ASME B18.2.6-2019
(Revision of ASME B18.2.6-2010)

# Fasteners for Use in Structural Applications

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Two Park Avenue • New York, NY • 10016 USA

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This Standard will be revised when the Society approves the issuance of a new edition.

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The American Society of Mechanical Engineers
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# FOREWORD

The B18 Standards Committee for the standardization of bolts, screws, nuts, rivets, and similar fasteners was organized in March 1922 as the B18 Sectional Committee under the aegis of the American Engineering Standards Committee [later the American Standards Association, then the United States of America Standards Institute and, as of October 6, 1969, the American National Standards Institute, Inc. (ANSI)], with the Society of Automotive Engineers and the American Society of Mechanical Engineers as joint sponsors. B18 Subcommittee 2 was subsequently established and charged with the responsibility for technical content of standards covering wrench head bolts and nuts.

Subcommittee 2, after appraisal of the requirements of industry, developed a proposed standard series of bolt head and nut dimensions. This proposal was finally approved and designated a Tentative American Standard in February 1927.

A first revision of the document was designated as an American Standard in March 1933 and was followed by a second revision, which was granted approval as an American Standard in January 1941.

Following reorganization of the B18 Committee in 1947, Subcommittee 2 was asked to expand the Standard on head proportions into a complete product standard. A proposal covering square and hexagon head bolts and nuts, hexagon head cap screws, and automotive hexagon head bolts was prepared and submitted to the B18 Committee in April 1950. While this draft was under consideration, the B18 Committee received a proposal from the British Standards Institution for unification of dimensions on products incorporating unified screw threads. The Committee welcomed the opportunity of discussing the proposals and an American-British-Canadian conference was held in New York, June 1 and 2, 1950.

It was agreed in the conference that the essentials of unification could be accomplished by selection of mutually satisfactory across-the-flats dimensions, since this would permit the use of the same wrenches and because other features would rarely affect interchangeability. After due consideration, suitable existing across-the-flats dimensions were selected for the hexagon products.

In its meeting on October 13, 1950, Subcommittee 2 agreed to incorporate in the proposed standard the conference recommendations on $\frac{1}{4}$-in. hexagon head bolts, $\frac{5}{8}$-in. hexagon head cap screws and automotive hexagon head bolts, $\frac{5}{16}$-in. and $\frac{3}{8}$-in. regular hexagon and square nuts, and $\frac{7}{16}$-in. light and regular hexagon and square nuts. At a subsequent meeting of Subcommittee 2, further changes were adopted in order to combine the light and regular series of nuts and to combine the automotive hexagon head bolt, hexagon head cap screw, and regular hexagon head close tolerance bolt.

In view of the progress made in the United States and the urgency of standardization for mutual defense, the British Standards Institution sponsored a second conference in London in April 1951 to complete the unification of certain hexagon bolts and nuts.

At a meeting on June 8, 1951, Subcommittee 2 reaffirmed its acceptance of the unified dimensions, which corresponded with those in the March 1951 draft, but attempted to select better nomenclature for the unified products. A final draft incorporating the nomenclature *Finished Hexagon Bolts and Nuts* and numerous editorial changes was submitted for letter ballot in September 1951. Following approval by the B18 Committee and the sponsors, the proposal was presented to the American Standards Association for approval and designation as an American Standard. This was granted on March 24, 1952.

Recognizing the Standard was in need of additional refinements, Subcommittee 2 began immediately to revise it by removing inconsistencies with respect to fillets, improving the length tolerances on heavy hexagon bolts, and incorporating numerous other corrections and clarifications. The most noteworthy editorial change was a decision to combine the coverage for hexagon cap screws and square-head set screws from the B18.2 Standard with the coverage for slotted-head cap screws and slotted headless set screws from the B18.6 Standard and publish them in a separate document. The requirements for the unified hexagon cap screws and finished hexagon bolts being identical in the overlapping sizes, this data would now be available in two publications. Following approvals by the B18 Committee and sponsor organizations, the proposal was submitted to the American Standards Association and declared an American Standard on February 2, 1955.

A revision of this document comprised of numerous editorial corrections and inclusions of an appendix for grade markings was duly approved and designated an American Standard on April 18, 1960.

At a meeting in February 1960, Subcommittee 2 approved a recommendation to reduce the head heights for heavy, heavy semifinished, and heavy finished hexagon bolts which were subsequently approved by letter ballot of the B18 Committee on August 16, 1960. A proposed standard for heavy hexagon structural bolts submitted and accepted by Subcommittee 2 at its October 17, 1960, meeting was approved by letter ballot of the B18 Committee on May 9, 1961. To

meet the urgent needs of the steel construction industry, it was considered necessary to publish the Standard for the structural bolts immediately. Consequently, Appendix IV to ASA B18.2-1960 containing coverage for the revised heavy hexagon bolts and the new heavy hexagon structural bolts was released in 1962.

In October 1961, Subcommittee 2 appointed a subgroup to review all product standards for square and hexagon bolts, screws, and nuts, and to recommend simplifications that would be compatible with technical, production, and distribution advances that had occurred over the previous several years. The subgroup presented its recommendations at a meeting of Subcommittee 2 in October 1962. It was agreed that the internally and externally threaded products should be published in separate documents as suggested, and draft proposals for each were completed.

The proposed revision for square and hex bolts, and screws incorporated the following subgroup recommendations: consolidation of hexagon head cap screws and finished hexagon bolts into a single product, consolidation of heavy semifinished hexagon bolts and heavy finished hexagon bolts into a single product, elimination of regular semifinished hexagon bolts, new length tolerancing values for all bolts and screws, documentation of a positive identification procedure for determining whether an externally threaded product should properly be designated a bolt or a screw, and an abbreviated and purified set of product nomenclature reflecting application of the identification procedure. Letter ballot of this proposal to the B18 Committee in March 1964 resulted in several comments, which were resolved to the satisfaction of the Committee in June 1964. Following acceptance by the sponsor organizations, the revision was submitted to the American Standards Association and was designated American Standard ASA B18.2.1 on September 8, 1965.

In 1992, Subcommittee 2 recognized the value of having all structural products in a single standard. In a revision initiated for the B18.2.1 Standard in that year, it was proposed to remove the heavy hex structural bolt from the B18.2.1 Standard, the heavy hex nut from the B18.2.2 Standard, and combine these with the dimensions of hardened steel washers from ASTM F436 and the compressible-washer-type direct tension indicator dimensions of ASTM F959. This new Standard would then provide all standardized dimensions for the fasteners intended for use in structural applications. The first draft of this Standard was submitted to Subcommittee 2 at its May 1993 meeting. It was subsequently approved as an American National Standard on December 4, 1996.

In December 2008, the B18.2 Subcommittee agreed to begin the updating of ASME B18.2.6. The document's format was revised to meet the new guidelines for B18 Standards. The inside diameters of the hardened washer were revised to match the revised size indicated in ASTM F436. An alternative design for the $\frac{5}{8}$-in. size compressible-washer-type direct tension indicator was introduced to simplify production tooling for some washer manufacturers. References to platings and coatings in the various product sections were removed and the users of this Standard are directed to the appropriate ASTM material standard to determine finish requirements in addition to other physical and mechanical properties. The quality assurance section was simplified by removing the reference to ASME B18.18.1 and the list of designated inspection characteristics. Instead, users are directed to ASME B18.18 for the quality assurance requirements and sampling plans for all product characteristics.

The revision of para. 2.1.6, Bearing Surface, was the final resolved issue. It was learned that a significant amount of ASTM A325 and ASTM A490 bolts have always been produced by the hot heading method, which leaves a die seam across the bolt-bearing surface. A sentence was added to the section specifically stating that die seams are permissible. Even though no problems had ever been reported relative to the presence of the die seams, one concerned party raised an objection to the addition of this statement. It was decided that this issue should be resolved by conducting a testing program to objectively determine if die seams on structural bolt-bearing surfaces cause any detrimental performance in application. Several lots of ASTM A325 and ASTM A490 bolts were tested in an ISO 17025 accredited laboratory. Bolts and nuts were assembled in tension-testing equipment with the tightening torque applied through the rotation of the nut in one set of lots and then by rotating the bolts by their heads in another series of lots. An 88-page report was created, including details on the testing of all lots, bolt chemical and physical certificates, photographs of each stage of testing, and the accreditation certificate for the testing laboratory. The report was submitted to Professor Emeritus Dr. John Fisher of Lehigh University for review and comment. In his conclusion, Dr. Fisher stated, "Hence I do not see any reason to consider the installation of bolts with or without seams to differ in achieving the desired preload thereby providing the desired slip resistance. The torque variability is consistent with past studies. Seams are not a significant factor as demonstrated by this study." The Standard was published containing the statement permitting die seams on structural bolt-bearing surfaces. The 2010 edition was approved by ANSI on July 8, 2010.

In May 2015, the Subcommittee elected to include flatness criteria for the tops of bolt heads, which in practice may be formed with a slight convex or concave surface to aid forming. In this edition, para. 2.1.4 has been revised accordingly. Section 5 on direct tension indicators has been revised to accommodate updates to ASTM F959/F959M, including a reduced minimum outer diameter and the common requirement of a minimum of four protrusions regardless of type. Revisions to the inside diameter have been incorporated as well. The release of ASTM F3125/F3125M consolidated the structural bolting standards of ASTM A325/A325M, ASTM A490/A490M, ASTM F1852, and ASTM F2280, and required updating of references throughout this Standard. It also reintroduced requirements for 1¼-in. twist-off-type structural

bolts, and those dimensions have been reinstated in this Standard. Further revisions include dropping the terminology of *tension control* and restructuring of the section on twist-off-type bolts to be consistent with the section on heavy hex bolts.

This edition was approved by ANSI on February 27, 2019.

# ASME B18 COMMITTEE
# Standardization of Bolts, Nuts, Rivets, Screws, Washers, and Similar Fasteners

(The following is the roster of the Committee at the time of approval of this Standard.)

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# CORRESPONDENCE WITH THE B18 COMMITTEE

**General.** ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B18 Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

**Proposing Revisions.** Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

**Proposing a Case.** Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

**Interpretations.** Upon request, the B18 Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B18 Standards Committee.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may mail the request to the Secretary of the B18 Standards Committee at the above address. The request for an interpretation should be clear and unambiguous. It is further recommended that the Inquirer submit his/her request in the following format:

| | |
|---|---|
| Subject: | Cite the applicable paragraph number(s) and the topic of the inquiry in one or two words. |
| Edition: | Cite the applicable edition of the Standard for which the interpretation is being requested. |
| Question: | Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable. |
| Proposed Reply(ies): | Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies. |
| Background Information: | Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information. |

Requests that are not in the format described above may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

Moreover, ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

**Attending Committee Meetings.** The B18 Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the B18 Standards Committee. Future Committee meeting dates and locations can be found on the Committee Page at http://go.asme.org/B18committee.

# FASTENERS FOR USE IN STRUCTURAL APPLICATIONS

## 1 INTRODUCTORY NOTES

### 1.1 Scope

**1.1.1** This Standard covers the complete general and dimensional data for five products in the inch series recognized as an American National Standard. These five structural products include

*(a)* heavy hex structural bolts: ASTM F3125/F3125M
*(b)* heavy hex nuts: ASTM A563 and ASTM A194/A194M
*(c)* hardened steel washers — circular, circular clipped, and beveled: ASTM F436/F436M
*(d)* compressible washer-type direct tension indicators: ASTM F959/F959M
*(e)* twist-off-type structural bolts — heavy hex and round: ASTM F3125/F3125M

**1.1.2** The inclusion of dimensional data in this Standard is not intended to imply that all products described herein are stock production sizes. Consumers should consult with suppliers concerning lists of available stock production sizes.

### 1.2 Dimensions

All dimensions in this Standard are in inches, unless stated otherwise, and apply to an unplated or uncoated product. When plating or coating is specified, the finished product dimensions shall be as agreed upon between supplier and purchaser. Symbols specifying geometric characteristics are in accord with ASME Y14.5.

### 1.3 Options

Options, where specified, shall be at the discretion of the supplier, unless otherwise agreed upon by the purchaser with the manufacturer or distributor.

### 1.4 Terminology

For definitions of terms relating to fastener dimensional or component features used in this Standard, refer to ASME B18.12.

### 1.5 Referenced Standards

Unless otherwise specified, the referenced Standard shall be the most recent issue at the time of order placement. The following is a list of publications referenced in this Standard:

ASME B1.1, Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.2, Gages and Gaging for Unified Inch Screw Threads
ASME B1.3, Screw Thread Gaging Systems for Dimensional Acceptability — Inch and Metric Screw Threads (UN, UNR, UNJ, M, and MJ)
ASME B18.2.1, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series)
ASME B18.2.9, Straightness Gage and Gaging for Bolts and Screws
ASME B18.12, Glossary of Terms for Mechanical Fasteners
ASME B18.18, Quality Assurance for Fasteners
ASME B18.24, Part Identifying Number (PIN) Code System Standard for B18 Fastener Products
ASME Y14.5, Dimensioning and Tolerancing
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

ASTM A194/A194M, Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A563, Carbon and Alloy Steel Nuts