ASME B18.2.1-2012
(Revision of ASME B18.2.1-2010)

Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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Errata
to
ASME B18.2.1-2012
Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

The errata corrections listed below apply to ASME B18.2.1-2012. These corrections will be incorporated into the next edition of B18.2.1.

Page	*Location*	*Change*
15	Table 8	In Note (3), formula for "L_G, max." corrected (see overleaf)
19	4.9(c)(1)	"SAE" corrected to read "SAE J429"
24	Table 14	Datum "A" added to straightness callout for consistency with Tables 1, 3, 4, 5, 7, and 8 (see overleaf)

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
Two Park Avenue, New York, NY 10016-5990

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Table 8 Dimensions of Hex Flange Screws (Cont'd)

Nominal Size or Basic Major Diameter of Thread		Minimum Bearing Diam., B_1	Maximum Runout of Bearing Surface FIM	Basic Thread Length, L_T [Note (3)]		Maximum Transition Thread Length, Y [Notes (3) and (4)]		Ring T		Ring B	
				For Screws With $L \le$ 6 in.	For Screws With $L >$ 6 in.	For Screws With $L \le$ 6 in.	For Screws With $L >$ 6 in.	Inside Diameter +0.0000 −0.0003	Minimum Thickness	Inside Diameter +0.0000 −0.0003	Thickness +0.0000 −0.0003
1/4	0.2500	0.480	0.010	0.750	1.000	0.400	0.650	0.4093	0.500	0.4380	0.1186
5/16	0.3125	0.600	0.011	0.875	1.125	0.417	0.667	0.5483	0.500	0.5820	0.1457
3/8	0.3750	0.730	0.012	1.000	1.250	0.438	0.688	0.6183	0.500	0.6550	0.1729
7/16	0.4375	0.850	0.013	1.125	1.375	0.464	0.714	0.6853	0.500	0.7300	0.2100
1/2	0.5000	0.980	0.014	1.250	1.500	0.481	0.731	0.8253	0.500	0.8750	0.2371
9/16	0.5625	1.100	0.015	1.375	1.625	0.750	0.750	0.8953	0.500	0.9500	0.2643
5/8	0.6250	1.230	0.017	1.500	1.750	0.773	0.773	1.0343	0.500	1.0950	0.2914
3/4	0.7500	1.470	0.020	1.750	2.000	0.800	0.800	1.2343	0.500	1.3120	0.3557

GENERAL NOTE: Refer to section 4 for further information.

NOTES:

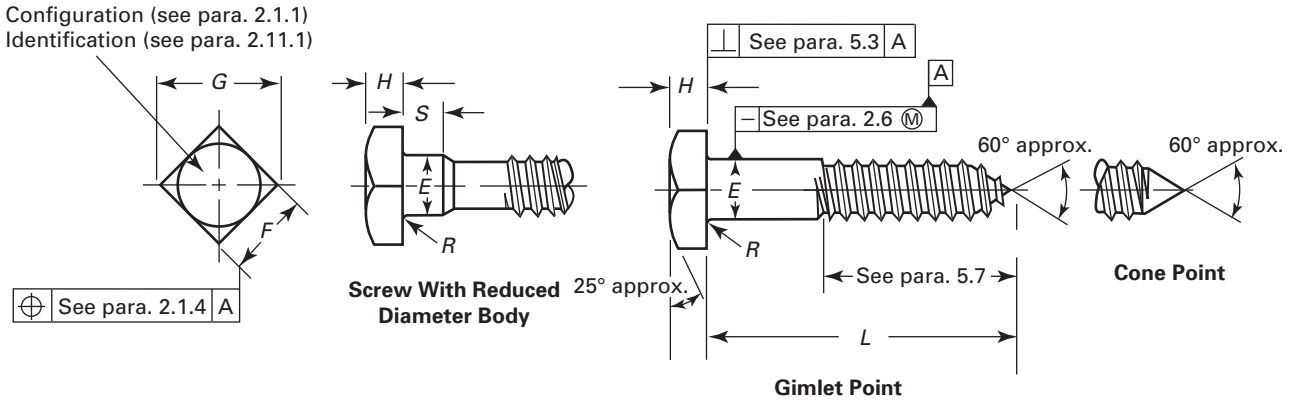
(1) Head acceptability shall be determined using the two rings described in Table 8. Ring B shall be placed on the screw head followed by Ring T. The head is acceptable if Ring T does not contact Ring B after both rings are in place on the head.

(2) The top surface of the flange shall be conical or slightly rounded (convex). Radius, R_2, applies both at the corners and at the flats of the hexagon. The contour of edge at flange periphery, between the maximum flange diameter, B, max., and the minimum bearing circle diameter, B_1, min., shall be optional provided that the minimum flange edge thickness, K, min., is maintained at the minimum bearing circle diameter, B_1, min.

(3) L_G, max. = L *nom.* − L_T; L_B, min. = L_G, max. − Y (see para. 4.7)

(4) Use Y dimensions in Table 8 for the calculation of L_G, max./L_B, min. (see para. 4.7) instead of following Table 12.

Table 14 Dimensions of Square Lag Screws



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AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers
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.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Periodically certain actions of the ASME B18 Committee may be published as Cases. Cases and interpretations are published on the ASME Web site under the Committee Pages at http://cstools.asme.org as they are issued.

Errata to codes and standards may be posted on the ASME Web site under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

The Committee Pages can be found at http://cstools.asme.org/. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting "Errata" in the "Publication Information" section.

The American Society of Mechanical Engineers
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CONTENTS

FOREWORD

American National Standards Committee B18 for the standardization of bolts, screws, nuts, rivets, and similar fasteners was organized in March 1922 as Sectional Committee B18, under the aegis of the American Engineering Standards Committee [AESC, later the American Standards Association (ASA), then the United States of America Standards Institute (USASI), and, as of October 6, 1969, the American National Standards Institute (ANSI)], with the Society of Automotive Engineers (SAE International) and The American Society of Mechanical Engineers (ASME) as joint sponsors. 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 that 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 (BSI) for unification of dimensions on products incorporating Unified screw threads. The Committee welcomed the opportunity to discuss the proposals and an American-British-Canadian Conference was held in New York on June 1 and June 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 affected.

In its meeting of 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, BSI 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 containing 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 ASA 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 immediately began to revise it, 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, these data would now be available in two publications. Following approval by the B18 Committee and sponsor organizations, the proposal was submitted to ASA and declared an American Standard on February 2, 1955.

A revision of this document comprised of numerous editorial corrections and inclusion of an ppendix 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 that was 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 meeting on October 17, 1960 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 of 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 prior several years. The subgroup presented its recommendations at a meeting of Subcommittee 2 in October of 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, a new length tolerancing pattern 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 that were resolved to the satisfaction of the committee in June of 1964. Following acceptance by the sponsor organizations, the revision was submitted to ASA and was designated American Standard ASA B18.2.1 on September 8, 1965.

Subcommittee 2 continued to further develop refinements initiated by the simplification subgroup and revisions reflecting changes in manufacturing practices and consumer requirements. This work culminated in Subcommittee acceptance of a 1970 proposal incorporating, in addition to numerous editorial changes, revisions in the following significant areas: addition of coverage for askew head bolts and hex head lag screws, addition of straightness requirements to applicable products, addition of minimum fillet to square and hex bolts and lag screws, application of UNR threads and new concepts for controlling thread length on products having Unified threads, and clarification of grade markings, thread runout gages, and formulas for dimensions. Also included were refinements to hex cap screw and heavy hex screw requirements consisting of the addition of wrenching height and revision of underhead fillets, washer face thicknesses, and controls on angularity of bearing face. The proposed revision, after approval by letter ballot of the B18 Committee in March 1970, was subsequently approved by the sponsors and submitted to ANSI for designation as an American National Standard. This was granted on January 18, 1972.

Numerous user complaints on interference of the elliptical fillet added in the 1972 revision resulted in the appointment of a subcommittee to study the problem. They recommended reverting back to the maximum/minimum radius fillet specified in the 1965 version with the elliptical fillet retained for use when specified by the user. Further refinements in the definition of the fillet for short length screws were added to "Hex Cap and Heavy Hex Screws." Geometric tolerancing was updated to conform to American National Standard Y14.5. The transition length of the hex cap screw was changed to equal five coarse (UNC) threads. Few, if any, users accepted the 1972 values that were designed to reduce tooling by providing the same body length for adjacent lengths. On screws, separate straightness requirements were deleted, and the combination thread runout and straightness gage described in Mandatory Appendix I was specified.

Straightness as a variable based on length was applied to bolts with gaging described in Appendix 11. Acceptability of screw threads based on gaging systems established by American National Standard B1.3-1979 were added to each type of screw or bolt, except lag screws. This proposal was approved by letter ballot of the Subcommittee and B18 in January 1980. Following acceptance by the secretariat organizations, the revision was referred to ANSI and granted recognition as an American National Standard on June 24, 1981.

In 1991, it was recognized that B18.2.1 required extensive revision to better meet the needs of conformance with Public Law 101-592. Included in these considerations were improved definition of a full body versus a reduced body and those dimensions that should be certified to ensure product fit, form, and function. Other dimensions given for each product would only be examined in the event of a dispute. Also, the term "finished hex bolt," which is today's cap screw, was dropped. Additionally, a weight table was included to assist users.

Furthermore, it was felt that the heavy hex structural bolt, heavy hex nut, hardened steel washers, and compressible washer-type direct tension indicators should be included in a new standard for fasteners intended for use in structural applications. For this reason, the heavy hex structural bolt was removed from this Standard. The new table for maximum grip gaging lengths and minimum body lengths for cap screws and heavy hex screws was included for the first time in the 1996 edition to assist users and is similar to the pattern used for metric bolts and screws.

Subcommittee 2 agreed to undertake the revision of B18.2.1 during the first quarter of 2008. The Standard was updated to incorporate the new format and additional sections as refined in ASME B18.12.1. The notes that had followed every table were reorganized into the body of the Standard to eliminate the redundancy created by repeating the same table notes under numerous tables. This revision added flange head and lobed head screws and extended the size range of heavy hex head cap screws from 3 in. to 6 in. in diameter. The thread details for lag screws were redefined to align with the way all other spaced threads are defined. Designated inspection characteristics were eliminated from each product type, and a general section on quality assurance was created stating that all products must meet the requirements in the Standard according to ASME B18.18.2. The title of the Standard was revised to indicate that the flange head and lobed head screws were added to the Standard.

Since the publication of the 2010 revision, a number of issues were brought to the attention of the B18.2 Subcommittee that needed correcting.

(a) The location of the left-hand dimension line for L_G, L_B, and L for cut thread hex cap screws on the illustrations for Tables 6 and 7 were corrected by moving them to the bottom of the washer face. The basic head heights for $2\frac{1}{2}$ and $2\frac{3}{4}$ on Table 7 were corrected to read $1\frac{17}{32}$ and $1\frac{11}{16}$, respectively.

(b) The most significant revisions are related to Table 8 and the associated illustration for hex flange head screws. The illustration had notes connected to the L_G, L_B, and L_T dimensions that referred to para. 4.7, which then referred to Table 12, that were in error. Since the Y transition length dimension for hex flange head screws is different from hex cap screws, Table 12 is not applicable to hex head flange screws. Notes (3) and (4) have been added to Table 8 that define how to calculate L_G and L_B based on the specified L_T and Y dimensions. Also in Table 8, dimensional errors were listed for the inspection rings designated Ring T and Ring B. This revision corrects those dimensions. After the publication of the corrections to the dimensions for flange head screws, the Industrial Fasteners Institute standard IFI-111, which preceded the addition to this Standard, was withdrawn.

(c) In Table 12, the L_B lengths for $\frac{1}{2} \times 11$, $1\frac{1}{4} \times 11$, and $1\frac{1}{4} \times 12$ were corrected to read 9.12, 7.29, and 8.29, respectively.

(d) Paragraph 2.13 was expanded to explain that ASME B18.18 covers dimensional inspection requirements and that chemical and physical requirements are covered by the material standard designated in the purchaser's part designation.

Suggestions for improvement of this Standard will be welcomed. They should be sent to The American Society of Mechanical Engineers, Secretary, B18 Main Committee, Two Park Avenue, New York, NY 10016-5990.

This revision was approved as an American National Standard on December 22, 2012.

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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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 for the purpose of providing 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, 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.

The request for 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.
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. 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 this format may be rewritten in the appropriate format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the B18 Standards Committee.

SQUARE, HEX, HEAVY HEX, AND ASKEW HEAD BOLTS AND HEX, HEAVY HEX, HEX FLANGE, LOBED HEAD, AND LAG SCREWS (INCH SERIES)

1 INTRODUCTION

1.1 Scope

1.1.1 This Standard covers the dimensional requirements for nine product types of inch series bolts and screws recognized as American National Standard. Also included are appendices covering gaging procedures, grade markings for bolts and screws, formulas on which dimensional data are based, and a specification to assist in identifying a product as being a screw or a bolt. Where questions arise concerning acceptance of product, the dimensions in the tables shall govern over recalculation by formula. Heavy hex structural bolts, formerly covered in ASME B18.2.1, are now covered in ASME B18.2.6.

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

1.2 Comparison With ISO Standards

Since these are inch fastener standards, there are no comparable ISO standards.

1.3 Dimensions

All dimensions in this Standard are in inches and apply to unplated or uncoated product. When plating or coating is specified, the finished product dimensions shall be as agreed upon between supplier and purchaser. Where nominal sizes are expressed in decimals, zeros preceding the decimal and zeros in the fourth decimal place shall be omitted.

Symbols specifying geometric characteristics are in accord with ASME Y14.5.

1.4 Options

Where specified, options shall be at the discretion of the manufacturer unless otherwise agreed upon by the manufacturer and purchaser.

1.5 Terminology

As used in this Standard, "short bolt" or "short screw" means a bolt or screw of a diameter-length combination that is required to be threaded for full length, whereas "long bolt" or "long screw" means a bolt or screw of a diameter-length combination that is not threaded for full length.

body length, L_B: the distance measured parallel to the axis of the bolt or screw from the underhead bearing surface to the last scratch of thread or, for rolled threads, to the top of the extrusion angle. Where specified, the minimum body length, L_B, min., is a criterion for inspection.

grip gaging length, L_G: the distance measured parallel to the axis of the bolt or screw from the underhead bearing surface to the face of the appropriate noncounterbored, noncountersunk special GO thread ring gage, assembled by hand as far as the thread will permit. The maximum grip gaging length, L_G, max., is a criterion for inspection.

point length: the length from the pointed end to the first fully formed thread at major diameter as determined by the distance that the point enters into a cylindrical NOT GO major diameter ring gage (refer to Gage 3.1 in ASME B1.2).

thread length: the length from the extreme point of the bolt or screw to the last complete (full form) thread. For bolts and screws in this Standard, other than lag screws, the nominal thread length, L_T, is a reference dimension intended for calculation purposes only.

transition thread length, Y: the length that includes the length of incomplete threads, the extrusion angle on rolled threads, and tolerances on grip length. Where specified, transition thread length is a reference dimension intended for calculation purposes only.

For definitions of terminology not specified in this Standard, refer to ASME B18.12.

1.6 Referenced Standards

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