, states that he requires this shorter thread length.

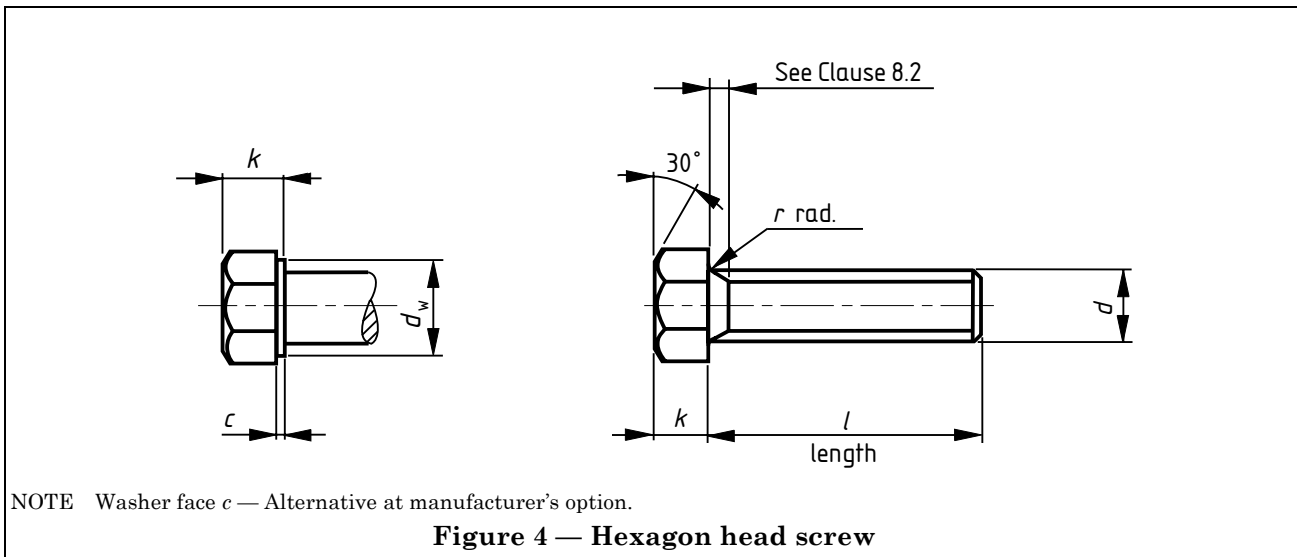
8.1.5 Bolts that are too short for minimum thread lengths shall be threaded as screws and shall be designated screws.

NOTE Guidance in this respect is given in Table 13.

The tolerances on bolt thread lengths shall be plus two pitches for all diameters.

8.2 Screws

Screws (see Figure 4) shall be threaded to permit a screw ring gauge being screwed by hand to within a distance from the underside of the head not exceeding the values given in Table 5.



9 Nuts — Squareness of thread to face

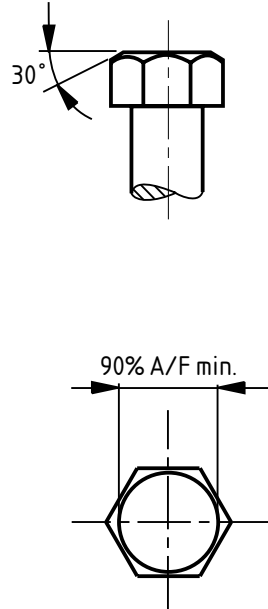
9.1 The bearing surface of unmachined (black) nuts shall be square to the axis of the thread of the nuts within 2° .

9.2 The bearing surface of machined nuts shall be square to the axis of the thread of the nuts within 1° .

10 Chamfering and facing

10.1 Bolts and screws

Bolt and screw heads shall be chamfered at an angle of approximately 30° on their upper faces. The diameter of the ring formed by the chamfer on the upper face of the bolt or screw head shall not be smaller than 90 % of the minimum across flats dimension. (See Figure 5.) The lower or bearing face shall be machined if specified by the purchaser. A washer face may be provided at the option of the manufacturer.



NOTE Attention is drawn to the fact that these alternative methods of finishing the lower face of the nut 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 such a request unless circumstances fully justify it.

Figure 5 — Head chamfering

10.2 Nuts

Hexagon nuts shall be chamfered at an angle of approximately 30° , on one or both faces at the option of the manufacturer. The diameter of the ring formed by the chamfer on the nut shall not be smaller than 90 % of the minimum across flats dimension (see Figure 5). The nuts shall be machined on the bearing side if specified by the purchaser unless the purchaser, in his enquiry or order, specifically states that nuts to be “full bearing” or “double chamfered” are required. (See Figure 6.)

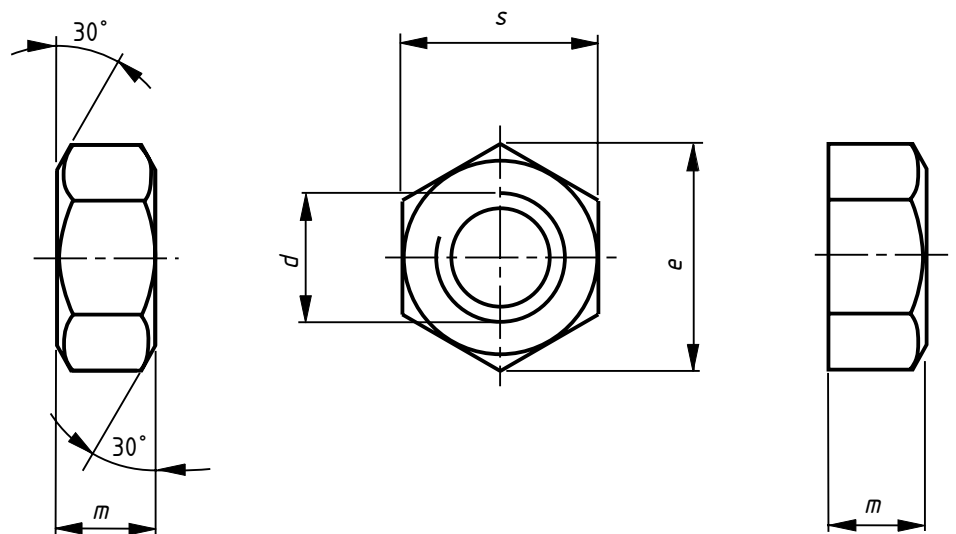


Figure 6 — Alternative types of normal thickness nut

10.3 Thin nuts

Thin nuts shall be chamfered at an angle of approximately 30° on both faces. (See Figure 7.) The diameter of the ring formed by the chamfer shall not be smaller than 90 % of the minimum across flats dimension. Thin nuts shall be machined on both faces.

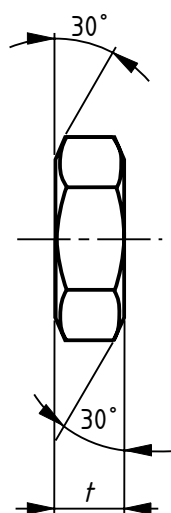


Figure 7 — Thin nut

11 Diameter of shank of bolt

11.1 The diameter of the unthreaded portion of the shank of the bolts shall be in accordance with the dimensions given in columns 3 and 4 of Table 10 for black bolts, columns 3 and 4 of Table 11 for bolts faced under head and columns 5 and 6 of Table 11 for bolts faced under head and turned on shank.

11.2 The unthreaded portion of the shank on bolts shall be machined only if required by the purchaser in his order.

12 Drilled bolts and split pin holes

12.1 Bolts with split pin holes shall be supplied only when specially ordered. The purchaser should state in his enquiry and order, dimension l_p (see Figure 3) and the diameter of hole required. Table 6 gives the tolerance on dimension l_p .

12.2 The split pin holes shall be drilled through the centre of the bolt, perpendicular to the axis.

Table 6 — Split pin holes

Dimensions in millimetres

Nominal size and thread diameter <i>d</i>	Tolerance on dimension l_p (see Figure 3)	
M5	-0	+0.8
M6	-0	+0.8
M8	-0	+0.8
M10	-0	+0.8
M12	-0	+0.8
M16	-0	+1.2
M20	-0	+1.2
(M22)	-0	+1.2
M24	-0	+1.2
(M27)	-0	+1.6
M30	-0	+1.6
(M33)	-0	+1.6
M36	-0	+1.6
(M39)	-0	+1.6
M42	-0	+1.6
(M45)	-0	+1.6
M48	-0	+1.6
(M52)	-0	+1.6
M56	-0	+1.6
(M60)	-0	+1.6
M64	-0	+1.6
(M68)	-0	+1.6
NOTE 1	Sizes in brackets are non-preferred.	
NOTE 2	For information, refer to BS EN ISO 1234.	

13 Strength grade designation system for steel bolts and screws

The strength grade designation system shall be in accordance with BS EN ISO 898-1. It consists of two figures; the first is one-hundredth of the minimum tensile strength in N/mm², and the second is one-hundredth of the ratio between the minimum yield stress and the minimum tensile strength, expressed as a percentage. Multiplication of these two figures will give the yield stress in newtons per square millimetre.

This is illustrated below for strength grade 4.6, in accordance with Table 7. Table 7 shows strength grade designations.

$\frac{1}{100}$ minimum tensile strength of 400 N/mm² gives the symbol “4”.

$\frac{1}{100}$ ratio $\frac{\text{yield strength}}{\text{minimum tensile strength}} \% = \frac{1}{100} \times \frac{240}{400} \times \frac{100}{1}$ gives the symbol “6”.

∴ Strength grade designation is “4.6”.

Table 7 — Strength grade designations for steel bolts and screws

Strength grade designation	4.6	4.8	6.8	8.8	10.9
Tensile strength					
R_m min. N/mm ²	400	400	600	800	1 000
Yield stress					
R_e min. N/mm ²	240	320	480	640	900

14 Material and manufacture of steel bolts and screws

14.1 Method of production

Bolts and screws may be produced by cold forging or hot forging at the discretion of the manufacturer.

14.2 Material grades

For various strengths grades, refer to BS EN ISO 898-1 Table 2.

15 Mechanical properties of bolts and screws

15.1 Steel bolts and screws shall meet the requirements for mechanical properties given in BS EN ISO 898-1 Table 3 for property classes 4.6, 4.8, 6.8, 8.8 and 10.9.

15.2 Mechanical testing shall be in accordance with clause 6 of BS EN ISO 898-1.

16 Strength grade designation system for steel nuts

16.1 The strength grade designation system for steel nuts shall be a number, which is one-hundredth of the specified proof load stress in N/mm². The proof load stress corresponds to the minimum tensile strength of the highest grade of bolt or screw with which the nut can be used (see Table 8), dictated by the method of manufacturer or the length of the production, or both.

Table 8 — Strength grade designations for steel nuts

Strength grade designation	4	6	8	10	12
Proof load stress N/mm ²	400	600	800	1 000	1 200

16.2 The mechanical properties of steel nuts are given in Table 14.

16.3 It is recommended that the grades of nut to be used with each grade of bolt or screw should be as shown in Table 9.

NOTE Nuts of a higher strength grade may be substituted for nuts of a lower strength grade.

Table 9 — Recommended bolt and nut combinations

Grade of bolt	4.6	4.8	6.8	8.8 ^a	8.8 ^a	10.9 ^a	10.9 ^a
Recommended grade of nut	4	4	6	8	10	10	12

^a When a thick protective coating is applied to a bolt of grade 8.8 or 10.9, which requires the nut thread to be overtapped, the next higher grade of nut should be used.

17 Material and manufacture of steel nuts

17.1 Method of production

Steel nuts may be produced by cold forging, hot forging or by turning from bar. The choice of method shall be left to the manufacturer.

17.2 Chemical composition

The chemical compositions of the steels from which nuts are made shall conform to those given in Table 15.

18 Mechanical properties of steel nuts (excluding thin nuts)

Steel nuts (excluding thin nuts) shall conform to the requirements for mechanical properties given in Table 14. The nuts shall withstand the proof load stress given in Table 14 when tested in accordance with Annex A. Nuts that are proof load tested shall have a hardness not in excess of the maximum given in Table 14. Nuts which are not proof load tested shall have a hardness not less than the minimum agreed between the purchaser and the supplier and not more than the maximum given in Table 14. The tests shall be made in accordance with Annex A.

19 Marking and identification

19.1 Bolts and screws

Marking of bolts and screws shall be in accordance with clause 9 of BS EN ISO 898-1.

19.2 Nuts

Nuts of grades 8 and 10 shall be marked in accordance with clause 9 of BS EN 20898-2:1994. Nuts of grades 4 and 6 will not normally be marked but, at the option of the manufacturer, nuts turned from hexagon bar may bear the ISO metric symbol "M", as illustrated in Figure 8.

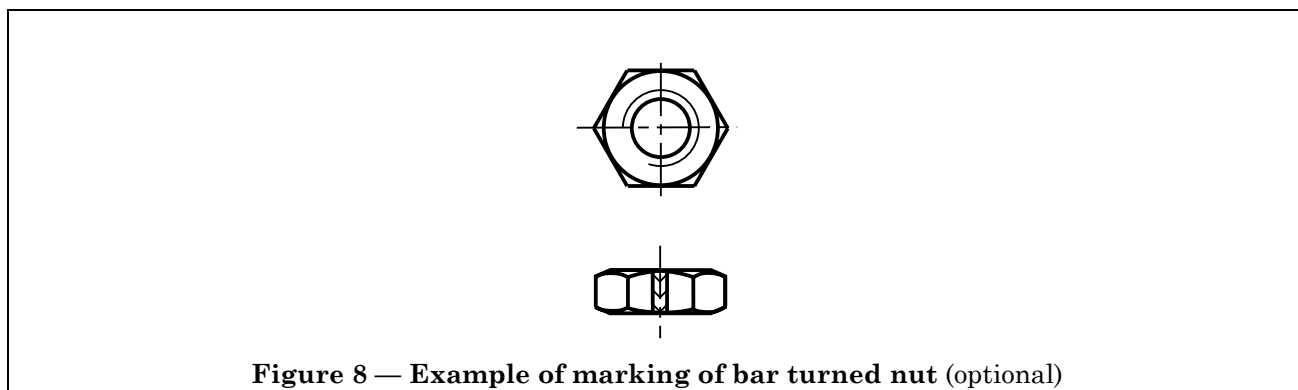


Figure 8 — Example of marking of bar turned nut (optional)

20 Inspection and testing

20.1 The manufacturer shall take the necessary steps to ensure that the requirements of this standard are fulfilled, but if, in addition, the purchaser desires the manufacturer to certify or demonstrate that the bolts, screws and nuts conform to this standard, the details and cost of any further inspection entailed shall be the subject of agreement between the purchaser and the manufacturer.

20.2 Tests for mechanical properties shall be in accordance with BS EN ISO 898-1 and Annex B.

21 Complete designation for the purpose of an enquiry or order

21.1 Information to be given

When designating ISO metric black bolts, screws and nuts for the purpose of an enquiry or order, the following information shall be given.

- a) General product description, e.g. “Black bolts”, “Screws faced under head only”, “Black nuts”, etc. as appropriate, in accordance with Table 1.
- b) The letter “M”, indicating that the product is ISO metric.
- c) The nominal size (thread diameter) of the product in millimetres.
- d) The nominal length in millimetres - this applies only to bolts and screws.
- e) The number of this British Standard, i.e. BS 4190.
- f) Details of the coating (if required), in accordance with the appropriate British Standard (e.g. BS 7371-6 or BS EN ISO 4042:2000).
- g) The strength grade.

21.2 Examples of information to be given

- a) Black bolts 10 mm diameter, 50 mm long, strength grade 4.6, would be designated:
“Black bolts M10 × 50, 4.6 to BS 4190”.
- b) Screws faced under head only, 8 mm in diameter, 20 mm long, strength grade 4.8, would be designated:
“Screws faced under head only, M8 × 20, 4.8 to BS 4190”.
- c) Black nuts 24 mm in diameter, galvanized, strength grade 4, would be designated:
“Black nuts M24, 4 to BS 4190, galvanized to BS 7371-6”.

21.3 Special requirements or options

Special requirements not dealt with in this standard are subject to agreement between the purchaser and the manufacturer. The user options referred to in the standard, relating to the thread length (clause 8) and the drilling of split pin holes (clause 12) shall be specifically set out (if required) by the purchaser in his enquiry and order.

Table 10 — Dimensions of ISO metric black hexagon head bolts and screws

(see Figure 3 and Figure 4)

Dimensions in millimetres

1	2	3	4	5	6	7	8	9	10	11	12	13
Nominal size and thread diameter <i>d</i>	Pitch of thread (coarse pitch series)	Diameter of unthreaded shank		Width across flats		Width across corners		Height of head		Radius under head	Washer face dia. (see note 2)	Depth of washer face
		<i>d</i>		<i>s</i>		<i>e</i>		<i>k</i>		<i>r</i>	<i>dw</i>	<i>c</i>
		max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
M5	0.8	5.48	4.52	8.00	7.64	9.2	8.63	3.875	3.125	0.35	6.8	0.5
M6	1	6.48	5.52	10.00	9.64	11.5	10.89	4.375	3.625	0.40	8.7	0.5
M8	1.25	8.58	7.42	13.00	12.57	15.0	14.20	5.875	5.125	0.8	11.5	0.6
M10	1.5	10.58	9.42	17.00	16.57	19.6	18.72	7.45	6.55	0.8	15.5	0.6
M12	1.75	12.70	11.30	19.00	18.48	21.9	20.88	8.45	7.55	1.25	17.2	0.6
M16	2	16.70	15.30	24.00	23.16	27.7	26.17	10.45	9.55	1.25	22.0	0.8
M20	2.5	20.84	19.16	30.00	29.16	34.6	32.95	13.90	12.10	1.78	27.7	0.8
(M22)	2.5	22.84	21.16	32.00	31.00	36.9	35.03	14.90	13.10	1.78		
M24	3	24.84	23.16	36.00	35.00	41.6	39.55	15.90	14.10	1.78	33.2	0.8
(M27)	3	27.84	26.16	41.00	40.00	47.3	45.20	17.90	16.10	2.28		
M30	3.5	30.84	29.16	46.00	45.00	53.1	50.85	20.05	17.95	2.28	42.7	0.8
(M33)	3.5	34.00	32.00	50.00	49.00	57.7	55.37	22.05	19.95	2.28		
M36	4	37.00	35.00	55.00	53.80	63.5	60.79	24.05	21.95	2.7	51.1	0.8
(M39)	4	40.00	38.00	60.00	58.80	69.3	66.44	26.05	23.95	2.7		
M42	4.5	43.00	41.00	65.00	63.80	75.1	72.09	27.05	24.95	2.8	60.8	1.0
(M45)	4.5	46.00	44.00	70.00	68.80	80.8	77.74	29.05	26.95	3.3		
M48	5	49.00	47.00	75.00	73.80	86.6	83.39	31.05	28.95	3.8	70.8	1.0
(M52)	5	53.20	50.80	80.00	78.80	92.4	89.04	34.25	31.75	4.7		
M56	5.5	57.20	54.80	85.00	83.60	98.1	94.47	36.25	33.75	4.9		
(M60)	5.5	61.20	58.80	90.00	88.60	103.9	100.12	39.25	36.75	4.9		
M64	6	65.20	62.80	95.00	93.60	109.7	105.77	41.25	38.75	4.9		
(M68)	6	69.20	62.80	100.00	98.60	115.5	111.42	44.25	41.75	4.9		

NOTE 1 Sizes in brackets are non-preferred.

NOTE 2 Calculations of washer face diameters for other sizes may be obtained from the following formulae:

1) for sizes up to and including M20:

$$\text{washer face diameter (min.)} = s_{\text{min.}} - \text{IT16};$$

2) for sizes over M20:

$$\text{washer face diameter (min.)} = s_{\text{min.}} - \text{IT17};$$

where

IT stands for standard tolerance, and belongs to the ISO series of tolerances (see BS EN 20286-1 and BS EN 20286-2).

Table 11 — Dimensions of ISO metric hexagon head bolts and screws faced under head or faced under head and turned on shank

(see Figure 3 and Figure 4)

Dimensions in millimetres

1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nominal size and thread diameter d	Pitch of thread (coarse pitch series)	Diameter of unthreaded shank d				Width across flats s		Width across corners e		Height of head K		Radius under head R	
		Faced under head		Faced under head and turned on shank		max.	min.	max.	min.	max.	min.	max.	min.
		max.	min.	max.	min.								
M6	1	6.48	5.52	6.00	5.82	10.00	9.64	11.5	10.89	4.24	3.76	0.4	0.25
M8	1.25	8.58	7.42	8.00	7.78	13.00	12.57	15.0	14.20	5.74	5.26	0.8	0.4
M10	1.5	10.58	9.42	10.00	9.78	17.00	16.57	19.6	18.72	7.29	6.71	0.8	0.4
M12	1.75	12.70	11.30	12.00	11.73	19.00	18.48	21.9	20.88	8.29	7.71	1.25	0.6
M16	2	16.70	15.30	16.00	15.73	24.00	23.16	27.7	26.17	10.29	9.71	1.25	0.6
M20	2.5	20.84	19.16	20.00	19.67	30.00	29.16	34.6	32.95	13.35	12.65	1.78	0.8
(M22)	2.5	22.84	21.16	22.00	21.67	32.00	31.00	36.9	35.03	14.35	13.65	1.78	0.8
M24	3	24.84	23.16	24.00	23.67	36.00	35.00	41.6	39.55	15.35	14.65	1.78	0.8
(M27)	3	27.84	26.16	27.00	26.67	41.00	40.00	47.3	45.20	17.35	16.65	2.28	1.0
M30	3.5	30.84	29.16	30.00	29.67	46.00	45.00	53.1	50.85	19.42	18.58	2.28	1.0
(M33)	3.5	34.00	32.00	33.00	32.61	50.00	49.00	57.7	55.37	21.42	20.58	2.28	1.0
M36	4	37.00	35.00	36.00	35.61	55.00	53.80	63.5	60.79	23.42	22.58	2.7	1.0
(M39)	4	40.00	38.00	39.00	38.61	60.00	58.80	69.3	66.44	25.42	24.58	2.7	1.0
M42	4.5	43.00	41.00	42.00	41.61	65.00	63.80	75.1	72.09	26.42	25.58	2.8	1.2
(M45)	4.5	46.00	44.00	45.00	44.61	70.00	68.80	80.8	77.74	28.42	27.58	3.3	1.2
M48	5.0	49.00	47.00	48.00	47.61	75.00	73.80	86.6	83.39	30.42	29.58	3.8	1.6
(M52)	5.0	53.20	50.80	52.00	51.54	80.00	78.80	92.4	89.04	33.50	32.50	4.7	1.6
M56	5.5	57.20	54.80	56.00	55.54	85.00	83.60	98.1	94.47	35.50	34.50	4.9	2.0
(M60)	5.5	61.20	58.80	60.00	59.54	90.00	88.60	103.9	100.12	38.50	37.50	4.9	2.0
M64	6	65.20	62.80	64.00	63.54	95.00	93.60	109.7	105.77	40.50	39.50	4.9	2.0
(M68)	6	69.20	66.80	68.00	67.54	100.00	98.60	115.5	111.42	43.50	42.50	4.9	2.0

NOTE Sizes in brackets are non-preferred.

Table 12 — Dimensions of ISO metric hexagon nuts and hexagon thin nuts

(see Figure 6 and Figure 7)

Dimensions in millimetres

1 Nominal size and thread diameter	2 Pitch of thread (coarse pitch series)	3 Width across flats <i>s</i>		4 Width across corners <i>e</i>		5 Thickness of nut <i>m</i>				6 Thickness of thin nut (faced both sides) <i>t</i>	
		max.	min.	max.	min.	7 Black		8 Faced one side		max.	min.
						max.	min.	max.	min.		
M5	0.8	8.00	7.64	9.20	8.63	4.375	3.625	4.0	3.52	—	—
M6	1	10.00	9.64	11.50	10.89	5.375	4.625	5.00	4.52	—	—
M8	1.25	13.00	12.57	15.00	14.20	6.875	6.125	6.50	5.92	5.00	4.52
M10	1.5	17.00	16.57	19.60	18.72	8.45	7.55	8.00	7.42	6.00	5.52
M12	1.75	19.00	18.48	21.90	20.88	10.45	9.55	10.00	9.42	7.00	6.42
M16	2	24.00	23.16	27.70	26.17	13.55	12.45	13.00	12.30	9.00	8.42
M20	2.5	30.00	29.16	34.60	32.95	16.55	15.45	16.00	15.30	9.00	8.42
(M22)	2.5	32.00	31.00	36.90	35.03	18.55	17.45	18.00	17.30	10.00	9.42
M24	3	36.00	35.00	41.60	39.55	19.65	18.35	19.00	18.16	10.00	9.42
(M27)	3	41.00	40.00	47.30	45.20	22.65	21.35	22.00	21.16	12.00	11.30
M30	3.5	46.00	45.00	53.10	50.85	24.65	23.35	24.00	23.16	12.00	11.30
(M33)	3.5	50.00	49.00	57.70	55.37	26.65	25.35	26.00	25.16	14.00	13.30
M36	4	55.00	53.80	63.50	60.79	29.65	28.35	29.00	28.16	14.00	13.30
(M39)	4	60.00	58.80	69.30	66.44	31.80	30.20	31.00	30.00	16.00	15.30
M42	4.5	65.00	63.80	75.10	72.09	34.80	33.20	34.00	33.00	16.00	15.30
(M45)	4.5	70.00	68.80	80.80	77.74	36.80	35.20	36.00	35.00	18.00	17.30
M48	5	75.00	73.80	86.60	83.39	38.80	37.20	38.00	37.00	18.00	17.30
(M52)	5	80.00	78.80	92.40	89.04	42.80	41.20	42.00	41.00	20.00	19.16
M56	5.5	85.00	83.60	98.10	94.47	45.80	44.20	45.00	44.00	—	—
(M60)	5.5	90.00	88.60	103.90	100.12	48.80	47.20	48.00	47.00	—	—
M64	6	95.00	93.60	109.70	105.77	51.95	50.05	51.00	49.80	—	—
(M68)	6	100.00	98.60	115.50	111.42	54.95	53.05	54.00	52.80	—	—

NOTE Sizes shown in brackets are non-preferred.

Table 13 — Standard nominal lengths and preferred sizes of ISO metric black hexagon bolts and screws

Dimensions in millimetres

Nominal size and thread diameter <i>d</i>	Standard nominal lengths <i>l</i>																										
	12	14	16	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	100	110	120	130	140	150	160	170	180
M5	X	X	X	X	X	X	X	X	X																		
M6	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
M8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
M10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M12			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M16				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M20				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M22)					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M24						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M27)							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M30								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M33)									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M36										X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M39)											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M42												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M45)													X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M48														X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M52)															X	X	X	X	X	X	X	X	X	X	X	X	X
M56																X	X	X	X	X	X	X	X	X	X	X	X
(M60)																	X	X	X	X	X	X	X	X	X	X	X
M64																		X	X	X	X	X	X	X	X	X	X
(M68)																			X	X	X	X	X	X	X	X	X

NOTE 1 Sizes shown in brackets are non-preferred.

NOTE 2 The inclusion of dimensional data in this standard is not intended to imply that all of the products described are stock production sizes. The purchaser is requested to consult with the manufacturer concerning lists of stock production sizes.

Table 13 — Standard nominal lengths and preferred sizes of ISO metric black hexagon bolts and screws (concluded)

Dimensions in millimetres

Nominal size and thread diameter <i>d</i>	Standard nominal lengths <i>l</i>														
	190	200	220	240	260	280	300	325	350	375	400	425	450	475	500
M5	Screws and bolts														
M6															
M8															
M10	X														
M12	X	X	X	X	X	X									
M16	X	X	X	X	X	X									
M20	X	X	X	X	X	X									
(M22)	X	X	X	X	X	X									
M24	X	X	X	X	X	X									
(M27)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M33)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M36	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M39)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M42	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M45)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M48	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M52)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M56	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M60)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
M64	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
(M68)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

NOTE 1 Sizes shown in brackets are non-preferred.

NOTE 2 The inclusion of dimensional data in this standard is not intended to imply that all of the products described are stock production sizes. The purchaser is requested to consult with the manufacturer concerning lists of stock production sizes.

Table 14 — Mechanical properties of steel nuts

Strength grade designation	4	6	8	10	12	
Proof load stress ^a N/mm ²	400	600	800	1 000	1 200	All nuts other than those exempted by agreement between the purchaser and manufacturer ^b
Brinell hardness (HB) max.	302	302	302	353	375	All nuts
Rockwell hardness ^c (HRC) max.	30	30	30	36	39	All nuts
Vickers hardness (HV) max.	310	310	310	370	395	All nuts

^a The proof load is calculated by multiplying the proof load stress by the tensile stress area of the bolt.
^b Nuts with a specified proof load in excess of 500 000 N (see Table 16) may be exempted from proof load testing. Such nuts shall meet the minimum hardness as agreed between the purchaser and the manufacturer.
^c The conversion from Brinell hardness into Rockwell hardness has been calculated according to BS EN ISO 6506-1, -2 and -3 and BS EN 10109-1.

Table 15 — Chemical composition of steel nuts

Strength grade designation	Chemical composition limits (check analysis)		
	Carbon max. %	Phosphorus max. %	Sulfur max. %
4 and 6 (see note)	0.50	0.110	0.150
8	0.58	0.060	0.150
10	0.58	0.048	0.058

NOTE 1 Free cutting steel may be used only by special agreement between the purchaser and the supplier. In such cases, the following maximum phosphorus, sulfur and lead contents are permissible: phosphorus, 0.12 %, sulfur, 0.34 %, lead, 0.35 %.
NOTE 2 Alloying elements may be added if necessary to develop the mechanical properties of the nuts stipulated in Table 14.

Table 16 — Proof loads for steel nuts (coarse pitch series)

Nominal size of nut	Tensile stress area of bolt	Strength grade designation				
		4	6	8	10	12
		Stress under proof load N/mm ²				
		400	600	800	1 000	1 200
mm	mm ²	Proof load N				
M5	14.2	5 680	8 500	11 400	14 800	17 000
M6	20.1	8 040	12 000	16 000	20 000	24 000
M8	36.6	14 600	22 000	29 000	36 500	43 000
M10	58.0	23 200	35 000	46 000	58 000	69 500
M12	84.3	33 700	50 500	67 000	84 000	100 000
M16	157	62 800	94 000	125 000	157 000	188 000
M20	245	98 000	147 000	196 000	245 000	294 000
M22	303	121 000	182 000	242 000	303 000	364 000
M24	353	141 000	212 000	282 000	353 000	423 000
M27	459	184 000	276 000	367 000	459 000	550 000
M30	561	224 000	336 000	448 000	561 000	673 000
M33	694	278 000	416 000	555 000	694 000	833 000
M36	817	327 000	490 000	653 000	817 000	980 000
M39	976	390 000	585 000	780 000	976 000	1 170 000
M42	1 120	448 000	672 000	896 000	1 120 000	1 340 000
M45	1 300	520 000	780 000	1 400 000	1 300 000	1 560 000
M48	1 470	588 000	882 000	1 180 000	1 470 000	1 760 000
M52	1 760	704 000	1 060 000	1 410 000	1 760 000	2 110 000
M56	2 030	812 000	1 220 000	1 620 000	2 030 000	2 440 000
M60	2 360	944 000	1 420 000	1 890 000	2 360 000	2 830 000
M64	2 680	1 072 000	1 610 000	2 140 000	2 680 000	3 220 000
M68	3 060	1 224 000	1 840 000	2 450 000	3 060 000	3 670 000

NOTE 1 Proof load = stress under proof load × tensile stress area divided by 1 000.
NOTE 2 For stress under proof load, see Table 16.
NOTE 3 Nuts with a specified proof load above 500 000 N may be exempted from proof load testing; see clause 18 and Table 14.

Annex A (normative)

Testing of mechanical properties of steel nuts (see clause 18)

A.1 Proof load test

A.1.1 The proof load test consists of applying the relevant proof load given in Table 16, which was obtained from the proof load stress given in Table 14.

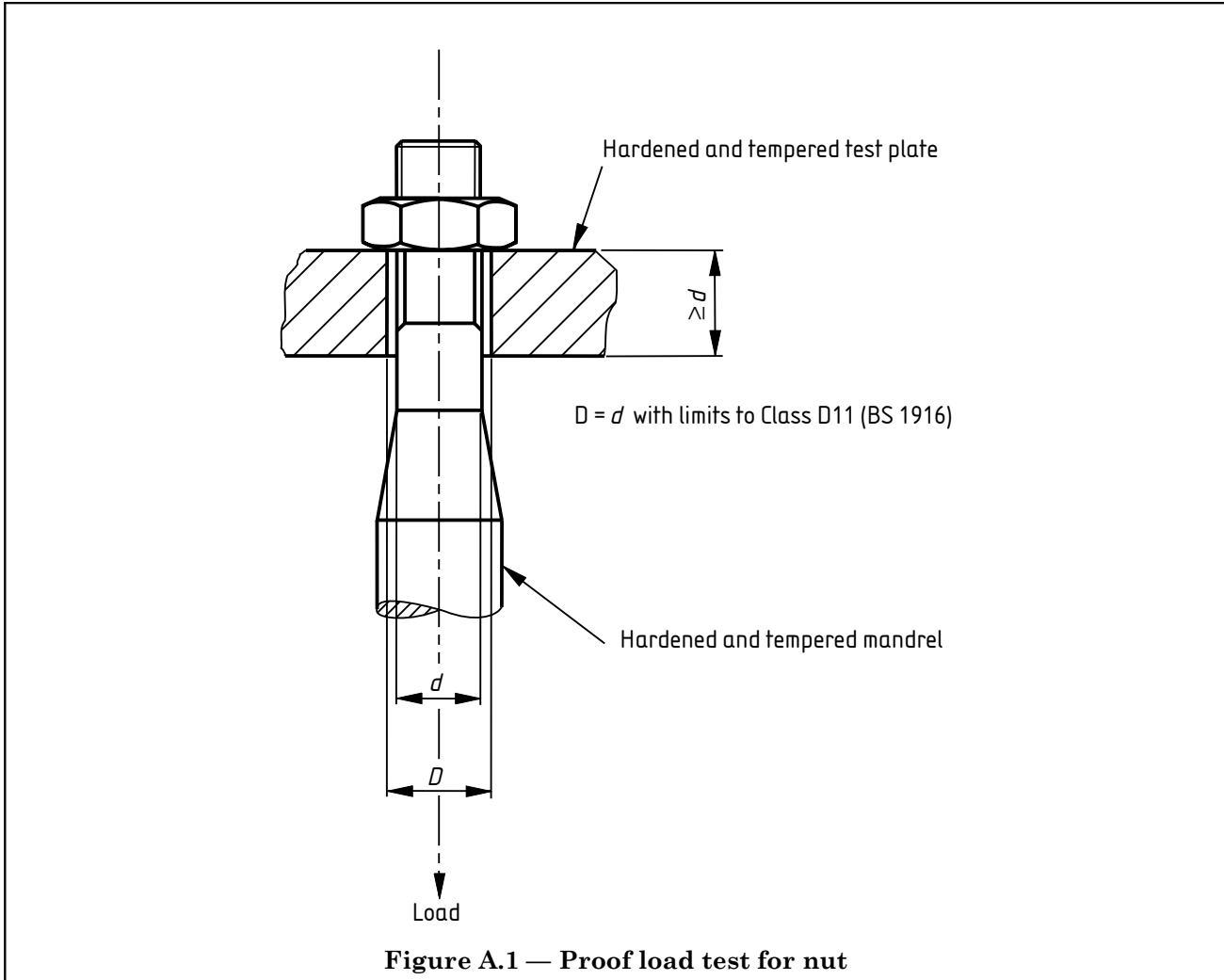
A.1.2 Assemble the nut to be tested on a hardened and tempered mandrel as shown in Figure B.1 and apply the specified load in an axial direction.

A.1.3 The nut should withstand this load without failure by stripping or rupture, and should be removable by the fingers after the load is released. If the threads of the mandrel are damaged during the test, the test shall be discarded.

NOTE It may be necessary to use a manual wrench to start the nut in motion. Such wrenching is permissible providing it is restricted to a half turn and the nut is then removable by the fingers following initial loosening.

A.1.4 Hardened mandrel: The mandrel shall have a hardness of not less than Rockwell C45. The thread shall be tolerance class $5h$ except that the tolerance on the major diameter shall be the last quarter of the $6g$ range on the minimum material side.

A.1.5 Hardened test plate: The test plate shall have a hardness of not less than Rockwell C38.



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A.2 Hardness tests on nuts

A.2.1 Brinell, Rockwell or Vickers hardness may be determined. Apply the impression to the top or bottom face of the nut, or on the side of the nut.

A.2.2 Perform a Brinell hardness test in accordance with the requirements of BS EN ISO 6506-1, -2 and -3.

A.2.3 Perform a Rockwell hardness test in accordance with the requirements of BS EN 10109-1, -2 and -3.

A.2.4 Perform a Vickers hardness test in accordance with the requirements of BS EN ISO 6507-1, -2 and -3.

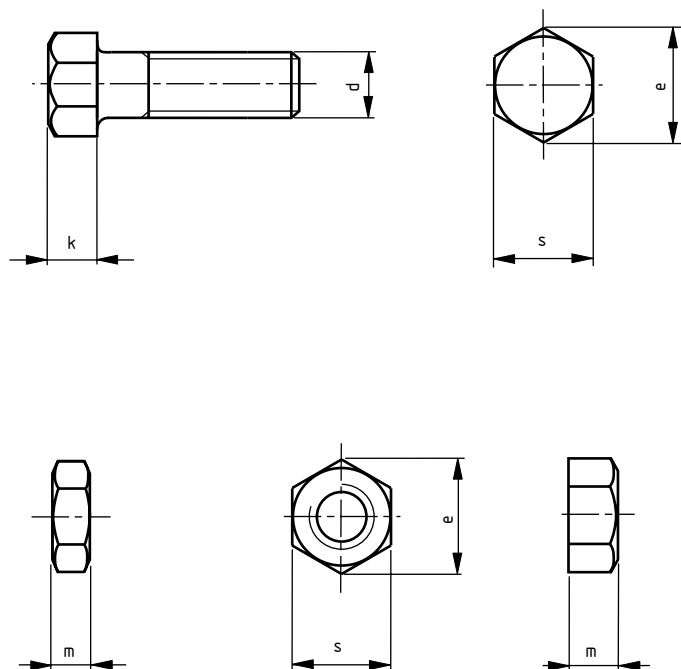
Annex B (normative)**Sizes greater than 68 mm diameter**

Although it is considered that the range of nominal sizes included is adequate for most of the applications for which this series is employed, information is provided in Table B.1 for the convenience of users requiring larger sizes.

Table B.1 — Sizes greater than 68 mm diameter

Dimensions in millimetres

Nominal size and thread diameter <i>d</i>	Width across flats <i>s</i>		Width across corners <i>e</i> min.	Nominal height of head <i>k</i>	Nominal thickness of nut <i>m</i>
	max.	min.			
M72	105	103.60	117.07	45	58
(M76)	110	108.60	122.72	48	61
M80	115	113.60	128.37	50	64
(M85)	120	118.60	134.02	54	68
M90	130	128.40	145.09	57	72
(M95)	135	133.40	150.74	60	76
M100	145	143.40	162.04	63	80
(M105)	150	148.40	167.69	66	84
M110	155	153.40	173.34	69	88
(M115)	165	163.40	184.64	72	92
(M120)	170	168.40	190.29	76	96
M125	180	178.40	201.59	79	100
(M130)	185	183.15	206.96	82	104
M140	200	198.15	223.91	88	112
M150	210	208.15	235.21	95	120



Annex C (informative)**Manufacturers' recommended range of sizes**

NOTE Depending on popular demand, the sizes in Table C.1 and Table C.2 may, from time to time, be revised. The purchaser is advised to consult the supplier concerning current production sizes.

Table C.1 — Hexagon head bolts

Nominal length mm	Nominal diameter						
	M6	M8	M10	M12	M16	M20	M24
20	●						
25	●	●	●	●			
30	●	●	●	●	○		
35	●	●	●	●	○	○	
40	●	●	●	●	○	○	
45	●	●	●	●	○	○	
50	●	●	●	●	⊕	○	
55			●	●	⊕	○	
60	●	●	●	●	⊕	⊕	○
65			●	●	⊕	⊕	
70	●	●	●	●	⊕	⊕	⊕
75			●	●	⊕	⊕	
80	●	●	●	●	⊕	⊕	⊕
90	●	●	●	●	⊕	⊕	⊕
100	●	●	●	●	⊕	⊕	⊕
110				●	●	●	●
120		●	●	●	●	●	●
130					●	●	
140			●	●	●	●	●
150						●	
160				●	●	●	●
180				●	●	●	●
200				●	●	●	●
220				●	●	●	●
260				●	●	●	●
300				●	●	●	●

● Standard thread lengths.
○ Short thread lengths.
⊕ Available in standard and short thread lengths.

Table C.2 — Hexagon head screws

Nominal length mm	Nominal diameter					
	M6	M8	M10	M12	M16	M20
16	●	●				
20	●	●	●			
25	●	●	●	●		
30	●	●	●	●	●	
35	●	●	●	●	●	
40	●	●	●	●	●	●
45	●	●	●	●	●	●
50	●	●	●	●	●	●
60	●	●	●	●	●	●
70	●	●	●	●	●	●
80			●	●	●	●
100			●	●	●	●

● Standard thread lengths.

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