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HIGH STRENGTH FRICTION GRIP BOLTS FOR STRUCTURAL ENGINEERING

Part 1. General Grade Bolts

BRITISH STANDARDS INSTITUTION

BRITISH STANDARD SPECIFICATION

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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 21st October, 1959.

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 5000, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook

This standard makes reference to the following British Standards:

B.S. 18. Tensile testing of metals.

B.S. 427. Diamond pyramid hardness numbers.

B.S. 860. Table of approximate comparisons of hardness scales.

B.S. 891. Method for direct reading hardness testing (Rockwell principle).

B.S. 1044. Recommended designs for gauges.

B.S. 1580. Unified screw threads.

B.S. 1769. Unified black hexagon bolts, nuts, screws and plain washers—heavy series.

B.S. 3294. The use of high strength friction grip bolts in structural steelwork. Part 1. General grade bolts.

B.S. 4882. Bolting for flanges and pressure containing purposes.

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 B.S.I. references relate to the work on this standard:
Committee references MEE/61, MEE/61/2
Draft for comment CY (MEE) 3179

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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:

Admiralty
 Air Ministry
 Associated Offices' Technical Committee
 Association of Consulting Engineers (Incorporated)
 British Chemical Plant Manufacturers' Association
 British Compressed Air Society
 *British Electrical and Allied Manufacturers' Association
 British Engineers' Association
 British Gear Manufacturers' Association
 British Internal Combustion Engine Manufacturers' Association
 *British Iron and Steel Federation
 *British Railways, The British Transport Commission
 *Crown Agents for Overseas Governments and Administrations
 D.S.I.R.—National Engineering Laboratory
 Electricity Council, The Generating Boards and the Area Boards for England and Wales
 Engineering Equipment Users' Association
 Gas Council
 *High Commission of India
 Institute of Marine Engineers
 Institute of Petroleum
 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
 Machine Tool Trades Association
 Ministry of Labour and National Service (Factory Inspectorate)
 *Ministry of Supply
 Ministry of Power
 Ministry of Transport and Civil Aviation
 *Ministry of Works
 *National Coal Board
 *National Physical Laboratory (D.S.I.R.)
 Radio Industry Council
 War Office

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
 British Constructional Steelwork Association
 Institution of Engineers and Shipbuilders in Scotland
 Institution of Naval Architects
 North East Coast Institution of Engineers and Shipbuilders
 Railway Carriage and Wagon Building Association
 United Society of Boilermakers and Iron and Steel Shipbuilders
 Washer Manufacturers' Association of Great Britain

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BRITISH STANDARD SPECIFICATION FOR
**HIGH STRENGTH FRICTION GRIP BOLTS
FOR STRUCTURAL ENGINEERING**
Part One : General Grade Bolts

FOREWORD

This British Standard has been prepared under the authority of the Mechanical Engineering Industry Standards Committee in response to a request submitted by the Black Bolt and Nut Association of Great Britain and the Heat Treated Bolt Association and supported by the British Constructional Steelwork Association and the British Iron and Steel Federation.

Owing to the increasing use of high strength friction grip bolts in recent years it is felt that they should be standardized before too many variations are established. This is desirable not merely from the point of view of simplification, but also because it makes it easier to give guidance in the use of these bolts—an important point, since it is essential that they should be used correctly if satisfactory results are to be obtained. Recommendations on this subject are now in course of preparation and will be issued as a British Standard; they are confined for the time being to a single grade of bolt, but as and when experience permits, further recommendations may be formulated on the use of a higher grade of bolt. At that time, consideration will also be given to the requirements which should be specified for higher grade bolts and these will be covered by a further part or parts of the present standard.

NOTE. Where metric equivalents have been given, the figures in British units are to be regarded as the standard. The metric conversions are approximate. More accurate conversions should be based on the tables in B.S. 350, 'Conversion factors and tables'

*As added
Oct., 1983*

Obsolescent (by Amendment No. 6)

The need for the product covered by this British Standard has been reviewed and it has been decided that, in the interests of rationalization, it should be regarded as obsolescent and not therefore used for new designs. The standard will be withdrawn in due course.

SPECIFICATION**SCOPE**

1. Part 1 of this British Standard relates to one 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 $\frac{1}{2}$ in. to $1\frac{1}{2}$ in. 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 in course of preparation and will be given in BS 3294 : Part 1.

*As added
Dec., 1977* In order to simplify stockholding as the use of these inch-sized fasteners is declining, 2H nuts specified in BS 4882 may be used as an alternative to the nuts in Section Two of this standard for sizes up to and including 1 in. The nuts supplied will have to comply with the requirements of the proof test specified in clause 19 of this standard.

TERMINOLOGY

2. The term 'high strength friction grip bolts' relates to bolts of high tensile steel, used in conjunction with high tensile steel nuts and hardened steel washers, which are tightened to a pre-determined 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.

Section One: Bolts

A. MATERIAL AND TESTING

MATERIAL

3. Steel used in the manufacture of bolts shall be that produced either by the open-hearth or by the electric furnace process and shall have a maximum sulphur and phosphorous content not exceeding 0.06 per cent each.

HEAT TREATMENT

4. Bolts shall be heat treated under uniform conditions. They shall be hardened by quenching in oil or water and shall then be tempered by being uniformly reheated to a minimum temperature of 430°C (800°F).

MECHANICAL PROPERTIES

5. Bolts shall be subjected to a tension test as follows:

Bolts 1½ in. diameter and under shall meet the requirements for proof load and ultimate load for bolts specified in Table 2 and Clauses 6 *a* and *b*.

Bolts of diameters 1¼ in. and 1½ in. should preferably meet the requirements for proof load and ultimate load for bolts specified in Columns 4 and 5 of Table 2 and Clauses 6 *a* and *b*. As equipment of sufficient capacity may not be readily available such tests shall be carried out by arrangement between manufacturer and purchaser. Alternatively, these bolts shall meet the requirements for reduced dimension test specimens as specified in Table 3 and Clause 6 *c*.

Bolts shall also meet the requirements for elongation and reduction of area specified in Columns 6 and 7 of Table 2 and Clause 6 *d*.

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NOTE. 1. Hardness values are given in Column 8 of Table 2 for guidance. If hardness tests are required by the purchaser, they are carried out in accordance with the provisions of Clause 7.

NOTE 2. For bolts specified in this standard, mechanical properties are the over-riding factor in determining their suitability for the purpose required, but in circumstances where notch brittleness is of particular importance, appropriate tests may be carried out by arrangement between manufacturer and purchaser.

PROOF LOAD AND ULTIMATE LOAD FOR BOLTS

6. *a. Proof load for bolts.* (i) *Method of test.* The proof load for bolts shall be determined with a straight, full size threaded bolt specimen. The bolt shall be placed in a suitable testing machine with the threaded end of the bolt in a threaded grip or in a nut. The grips of the testing machine (see Fig. 1) shall be self aligning to avoid side thrust.

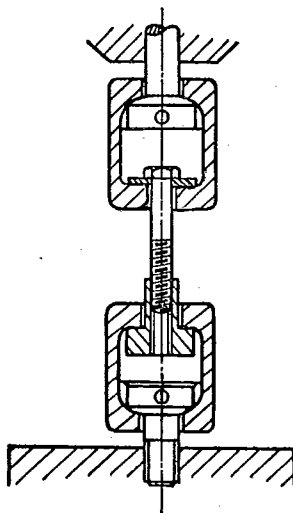


Fig. 1. Proof load testing machine

The bolt shall be screwed into the grip or nut to the thread runout of the bolt and then unscrewed six full threads. The bolt shall be subjected to the proof load for bolts specified in Column 5 of Table 2 and the load then released.

(ii) *Method of measurement.* Measurement of the specimens subjected to the proof loads for bolts shall be performed in the following manner:

The overall length of the bolt shall be measured at its true centre line with an instrument capable of measuring changes in length of 0.0001 in. to an accuracy of 0.0001 in. in any 0.001 in. range.

After the bolt has been loaded in accordance with the provisions of (i) of this clause, its length shall again be measured. There shall be no permanent elongation of the bolts, but to allow for errors of determination between consecutive

measurements of bolt length, this condition is considered to have been achieved if the measurement is within ± 0.0005 in. of that made before loading.

NOTE. The preferred method of carrying out this test is to measure the length between conical centres on the centre line of the bolt which has been set up on the mating centres of the anvils of the measuring fixture; the head or shank of the bolt should be marked so that it can be placed in the same position for all measurements.

b. Ultimate load for bolts. (i) Method of test. The ultimate load for bolts shall be determined with the same bolt in the testing fixture used for the proof load test. The bolt shall be placed in the fixture with a 10° wedge under the head as shown in Fig. 2. The wedge shall conform to the dimensions given in (ii) of this clause.

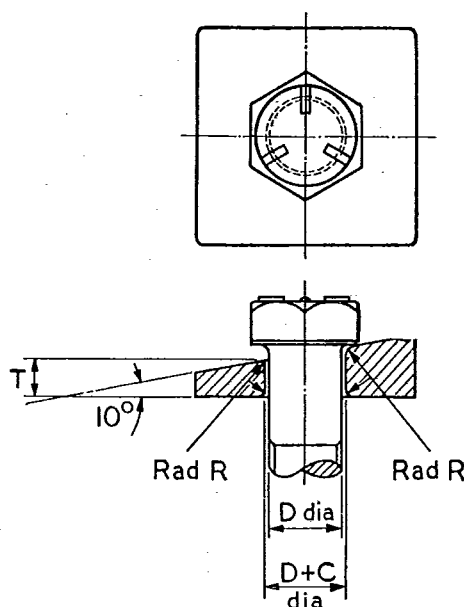


Fig. 2. Wedge for ultimate load test

The bolt shall be screwed into the threaded grip or nut to the thread run-out on the bolt and then unscrewed six full threads. The bolt shall be so placed that no corner of the hexagon takes bearing load; that is, one of the flats of the head shall be aligned with the direction of the uniform thickness of the wedge. The bolt shall be subjected to load at a testing machine crosshead speed (free running) not greater than 1 inch per minute until fracture of the bolt occurs. Fracture shall be in the shank or threads of the bolt without any fracture at the junction