

**SPECIFICATION FOR
ISO METRIC
PRECISION HEXAGON BOLTS
SCREWS AND NUTS**

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 31st August, 1967.

First published, 19th December, 1963.

First revision, August, 1967.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 9,000, fully indexed and with a note of the contents of each, will be found in the BSI Catalogue which may be purchased from BSI Sales Department. The Catalogue may be consulted in many public libraries and similar institutions.

This standard makes reference to the following British Standards:

- BS 18. Methods for tensile testing of metals.**
- BS 131. Methods for notched bar tests.**
 - Part 3. The Charpy U-notch impact test on metals.**
- BS 240. Method for Brinell hardness test.**
 - Part 1. Testing of metals.**
- BS 427. Method for Vickers hardness test.**
 - Part 1. Testing of metals.**
- BS 891. Method for Rockwell hardness test.**
 - Part 1. Testing of metals.**
- BS 1574. Split cotter pins**
- BS 1916. Limits and fits for engineering.**
- BS 3382. Electroplated coatings on threaded components.**
 - Part 1. Cadmium on steel components.**
 - Part 2. Zinc on steel components.**

Amendment Slip No.1, published 30 April 1975
to BS 3692 : 1967

ISO metric precision hexagon bolts,
screws and nuts

Revised text

Foreword. In the second paragraph, delete and substitute text as follows:

Delete

Substitute

ISO Draft Recommendation DR 911	ISO Recommendation R 898/1
ISO Draft Recommendation DR 947	ISO Recommendation R 272
ISO Draft Recommendation DR 950	ISO Recommendation R 888
ISO Draft Recommendation DR 952	ISO Recommendation R 733
ISO Draft Recommendation DR 987	ISO Recommendation R 885

Throughout the standard, delete all references to ISO Draft Recommendations and substitute the appropriate references as given in the above list.

1. Scope. In the second line of the Note to 1.2, delete '1.5d' and substitute '1.45d'.

4.1 Nominal length. In the Note, add the following sentence:

'The manufacturers' recommended range of sizes is given in Appendix K.'

11.6 Decarburization. In the first paragraph, insert '8.8,' immediately before '10.9,'.

19.1 Information to be given. Delete item (3) and substitute the following:

'(3) The nominal size (thread diameter), if a fine pitch is also to be included in the designation, e.g. M10 × 1.25.'

New appendix. Insert the following as Appendix K:

APPENDIX K

MANUFACTURERS' RECOMMENDED RANGE OF SIZES

TABLE 23. HEXAGON HEAD BOLTS, STEEL, GRADE 8.8

Nominal length mm	Nominal diameter							
	M5	M6	M8	M10	M12	M16	M20	M24
25	•	•						
30	•	•	•					
35	•	•	•	•				
40	•	•	•	•	•			
45	•	•	•	•	•	•		
50	•	•	•	•	•	•		
55		•	•	•	•	•	•	
60		•	•	•	•	•	•	
65		•	•	•	•	•	•	•
70		•	•	•	•	•	•	•
75		•	•	•	•	•	•	•
80			•	•	•	•	•	•
90			•	•	•	•	•	•
100			•	•	•	•	•	•
110				•	•	•	•	•
120				•	•	•	•	•
130					•	•	•	•
140						•	•	•
150						•	•	•
160						•	•	•

TABLE 24. HEXAGON HEAD SCREWS, STEEL, GRADE 8.8

Nominal length mm	Nominal diameter							
	M5	M6	M8	M10	M12	M16	M20	M24
10	•							
12	•	•						
16	•	•	•					
20	•	•	•	•				
25	•	•	•	•	•			
30	•	•	•	•	•	•		
35		•	•	•	•	•		
40		•	•	•	•	•	•	
45			•	•	•	•	•	
50		•	•	•	•	•	•	•
55				•	•	•	•	
60			•	•	•	•	•	•
70				•	•	•	•	
80				•	•	•	•	

NOTE: Depending on popular demand, the sizes stated in Tables 23 and 24 may, from time to time, be revised. The purchaser is advised to consult the supplier concerning current stock production sizes.

Amendment No. 2
published and effective from 15 November 1994
to British Standard BS 3692 : 1967

ISO metric precision hexagon bolts,
screws and nuts
metric units

Obolescence

Insert the following paragraph before clause 1.

‘Obsolescent (by Amendment No. 2).

The need for bolts, 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 24014 : 1992 and BS EN 24032 : 1992 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.

As the BS EN standards have mechanical properties in accordance with BS EN 20898-1 : 1992 and BS EN 20898-2 : 1992, which reflect more up to date thinking and are different to the mechanical properties specified in BS 3692 : 1967, it is recommended that every effort should be made to utilize the BS EN series of fastener standards for any new designs’.

- BS 3382.** Electroplated coatings on threaded components.
Part 3. Nickel or nickel plus chromium on steel components.
Part 4. Nickel or nickel plus chromium on copper and copper alloy (including brass) components.
Part 5. Tin on copper and copper alloy (including brass) components.
Part 6. Silver on copper and copper alloy (including brass) components.
Part 7. Thicker platings for threaded components.
- BS 3580.** Guide to design considerations on the strength of screw threads.
- BS 3643.** ISO metric screw threads.
Part 1. Thread data and standard thread series.
Part 2. Limits and tolerances for coarse pitch series threads.

British Standards are revised, when necessary, by the issue either of amendment slips or of revised editions. It is important that users of British Standards should ascertain that they are in possession of the latest amendments or editions.

The following BSI references relate to the work on this standard:
Committee references MEE/60 and MEE/60/1
Draft for comment 67/1366

CONTENTS

	Page
Co-operating organizations	8
Foreword	9

SPECIFICATION

1. Scope	10
2. Finish	10
3. General dimensions	11
4. Length of bolts and screws	11
5. Ends of bolts and screws	11
6. Screw threads	11
7. Length of thread	12
8. Angularity and eccentricity of bolts, screws and nuts	12
9. Chamfering, washer facing and counter-sinking	13
10. Strength grade designation system for steel bolts and screws	13
11. Material and manufacture of steel bolts and screws	14
12. Mechanical properties of steel bolts and screws	16
13. Strength grade designation system for steel nuts	16
14. Material and manufacture of steel nuts	17
15. Mechanical properties of steel nuts	17
16. Drilled bolts with split pin holes	17
17. Marking and identification	17
18. Inspection and testing	19
19. Complete designation for the purpose of an enquiry or order	19

APPENDICES

A. Recommended gauge for checking squareness of thread to face of nut	34
B. Chemical composition of steel bolts and screws	35
C. Chemical composition of steel nuts	37
D. Testing of mechanical properties of steel bolts and screws	38
E. Testing of mechanical properties of steel nuts	44

	Page
F. Examples of the marking of bolts, screws and nuts	46
G. Association of bolt and screw lengths and diameters	48
H. Basis for the derivation of tolerances	51
J. BSI policy statement on screw threads and the metric system	57
K. Manufacturers' recommended range of sizes	59

TABLES

1. Basis for standard thread lengths	12
2. Strength grade designations of steel bolts and screws	14
3. Strength grade designations of steel nuts	16
4. Recommended bolt and nut combinations	16
5. Split pin holes	18
6. ISO metric precision hexagon bolts and screws	22
7. ISO metric precision hexagon nuts and thin nuts	24
8. ISO metric precision hexagon slotted nuts and castle nuts	26
9. Tolerances on the standard nominal lengths of bolts and screws	28
10. Mechanical properties of steel bolts and screws	29
11. Acceptance tests for steel bolts and screws	30
12. Mechanical properties of steel nuts	31
13. Proof loads for steel bolts and screws (coarse pitch series)	32
14. Proof loads for steel nuts (coarse pitch series)	33
15. Chemical composition of steel bolts and screws	36
16. Chemical composition of steel nuts	37
17. Dimensions for wedge loading test	41
18. Angle dimensions for head soundness test	42
19. Strength grade designation marking of bolts and screws	46
20. Strength grade designation marking of nuts	47
21. Preferred standard sizes of ISO metric precision hexagon bolts and screws	48

	Page
22. Standard thread lengths and the shortest lengths designated as bolts, related to diameter	50
23. Hexagon head bolts, steel, Grade 8.8	59
24. Hexagon head screws, steel, Grade 8.8	60

FIGURES

1. Depth of de-carburization on steel bolts and screws	15
2. Hexagon head bolt, washer faced	22
3. Hexagon head screw, washer faced	22
4. Full bearing head	22
5. Rounded end	22
6. Rolled thread end	22
7. Normal thickness nut	24
8. Thin nut	24
9. Enlarged view of nut countersink	24
10. Slotted nut. Sizes M4 to M39 only. (Six slots)	26
11. Castle nut. Sizes M12 to M39 only. (Six slots)	26
12. Castle nut. Sizes M42 to M68 only. (Eight slots)	26
13. Nut squareness gauge	34
14. Test piece	38
15. Application of proof load to full size bolt	40
16. Wedge loading of full size bolt	41
17. Head soundness test	42
18. Proof load test for nut	44
19. Examples of marking of forged products	46
20. Example of marking of bar turned product	46
21. Examples of marking of forged nuts	47
22. Example of marking of bar turned nut	47
23. Widths across flats (bolts and screws)	51
24. Widths across corners (bolts and screws)	51
25. Heights of heads	52
26. Shank diameter of full size bolts	52
27. Nominal lengths	52
28. Thread lengths	52
29. Eccentricity of the head	53
30. Angularity of the head	53
31. Eccentricity between shank and thread	53
32. Eccentricity of split pin hole	53

	Page
33. Widths across flats (nuts)	54
34. Widths across corners (nuts)	54
35. Thicknesses of nuts	54
36. Dimensions of slots	55
37. Eccentricity of the hexagon	55
38. Eccentricity of the slots	56
39. Angularity of the nuts	56

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
 Association of Consulting Engineers
 Association of Mining Electrical and Mechanical Engineers
 Board of Trade
 British Chemical Plant Manufacturers' Association
 British Compressed Air Society
 *British Electrical and Allied Manufacturers' Association
 British Gear Manufacturers' Association
 British Internal Combustion Engine Manufacturers' Association
 *British Iron and Steel Federation
 British Mechanical Engineering Federation
 British Pump Manufacturers' Association
 Crown Agents for Oversea Governments and Administrations
 *Electricity Council, the Central Electricity Generating Board and the Area Boards in England and Wales
 *Engineering Equipment Users' Association
 Gas Council
 Institute of Marine Engineers
 Institution of Civil Engineers
 Institution of Gas Engineers
 Institution of Heating and Ventilating Engineers
 Institution of Mechanical Engineers
 Institution of Mechanical Engineers (Automobile Division)
 *Institution of Production Engineers
 *Locomotive and Allied Manufacturers' Association of Great Britain
 London Transport Board
 *Machine Tool Trades Association
 Ministry of Defence
 Ministry of Labour (H.M. Factory Inspectorate)
 Ministry of Power
 Ministry of Public Building and Works
 *Ministry of Technology—National Engineering Laboratory
 Ministry of Transport
 *National Coal Board
 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
 Black Bolt and Nut Association of Great Britain
 British Bolt, Nut, Screw and Rivet Federation
 British Railways Board
 British Constructional Steelwork Association
 British Cycle and Motor Cycle Industries Association Ltd.
 Council of British Manufacturers of Petroleum Equipment
 Electronic Engineering Association
 Fasteners and Turned Parts Institute
 Institute of Iron and Steel Wire Manufacturers
 Ministry of Defence, Navy Department
 Ministry of Technology
 Post Office
 Precision Bolt and Nut Institute
 Rolled Thread Screw Association
 Scientific Instrument Manufacturers' Association
 Society of Motor Manufacturers and Traders Limited
 Telecommunication Engineering and Manufacturing Association
 Washer Manufacturers' Association of Great Britain
 Individual manufacturers

BRITISH STANDARD SPECIFICATION FOR ISO METRIC PRECISION HEXAGON BOLTS, SCREWS AND NUTS

FOREWORD

This revised British Standard has been prepared under the authority of the Mechanical Engineering Industry Standards Committee to supersede BS 3692: 1963, 'Dimensions of ISO metric precision hexagon bolts, screws and nuts', which was based on ISO Recommendation R 272, 'Hexagon bolts and nuts', published at that time but containing only details of the basic widths across flats, height of head and thicknesses of bolts and nuts up to 39 mm diameter.

Since the publication of the first edition of this standard, ISO Technical Committee ISO/TC 2 'Bolts, nuts and accessories', has prepared the following recommendations and draft recommendations upon which this revision has been based:

ISO Recommendation R 288,	'Slotted and castle nuts with metric thread'.
ISO Recommendation R 898/1,	'Mechanical properties of fasteners', Part 1, 'Bolts, screws and studs'.
ISO Recommendation R 272,	'Hexagon bolts and nuts, metric series, widths across flats, height of head, thickness of nut'. (Supplement to ISO/R 272.)
ISO Recommendation R 888,	'Nominal lengths for bolts, screws and studs, thread lengths for general purpose bolts'.
ISO Recommendation R 733,	'Hexagon bolts and nuts, metric series, tolerances on widths across flats, widths across corners'.
ISO Recommendation R 885,	'Bolts and screws, radii under the head of general purpose bolts and screws'.

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. Agreement has yet to be reached internationally on several items such as the tolerances on nominal lengths and thread lengths and concentricity, but wherever possible information on these matters has been provided, based on proposals at present before ISO/TC 2, for adoption.

To summarize, the 1963 edition specified only the dimensions of ISO metric precision hexagon bolts, screws and nuts from 3 mm to 39 mm diameter. This

edition extends the range from 1.6 mm to 68 mm diameter and provides much additional information, particularly in respect of the mechanical properties of fasteners, based on ISO proposals and draft recommendations.

*As altered
April 1975*

NOTE 1. 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'.

NOTE 2. For the BSI policy statement on screw threads, see Appendix J.

SPECIFICATION

1. SCOPE

1.1 This British Standard gives the general dimensions and tolerances of precision hexagon bolts, screws and nuts with ISO metric threads in diameters from 1.6 mm to 68 mm inclusive.

1.2 Mechanical properties are given only in respect of carbon or alloy steel bolts, screws and nuts, which are not to be used for special applications, such as those requiring weldability, corrosion resistance or ability to withstand temperatures above 300°C or below -50°C.

*As altered
April 1975*

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

1.3 The dimensional requirements of this standard also apply to non-ferrous and stainless steel bolts, screws and nuts.

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, further information in relation to the derivation of tolerances is provided in Appendix H.

2. FINISH

2.1 Steel precision bolts, screws and nuts are normally supplied with the following finishes:

2.1.1 *Heat-treated bolts and screws.* Components heat-treated after manufacture are customarily dull black, although the manufacturer may machine some of the surfaces of the larger size bolts and screws after heat treatment.

2.1.2 *Bright finished bolts and screws.* This term is used to describe bolts and screws which are finished bright on all surfaces or which have a finish on the hexagon, produced by bright drawing.

2.1.3 *Nuts.* These may be bright on all surfaces or dull black when heat-treated.

2.1.4 *Other finishes.* If the purchaser requires bolts, screws or nuts of steel (or other material) to be coated, he should state the type of coating required in

his enquiry and order and it is recommended that reference be made to BS 3382*, in this respect.

2.2 If steel bolts, screws or nuts are required finished bright all over, the purchaser should state this in his enquiry and order.

3. GENERAL DIMENSIONS

The bolts, screws and nuts shall conform to the general dimensions given in Tables 1, 6, 7 and 8 and in Clauses 4 to 9 inclusive.

4. LENGTH OF BOLTS AND SCREWS

4.1 Nominal length. The nominal length of a bolt or screw is the distance from the underside of the head to the extreme end of the shank including any chamfer or radius.

The standard nominal lengths are given in Table 9.

NOTE. Preferred nominal lengths of bolts and screws in association with diameters, are given in Appendix G. The manufacturers' recommended range of sizes is given in Appendix K.

*As altered
April 1975*

4.2 Tolerance on length. The tolerance on the nominal length shall be as given in Table 9.

5. 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 depths of thread or a radius approximately equal to 1 ¼ times the nominal diameter of the shank. When bolts and screws are made with rolled threads the lead formed at the end of the bolt by the rolling operation may be regarded as providing the necessary chamfer to the end, no other machining operation being necessary, and the end shall be reasonably square with the centre line of the shank (see Figs. 5 and 6).

6. SCREW THREADS

6.1 General. The form of thread and diameters and associated pitches of standard ISO metric bolts, screws and nuts are in accordance with BS 3643: Part 1†.

6.2 Tolerances. The screw threads shall be made to the tolerances for the medium class of fit (6H/6g) as specified in BS 3643 : Part 2†.

NOTE. If a purchaser requires other classes of fit or fine pitch threads then this shall be the subject of agreement between the purchaser and the manufacturer.

* 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'.

7. LENGTH OF THREAD

7.1 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 screw ring gauge which has been screwed as far as possible on to the bolt by hand.

7.1.1 The standard thread lengths, as given in Table 22, are based on the formulae given in Table 1.

7.1.2 The length of thread runout shall not exceed the values given in Column 3 of Table 6.

TABLE 1. BASIS FOR STANDARD THREAD LENGTHS

Nominal length of bolt l	Length of thread b
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

7.1.3 Bolts that are too short for minimum thread lengths shall be threaded as screws and shall be designated screws. Guidance in this respect is given in Appendix G.

7.2 Tolerances. The tolerances on bolt thread lengths shall be plus two pitches for all diameters, as given in Table 22.

The eccentricity of the thread relative to the shank of bolts shall not exceed the values given in Column 19 of Table 6.

7.3 Screws. Screws 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 two and a half times the pitch for diameters up to and including 52 mm and three and a half times the pitch for diameters over 52 mm, in accordance with Column 3 of Table 6.

8. ANGULARITY AND ECCENTRICITY OF BOLTS, SCREWS AND NUTS

8.1 The axis of the thread of the nut shall be square to the face of the nut subject to the 'squareness tolerance' given in Column 9 of Table 7, which is equivalent to an out of squareness of $\pm 1^\circ$.

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 at exactly 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 Appendix A).

8.2 The hexagon flats of bolts, screws and nuts shall be square to the bearing face, and the angularity of the head shall be within the limits of $90^\circ \pm 1^\circ$ (see Appendix H).

8.3 The eccentricity of the hexagon flats of nuts relative to the thread diameter shall not exceed the values given in Column 10 of Table 7.

8.4 The eccentricity of the head relative to the width across flats and eccentricity between the shank and thread of bolts and screws shall not exceed the values given in Columns 18 and 19, respectively, of Table 6.

9. CHAMFERING, WASHER FACING AND COUNTERSINKING

9.1 Bolts and screws. Bolt and screw heads shall have a chamfer of approximately 30° on their upper faces and, at the option of the manufacturer, a washer face or full bearing face on the underside.

The option referred to in the preceding paragraph shall apply unless the purchaser in his enquiry or order specifically states that he requires one of the alternatives available.

Attention is drawn to the fact that these alternative methods of finishing the underside of bolt and screw heads are associated with both 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.

9.2 Nuts

9.2.1 Nuts shall have a chamfer of approximately 30° on both faces.

9.2.2 Nuts shall be countersunk at an included angle of $120 \pm 10^\circ$ at both ends of the thread. The diameter of the countersink shall not exceed the nominal major diameter of the thread plus 0.13 mm up to and including 12 mm diameter, and plus 0.25 mm above 12 mm diameter. This stipulation does not apply to slotted, castle or thin nuts.

10. STRENGTH GRADE DESIGNATION SYSTEM FOR STEEL BOLTS AND SCREWS

Being in accordance with ISO/R 898/1* the strength grade designation system for steel bolts and screws consists of two figures, the first is one tenth of the minimum tensile strength in kgf/mm², and the second is one tenth of the ratio

*As altered
April 1975*

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