ASME B18.21.1-2009

(Revision and consolidation of ASME B18.21.1 and ASME B18.22.1)

Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda issued to this 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.

The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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FOREWORD

In response to the request of the U.S. War Department the American National Standards Committee B27, for the standardization of plain and lock washers was organized between August 1925 and March 1926 as Sectional Committee B27 under the aegis of the American Standards Association (later the American Engineering Standards, then The United States of America Standards Institute, the American National Standards Institute and in subsequent years, the committee came under the sole sponsorship of the American Society of Mechanical Engineers (ASME).

In May 1928, the B27 Committee established two subcommittees to carry on development work, Subcommittee 1 on plain washers and Subcommittee 2 on lock washers.

Subcommittee 2 circulated a tentative standard for helical spring-lock washers for industry comment in November 1931, but failed to achieve acceptance and committee activity was dormant for some years. In 1940 the Subcommittee 2 project was reactivated and proceeded to draft a proposal covering three series of helical spring-lock washers designated light, medium, and heavy. In 1943 this proposal was amended to include the extra-heavy series washers and following approval by the B27 Committee and sponsor organizations it was accepted as an American Standard under the designation ASA B27.1-1944.

Subcommittee 1 submitted a proposed standard for plain washers in October 1932, after circulation it was revised and distributed in May 1935. This led to a third revision and was referred to the sectional committee but did not receive the votes necessary for approval. From 1937 until 1946 the Subcommittee 1 activity was dormant owing in part to industry preoccupation with the war effort and to the development of a standard for lock washers, there being some resistance to the concurrent development of both projects.

In 1946 the Subcommittee 1 project for plain washers was reactivated and in December of that year a new proposal for the standard was approved at a meeting of the sectional committee subject to confirming approval by letter ballot. The proposal received an overwhelming vote of approval in the letter ballot and at the sectional committee meeting in December 1948 ordered its referral to the sponsor societies. Following approval by the B27 Committee and sponsor organizations it was accepted as an American Standard on August 31, 1949 under the designation ASA B27.2-1949.

Subcommittee 2 considered minor refinements during the ensuing years to the hardness requirements and methods of testing for lock washers. In December 1948, the B27 Committee accepted, in principle, expansion of the Standard to cover helical spring-lock washers made from materials other than carbon steel. A draft proposal incorporating requirements applicable to corrosion-resistant steel, phosphor bronze, silicon bronze, aluminum-zinc alloy, K-monel for helical spring-lock washers, the inclusion of specifications for tooth-lock washers, and machine screw assemblies was completed in September 1949. Following approval by the B27 Committee and sponsors, this proposal was forwarded to the American Standards Association and declared an American Standard on May 22, 1950.

Subcommittee 1 reviewed the plain washer and revised it editorially to include notes covering general applications, material, thickness, and defects which were inadvertently omitted from the 1949 original printing. A proposed revision dated June 1952, was approved by letter ballot vote of the sectional committee, sponsors, and American Standards Association. Official designation as an American Standard was given March 30, 1953. Subsequent to publication of the 1953 issue certain changes and inclusion of an additional series of washers were proposed. A proposed revision dated February 1956 was approved by letter ballot. Following the approval by the B27 Committee and sponsors, this proposal was forwarded to the American Standards Association and declared an American Standard on August 5, 1958.

Subcommittee 2 held five meetings from 1951 through 1958 at which time members agreed to extend the light and heavy series helical spring-lock washer, to include sizes $1\frac{5}{8}$ in. through 3 in., establish tolerances on the nominal thickness of helical spring-lock washers, and recognize

hardened screw and lock washer assemblies. A formal draft, dated June 1957, was approved by letter ballot of the B27 Committee and the sponsor organizations and submitted to the American Standards Association for designation as an American Standard. This was granted on November 3, 1958.

Subcommittee 1 continued to refine the specifications for plain washers following issuance of the 1958 standard. Several meetings resulted in adjustment of the tolerances for inside and outside diameters to conform with good commercial stamping practices and the application of the same tolerances to both Type A and Type B washers. Also, to provide better guidance for users, it was agreed to tabulate the preferred sizes of Type A washers separately. A proposed revision dated November 1963, was circulated for simultaneous letter ballot approval of Subcommittee 1 and the Sectional Committee on November 18, 1963. Following acceptance by the subcommittee, the proposal was letter balloted to the B27 Committee on February 12, 1965. The proposal was approved by the sponsor organizations and the American Standards Association and granted formal recognition as an American Standard on September 20, 1965.

From 1959 through 1961, a number of changes were recommended by the Helical Washer Institute, which had undertaken a program to refine the helical spring-lock washers to meet more exacting demands of consumer industries. Also, at a meeting held on November 28, 1961 the B27 Committee recognized the desirability of publishing the screw and washer assemblies as a separate document under the jurisdiction of the B18 Committee, but subject to joint approval by the B27 Committee and affected subcommittees thereof. Subsequently, a draft proposal deleting the coverage on screw and washer assemblies and incorporating revisions to the helical spring-lock washers was prepared. The latter included changing the designation of medium series to regular series and extra-heavy series to extra-duty series, and the addition of the high-collar series, for use with socket head cap screws. Following acceptance by the subcommittee, the proposal was letter balloted to the B27 Committee on November 18, 1963. The proposal was approved by the sponsor organizations and the American Standards Association and granted formal recognition as an American Standard on September 20, 1965.

As of April 1, 1966, Subcommittee 1 was redesignated Subcommittee 2 on plain washers, and Subcommittee 2 was redesignated Subcommittee 1 on lock washers to align with the standard(s) numbering.

After continued studies conducted by the Helical Washer institute, the group submitted further recommendations for changes at a meeting of the American National Standards Committee B27 in October 1969. Subcommittee 1 then prepared a proposal in May 1970 to incorporate the recommended changes to helical spring-lock washers. These changes consisted of deleting coverage for the light series and Type 420 corrosion-resistant steels, adding control on section-corner radius, adjusting the inside diameter, and relegating the heavy series to "Not Recommended for New Applications" status. Other minor corrections to dimensional data and extensive editorial refinements were also included. This draft was approved by letter ballot of Standards Committee B27 on August 11, 1970 and by the sponsor organizations and submitted to American National Standards Institute for designation as an American National Standard. After approval of this revision by the American National Standards Committee B27, the washer activities were transferred to American National Standards Committee B18. This revision was approved as an American National Standard on April 28, 1972.

After the transfer Subcommittee 1 of B27 was redesignated as Subcommittee 21 (Lock Washers) and Subcommittee 2 of B27 was redesignated as Subcommittee 22 (Plain Washers) of Standards Committee B18.

Revisions were made to the lock washer in 1972 and at the December 1985 Subcommittee 21 meeting a draft of these revisions was reviewed by its members. Between that meeting and the December 1987 subcommittee meeting the Standard was reviewed, refinements completed and it was sent out for balloting. All ballot comments were reviewed, editorial changes made and at the May 1989 meeting the revised draft was submitted for publication. Changes to the helical spring lock washers included a graphic illustration with tables to help define the flat face after the allowable radii dimension was subtracted, lowering of the Rockwell hardness for carbon steel, the addition of a table of hardness values for other materials, and a table covering materials. Dimensional changes were made to the inside and outside diameters for regular, heavy, and extra-duty series $\frac{1}{4}$ in. through $1\frac{1}{2}$ in., and up to the 3 in. size for high-collar. The regular, heavy,

and extra duty tables were expanded to include the sizes from $1\frac{1}{2}$ in. up to 3 in. The data for tooth-lock washers remained the same. Following approval by ASME, the document was submitted to the American National Standards Institute, and was approved as an American National Standard on July 5, 1990.

On December 9, 1992, a proposal to revise the dimensions of the inside diameter for $\frac{5}{8}$ in. and larger helical spring-lock washers was developed to correct an excessive reduction in the tolerance for these sizes. In addition, the trapezoid dimensions were replaced with the formula used in prior standards; several materials and hardness values were added; paragraphs covering lot size, inspection and quality assurance requirements, and inspection characteristics were added; and editorial changes were made. The proposal was sent out for balloting, and at the December 7, 1993 meeting, comments were reviewed and acted upon as needed. Following approval by ASME, the document was submitted to the American National Standards Institute, and was approved as an American National Standard on October 6, 1994.

On December 4, 1995, a proposal was developed to revise and clarify several items in this Standard. For helical spring-lock washers the changes included adding clearance to the washers inside diameter for heavier coatings such as those mechanically galvanized, moving the decarburization measuring requirement into the proper designated heading, and correcting illustrations above tables. For tooth-lock washers, the changes included clarifying the wording used in the measurement of the tooth projections on both sides, removing the need for twist testing, and changing some thickness dimensions in Tables 6 and 8 and the notes for Table 9. In addition, this Standard was revised to conform to the standard format of B18 documents. This new edition of the Standard was approved as an American National Standard on November 2, 1999.

During the ASME B18 Standards Committee meeting on November 28, 2007 a suggestion was made to incorporate the B18.22.1 Plain Washers into the B18.21.1 Lock Washers (Inch Series) standard. Both documents were reviewed and a determination was made that the proposal was feasible. With a new name, Washers: Helical Spring-Lock, Tooth-Lock, and Plain Washers (Inch Series) and a reference noting that ASME B18.21.1-2009 was a "Revision and consolidation of ASME B18.21.1 and ASME B18.22.1" the consolidation which included editorial and technical changes was made. The lock washer changes were mostly editorial with the tooth washers received additional figures to help differentiate Type A from Type B. The plain washer tables 1B and 2 included dimensions that were actually considered specials so tables with preferred sizes were adapted and fender washer dimensions were included. After balloting and revisions were made the standard was reballoted and B18.21.1-2009 was approved by B18 Subcommittee 21, Subcommittee 22 and the B18 Standards Committee. This Standard was approved by the American National Standard Institute on October 13, 2009.

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, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B18 Standards Committee
The American Society of Mechanical Engineers
Three 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 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.
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.

WASHERS: HELICAL SPRING-LOCK, TOOTH LOCK, AND PLAIN WASHERS (INCH SERIES)

1 GENERAL DATA RELATED TO ALL WASHERS

1.1 Scope

1.1.1 This Standard covers the dimensional requirements, physical properties, and related test methods for helical spring-lock washers (# 0 through 3 in.), tooth-lock washers (# 2 through $1\frac{3}{4}$ in.), and plain washers (# 0 through 3 in.).

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

NOTE: The word *lock* appearing in the names of products in this Standard is a generic term historically associated with their identification and is not intended to imply an indefinite permanency of fixity in attachments where the fasteners are used.

1.2 Comparison to ISO Standards

No comparable ISO standards exist for these parts.

1.3 Types

1.3.1 Helical Spring-Lock Washers. This Standard covers helical spring-lock washers of the following sections: regular, heavy, extra duty, and high-collar.

1.3.2 Tooth-Lock Washers. This Standard covers tooth-lock washers of the following types: internal tooth, external tooth, countersunk external tooth, internal/external tooth, and of two constructions, designated Types A and B.

1.3.3 Plain Washers. This Standard covers plain (flat) washers of three constructions designated Type A, Type B, and Fender washers.

1.4 Dimensions

All dimensions in this Standard are given in inches and are applicable before any coating is applied.

1.5 Responsibility for Modifications

The washer manufacturers shall not be held responsible for malfunctions of product determined to be due to plating or other modifications when such plating or modification is not performed under the control or direction of the manufacturer.

1.6 Terminology

For definitions of terms relating to washers or features thereof used in this Standard, refer to ASME B18.12.

1.7 References

The following is a list of publications referenced in this Standard. Unless otherwise specified, the latest issue shall apply.

ASME B18.12, Glossary of Terms for Mechanical Fasteners

ASME B18.18.2M, Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners Engineered Applications

ASME B18.24, Part Identifying Number (PIN) Code System Standard

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007 (www.asme.org)

ASTM B 99, Standard Specification for Copper-Silicon Alloy Wire for General Applications

ASTM B 159, Standard Specification for Phosphor Bronze Wire

ASTM B 211, Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire

ASTM B 591, Standard Specification for Copper-Zinc-Tin and Copper-Zinc-Tin-Iron-Nickel Alloys Plate, Sheet, Strip, and Rolled Bar

ASTM B 695, Coatings of Zinc Mechanically Deposited on Iron and Steel

ASTM E 140, Standard Hardness Conversion Tables for Metals (Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Rockwell Superficial Hardness, Knoop Hardness, and Scleroscope Hardness)

ASTM F 436, Standard Specification for Hardened Steel Washers

ASTM F 844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use

Publisher: The American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 (www.astm.org)

Federal Specification QQ-N-286, Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500)