

Specification for

High strength friction grip bolts and associated nuts and washers for structural engineering metric series —

Part 1: General Grade

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Electronic Engineering Association	Washer Manufacturers' Association of Great Britain
Fasteners and Turned Parts Institute	Individual Manufacturer

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Foreword

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 21, *Pipe threads*.

BS 240, *Method for Brinell hardness test*.

BS 240-1, *Testing of metals*.

BS 427, *Method for Vickers hardness test*.

BS 427-1, *Testing of metals*.

BS 891, *Method for Rockwell hardness test*.

BS 891-1, *Testing of metals*.

BS 1580, *Unified screw threads*.

BS 1916, *Limits and fits for engineering*.

BS 3643, *ISO metric screw threads*.

BS 3643-1, *Thread data and standard thread series*.

BS 3643-2, *Limits and tolerances for coarse pitch series threads*.

BS....¹⁾, *The use of high strength friction grip bolts in structural engineering*.

BS-1, *General grade metric series*.

This British Standard has been prepared under the authority of the Mechanical Engineering Industry Standards Committee as a result of the decision taken to adopt the ISO metric screw thread system in the United Kingdom (see Appendix A), and requests received from industry for the provision of a specification for high strength friction grip bolts to basic metric dimensions.

Although at present there are no ISO Recommendations, dealt recommendations or draft proposals relating specifically to high strength friction grip bolts, account has been taken of current documentation prepared by ISO Committee ISO/TC 2 "Bolts, nuts and accessories", and where possible the provisions of the following ISO Recommendation and draft recommendations have been incorporated in the text of this standard:

ISO Recommendation R 272, "*Hexagon bolts and nuts, metric series, widths across flats, heights of heads, thicknesses of nuts*".

ISO Draft Recommendation DR 950, "*Nominal lengths for bolts, screws and studs, thread lengths for general purpose bolts*".

ISO Draft Recommendation DR 952, "*Hexagon bolts and nuts, metric series, tolerances on widths across flats, widths across corners*".

ISO Draft Recommendation DR 987, "*Bolts and screws, radii under the head of general purpose bolts and screws, metric series*".

Although the basic hexagon sizes for the bolts and nuts are in accordance with ISO Recommendation R 272, the next larger width across flats for any given diameter, as shown in the normal metric series, have been selected in order to provide greater bearing areas for both bolts and nuts.

¹⁾ In course of preparation.

The diametral dimension for the flat washers given in this standard have been based on the “large diameter series” detailed in draft ISO Recommendation No. 940 “Washers for hexagon bolts — metric series”. The thicknesses for the flat washers have been based on those currently given in BS 3139²⁾, and the American Standard ASTM A 325³⁾, since it was felt that these thicknesses were more compatible with the function for which these washers are used, the washer thicknesses quoted in ISO/DR 940 being more applicable to ordinary hexagon bolts and nuts.

The dimensions of square taper washers given in this standard have been based on the inch sizes at present given in BS 3139, since it seems unlikely that BS 4 “Structural steel sections”, will be revised to provide rational metric sizes for sections in the near future. It also seems unlikely that a metric version of BS 4 would in any way change the flange angles, and there appears to be justification for retaining them as at present, since ISO is currently considering the adoption of structural steel sections covered by BS 4.

On the question of the material to be utilized for general grade bolts to Part 1 of this standard, the BSI committee responsible were unable to reconcile the different practices adopted on the continent, as detailed in ISO Draft Recommendation No. 911⁴⁾ and BS 3692⁵⁾ and the American practice as detailed in ASTM A 325. It is continental practice to maintain a constant tensile strength throughout the diameter range of threaded products, thus necessitating a change in chemical composition because of the increase in ruling section, whereas it is the American practice to maintain a generally constant chemical composition, which in practice leads to a reduction in the tensile strength over the diameter range.

It was originally intended to specify ISO strength Grade 8.8 for general grade metric high strength friction grip bolts to Part 1 of this standard, and ISO strength Grade 10.9 for high grade bolts in the envisaged Part 2 (see BS 3692). However, it was pointed out in committee that if ISO strength Grade 8.8 was specified in Part 1, an alloy steel rather than a carbon steel would need to be used for diameters greater than 24 mm. It was felt by the committee that economic considerations were important in this respect and might prove paramount for users intending to change over to metric products. Accordingly this Part 1 has been prepared with the material requirements based on the American Grade 5 material used in ASTM A 325 and BS 3139-1 (see notes to Table 1).

NOTE 1 Although the minimum radii under the head specified for bolts in this standard are in accordance with ISO/DR 987, the transition diameter (d_a max.) quoted in Table 5 falls between the values quoted for finished and semi-finished products in the draft recommendation. This minor deviation was justified by the committee on the grounds that these products were not general purpose bolts and as such, it was felt desirable to specify a maximum transition diameter consistent with their specialized function.

NOTE 2 Although the mechanical requirements specified in this standard are in metric technical units (i.e. kgf/mm²) in accordance with present ISO agreements (ISO/DR 911), 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 PD 5686. “The use of SI units”, and Supplement No. 1 (1967) to BS 350-2, “Additional tables for SI conversions”.

²⁾ BS 3139, “High strength friction grip bolts for structural engineering”, Part 1, “General grade bolts”.

³⁾ ASTM A 325, “High-strength carbon steel bolts for structural joints, including the suitable nuts and plain hardened washers”.

⁴⁾ ISO Draft Recommendation No. 911, “Mechanical properties of fasteners”, Part 1, “Bolts, screws and studs”.

⁵⁾ BS 3692, “ISO metric precision hexagon bolts, screws and nuts”.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to vi, pages 1 to 19 and a back cover.

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

1 General

1.1 Scope

Part 1 of this British Standard specifies requirements for one (general) grade of quenched and tempered high strength friction grip hexagon head bolts and their associated nuts and washers for use in structural engineering.

Dimensions are given for a range of nominal sizes from 12 mm (M 12) to 36 mm (M 36) inclusive and mechanical properties are specified. Full details of tests, inspection procedure and provisions for marking are also included.

NOTE Attention is drawn to the importance of ensuring that these bolts are correctly used if satisfactory results are to be obtained. Recommendations giving guidance in the use of this form of fastener are given in BS "The use of high strength friction grip bolts in structural engineering", Part 1, "General grade metric series" (in course of preparation).

Any alternative method of use should be left to the responsibility of the engineer and should be noted on the appropriate drawings or documents, or both.

1.2 Terminology

The term "high strength friction grip bolts" relates to bolts of high tensile steel, used in conjunction with high tensile steel nuts and quenched and tempered steel washers, which are tightened to a predetermined shank tension in order that the clamping force thus provided will transfer loads in the connected members by friction between the parts and not by shear in or bearing on the bolts or plies of connected members.

2 Bolts

2.1 Material

Steel used in the manufacture shall be that produced by the open-hearth, electric or any of the oxygen processes⁶⁾. The maximum content of sulphur and phosphorus shall not exceed 0.06 % each. In the case of the oxygen processes the maximum content of nitrogen shall not exceed 0.008 %.

2.2 Heat treatment

Bolts shall be heat-treated under uniform conditions. They shall be hardened by quenching in oil or water and shall then be tempered.

2.3 Mechanical properties

Bolts shall meet the requirements set out in Table 4 for all properties selected for the test programme (see 2.4).

NOTE The figures given in Columns 4 to 10 inclusive of Table 4 are minimum values.

The manner in which tests are to be carried out is specified in Appendix B.

2.4 Test programme

Appendix D consists of a list of mechanical properties for bolts and indicates by the symbol "●" the tests to be carried out by the supplier for all bolts. The tests indicated by the symbol "⊕" may be carried out at the special request of the purchaser. If these tests are required, this should be clearly stated in the enquiry, order or contract.

2.5 General test requirements

2.5.1 Number of tests. Each test selected from Appendix D shall be carried out three times per batch of bolts. A batch shall consist of the number of pieces shown in Table 1.

Table 1 — Number of pieces comprising a batch of bolts

Diameter of bolt <i>d</i>	Number of pieces in batch
Up to and including 16 mm	15 000 or fraction thereof
Over 16 mm up to and including 24 mm	5 000 or fraction thereof
Over 24 mm	2 500 or fraction thereof

2.5.2 Retests. Should any specimen fail to meet the requirements of a specified test, an additional sample of double the number of specimens from the same batch at the time of manufacture shall be tested and if all the additional specimens satisfy the requirements of the test the batch shall be deemed to comply with this standard.

2.6 Dimensions and finish

The dimensions, tolerances and general finish of the bolts shall be in accordance with the requirements specified in 2.6.1 to 2.7 inclusive and in Table 5 (Figure 2).

2.6.1 Length of bolts

2.6.1.1 Nominal length. The nominal length of the bolt shall be 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 Appendix F, together with preferred size combinations of diameter and length.

2.6.1.2 Tolerance. The tolerance on the nominal length shall be as given in Table 2.

⁶⁾ This term includes both top and bottom blown oxygen processes.