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ASME B18.21.1-1999
(Revision of ASME B18.21.1-1994)

# LOCK WASHERS (INCH SERIES)

AN AMERICAN NATIONAL STANDARD



The American Society of
Mechanical Engineers

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# FOREWORD

American National Standards Committee B27 for the standardization of plain and lock washers was organized in March 1926 as Sectional Committee B27 under the aegis of the American Standards Association (later the United States of America Standards Institute and, as of October 6, 1969, the American National Standards Institute, Inc.), with the Society of Automotive Engineers and the American Society of Mechanical Engineers as joint sponsors. Since 1950, this Committee has been responsible for the standardization of washers and machine rings.

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. A tentative standard for helical spring-lock washers circulated for industry comment in November 1931, but failed to achieve acceptance. Hence, Committee activity was dormant for some years.

In 1940, the B27 Committee was reorganized, and Subcommittee 2 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, was accepted as an American Standard under the designation ASA B27.1-1944.

During the ensuing years, minor refinements to the hardness requirements and methods of test were considered. 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, the inclusion of specifications for tooth-lock washers, and both helical spring- and tooth-lock washers, and machine screw assemblies. A draft proposal incorporating requirements applicable to corrosion-resistant steel, phosphor bronze, silicon bronze, aluminum-zinc alloy, K-monel helical spring-lock washers, and the other new products was completed by Subcommittee 2 in September 1949. Subsequent to 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.

From 1951 through 1958, Subcommittee 2 held five meetings, at which members agreed to extend the light and heavy series helical spring-lock washers 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.

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

* As of April 1, 1966, Subcommittee 1 was redesignated Subcommittee 2 on plain washers, and Subcommittee 2 was redesignated Subcommittee 1 on lock washers.



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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. It was then approved by the sponsors and the American Standards Association, and officially granted recognition as an American Standard on September 20, 1965.

After continued studies conducted by the Helical Washer Institute, the group submitted further recommendations for changes to the Standard 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 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 Commitee B27 on August 11, 1970. Subsequent to the inclusion of additional editorial refinements, the proposal was accepted 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 activity was transferred to American National Standards Committee B18. Subcommittee 1 of B27 was redesignated as Subcommittee 21 of Standards Committee B18. This is the reason for the redesignation of the Standard. This revision was approved as an American National Standard on April 28, 1972. In 1983, the B18.21.1 Subcommittee reaffirmed the 1972 standard.

On December 1, 1985, the first draft containing revisions to the 1972 reaffirmed standard was completed. This revised draft was reviewed by the members of Subcommittee 21 at the December 1985 meeting. Between the meetings in December 1985 and December 1987, the Standard was reviewed by the Subcommittee and refinements were made. A motion to ballot the Standard was made in December 1987. By December 1988, all ballot comments were reviewed and editorial changes were made. At the May 1989 meeting, a revised draft, dated May 7, 1989, was submitted for publication. Some of the changes for the helical spring-lock washer 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 washer inside diameter, requiring heavier coatings such as ones that are mechanically



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galvanized, moving the decarburization measuring requirement into the proper designated head, 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 with the standard format of B18 documents.

This new edition of the Standard was approved as an American National Standard on November 2, 1999.



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

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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.

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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 which are necessary to explain the question; however, they should not contain proprietary names or information. |

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

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# LOCK WASHERS (INCH SERIES)

## 1 INTRODUCTORY NOTES

### 1.1 Scope

**1.1.1** This Standard covers the dimensions, physical properties, and methods of testing for helical spring- and tooth-lock washers.

**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 Types

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

**1.2.2 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 Dimensions

All dimensions in this Standard are given in inches and are valid before any coating is applied, unless otherwise specified.

### 1.4 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 accomplished under the control or direction of the manufacturer.

### 1.5 Terminology

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

### 1.6 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 B18.18.1M, Inspection and Quality Assurance for General Purpose Fasteners

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

ASME B18.18.3M, Inspection and Quality Assurance for Special Purpose Fasteners

ASME B18.18.4M, Inspection and Quality Assurance for Fasteners for Highly Specialized Engineered Applications

ASME B18.24.3, Part Identifying Number (PIN) Code System Standard for B18 Nonthreaded Products

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016; Order Department: 22 Law Drive, Box 2900, Fairfield, NJ 07007

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

Publisher: The American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428



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SAE J403, Chemical Composition of SAE Carbon Steels
SAE J404, Chemical Composition of SAE Alloy Steels
SAE J405, Chemical Composition of SAE Wrought Stainless Steels
SAE J411, Carbon and Alloy Steels
SAE J419, Methods of Measuring Decarburization

Publisher: The Society of Automotive Engineers (SAE), 400 Commonwealth Drive, Warrendale, PA 15096

Federal Specification QQ-N-286, Nickel-Copper-Aluminum Alloy, Wrought

Publisher: Department of Defense Single Stock Point for Military Specifications and Standards (DODSSP), Defense Automated Printing Service, 700 Robbins Avenue, Building 4/D, Philadelphia, PA 19111

### 1.7 Lot

For all inspections referenced in this Standard, the lot shall consist of all washers of one type, grade, style, finish, and size fabricated by the same production process from the same heat number of metal as provided by the metal manufacturer, and submitted for inspection and testing at the same time. The maximum lot size shall be restricted to one shift of production.

### 1.8 Inspection and Quality Assurance

Unless otherwise specified, acceptability of this Standard shall be determined in accordance with ASME B18.18.1M.

## 2 GENERAL DATA FOR HELICAL SPRING-LOCK WASHERS

### 2.1 Application

The helical spring-lock washers covered in this Standard are intended for general applications. Helical spring-lock washers compensate for developed looseness between component parts of an assembly, distribute the load over a larger area for some head styles, and provide a hardened bearing surface.

### 2.2 Dimensions

The dimensions of regular, extra duty, and high-collar helical spring-lock washers shall be specified in Tables 1 through 4. Selection should be made from the regular, heavy, extra duty, or high-collar series in Tables 1, 2, 3, and 4, respectively, to suit design requirements.

### 2.3 Material and Hardness

**2.3.1 Material Composition.** Washers shall be made from material meeting the chemical composition requirements of one of the following standards.

*(a) Carbon Steel.* SAE J403 1055–1065 (UNS G10550–G10650).

*(b) Boron Steel.* SAE J411 10B55–10B65.

*(c) Stainless Steel.* SAE J405 302–305 (UNS S30200–S30500) or SAE J405 316 (UNS S31600).

*(d) Aluminum Alloy.* ASTM B 211, Alloy 7075 (UNS A97075).

*(e) Phosphor-Bronze.* ASTM B 159, Copper Alloy No. 510 (UNS C51000).

*(f) Silicon-Bronze.* ASTM B 99, Copper Alloy No. 651 or 655 (UNS C65100 or C65500).

*(g) Nickel-Copper-Aluminum.* Federal Specification QQ-N-286 (UNS N05500).

*(h) Alloy Steel.* SAE J404 4037 (UNS G40370).

Other materials and grades shall be as agreed upon by the manufacturer and purchaser.

**2.3.2 Hardness.** All washers shall be prepared for checking the material hardness by cold (water) grinding or filing the sides sufficiently flat and parallel to ensure correct readings. If applicable, be sure to remove the decarburized or plated surface. During this operation, care shall be exercised to prevent the surface temperature of the washer from exceeding 250°F. Hardness requirements applicable to washers of the respective materials shall be as follows. Refer to ASTM E 140 for hardness conversion.

*(a) Carbon Steel.* 38 to 46 HRC, 372 to 458 HV.

*(b) Boron Steel.* 38 to 46 HRC, 372 to 458 HV.

*(c) Stainless Steel.* 35 to 43 HRC, 345 to 423 HV for lock washers up to and including $\frac{5}{8}$ in., for larger sizes 32 to 43 HRC, 318 to 423 HV.

*(d) Aluminum Alloy.* 75 to 97 HRB, 137 to 222 HV.

*(e) Phosphor-Bronze.* 90 min. HRB, 185 min. HV, or equivalent.

*(f) Silicon-Bronze.* 90 min. HRB, 185 min. HV, or equivalent.

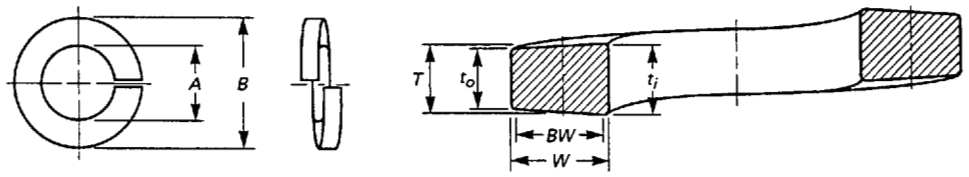
*(g) Nickel-Copper-Aluminum.* 33 to 40 HRC, 327 to 392 HV.

*(h) Alloy Steel.* 38 to 46 HRC, 372 to 458.

**2.3.3 Decarburization.** Carbon steel-, boron steel-, and alloy steel-lock washers shall meet the limits for decarburization shown in Table 5. Method for testing decarburization limits shall conform with SAE J419.



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Enlarged Section

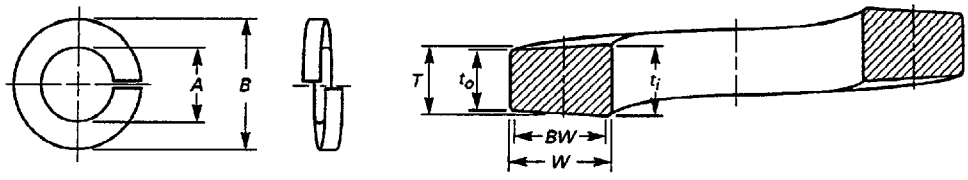
## TABLE 1 DIMENSIONS OF REGULAR HELICAL SPRING-LOCK WASHERS

| Nominal Washer Size | Inside Diameter, A | | Outside Diameter, B | Mean Section Thickness $(t_i + t_o)/2$, T | Section Width, W | Bearing Width, BW |
|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Min. | Min. |
| No. 2 (0.086) | 0.094 | 0.088 | 0.172 | 0.020 | 0.035 | 0.024 |
| No. 3 (0.099) | 0.107 | 0.101 | 0.195 | 0.025 | 0.040 | 0.028 |
| No. 4 (0.112) | 0.120 | 0.114 | 0.209 | 0.025 | 0.040 | 0.028 |
| No. 5 (0.125) | 0.133 | 0.127 | 0.236 | 0.031 | 0.047 | 0.033 |
| No. 6 (0.138) | 0.148 | 0.141 | 0.250 | 0.031 | 0.047 | 0.033 |
| No. 8 (0.164) | 0.174 | 0.167 | 0.293 | 0.040 | 0.055 | 0.038 |
| No. 10 (0.190) | 0.200 | 0.193 | 0.334 | 0.047 | 0.062 | 0.043 |
| No. 12 (0.216) | 0.227 | 0.220 | 0.377 | 0.056 | 0.070 | 0.049 |
| 1/4 (0.250) | 0.260 | 0.252 | 0.487 | 0.062 | 0.109 | 0.076 |
| 5/16 (0.3125) | 0.322 | 0.314 | 0.583 | 0.078 | 0.125 | 0.087 |
| 3/8 (0.375) | 0.385 | 0.377 | 0.680 | 0.094 | 0.141 | 0.099 |
| 7/16 (0.4375) | 0.450 | 0.440 | 0.776 | 0.109 | 0.156 | 0.109 |
| 1/2 (0.500) | 0.512 | 0.502 | 0.869 | 0.125 | 0.171 | 0.120 |
| 9/16 (0.5625) | 0.574 | 0.564 | 0.965 | 0.141 | 0.188 | 0.132 |
| 5/8 (0.625) | 0.641 | 0.628 | 1.073 | 0.156 | 0.203 | 0.142 |
| 11/16 (0.6875) | 0.704 | 0.691 | 1.170 | 0.172 | 0.219 | 0.153 |
| 3/4 (0.750) | 0.766 | 0.753 | 1.265 | 0.188 | 0.234 | 0.164 |
| 13/16 (0.8125) | 0.832 | 0.816 | 1.363 | 0.203 | 0.250 | 0.175 |
| 7/8 (0.875) | 0.894 | 0.878 | 1.459 | 0.219 | 0.266 | 0.186 |
| 15/16 (0.9375) | 0.958 | 0.941 | 1.556 | 0.234 | 0.281 | 0.197 |
| 1 (1.000) | 1.024 | 1.003 | 1.656 | 0.250 | 0.297 | 0.208 |
| 1 1/16 (1.0625) | 1.087 | 1.066 | 1.751 | 0.266 | 0.312 | 0.218 |
| 1 1/8 (1.125) | 1.153 | 1.129 | 1.847 | 0.281 | 0.328 | 0.230 |
| 1 3/16 (1.1875) | 1.217 | 1.192 | 1.943 | 0.297 | 0.344 | 0.241 |
| 1 1/4 (1.250) | 1.280 | 1.254 | 2.036 | 0.312 | 0.359 | 0.251 |
| 1 5/16 (1.3125) | 1.344 | 1.317 | 2.133 | 0.328 | 0.375 | 0.262 |
| 1 3/8 (1.375) | 1.408 | 1.379 | 2.219 | 0.344 | 0.391 | 0.274 |
| 1 7/16 (1.4375) | 1.472 | 1.442 | 2.324 | 0.359 | 0.406 | 0.284 |
| 1 1/2 (1.500) | 1.534 | 1.504 | 2.419 | 0.375 | 0.422 | 0.295 |
| 1 5/8 (1.625) | 1.663 | 1.633 | 2.553 | 0.389 | 0.424 | 0.297 |
| 1 3/4 (1.750) | 1.789 | 1.758 | 2.679 | 0.389 | 0.424 | 0.297 |
| 1 7/8 (1.875) | 1.914 | 1.883 | 2.811 | 0.422 | 0.427 | 0.299 |
| 2 (2.000) | 2.039 | 2.008 | 2.936 | 0.422 | 0.427 | 0.299 |
| 2 1/4 (2.250) | 2.293 | 2.262 | 3.221 | 0.440 | 0.442 | 0.309 |
| 2 1/2 (2.500) | 2.543 | 2.512 | 3.471 | 0.440 | 0.442 | 0.309 |
| 2 3/4 (2.750) | 2.793 | 2.762 | 3.824 | 0.458 | 0.491 | 0.344 |
| 3 (3.000) | 3.043 | 3.012 | 4.074 | 0.458 | 0.491 | 0.344 |

GENERAL NOTES:
(a) For additional requirements, refer to section 2.
(b) Dimensions are in inches.



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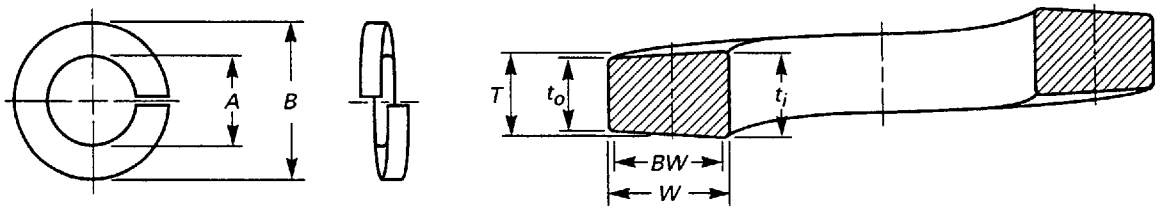
## TABLE 2 DIMENSIONS OF HEAVY HELICAL SPRING-LOCK WASHERS

| Nominal Washer Size | Inside Diameter, *A* | | Outside Diameter, *B* | Mean Section Thickness $(t_i + t_o)/2$, *T* | Section Width, *W* | Bearing Width, *BW* |
|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Min. | Min. |
| No. 2 (0.086) | 0.094 | 0.088 | 0.182 | 0.025 | 0.040 | 0.028 |
| No. 3 (0.099) | 0.107 | 0.101 | 0.209 | 0.031 | 0.047 | 0.033 |
| No. 4 (0.112) | 0.120 | 0.114 | 0.223 | 0.031 | 0.047 | 0.033 |
| No. 5 (0.125) | 0.133 | 0.127 | 0.252 | 0.040 | 0.055 | 0.038 |
| No. 6 (0.138) | 0.148 | 0.141 | 0.266 | 0.040 | 0.055 | 0.038 |
| No. 8 (0.164) | 0.174 | 0.167 | 0.307 | 0.047 | 0.062 | 0.043 |
| No. 10 (0.190) | 0.200 | 0.193 | 0.350 | 0.056 | 0.070 | 0.049 |
| No. 12 (0.216) | 0.227 | 0.220 | 0.391 | 0.063 | 0.077 | 0.054 |
| 1/4 (0.250) | 0.260 | 0.252 | 0.489 | 0.077 | 0.110 | 0.077 |
| 5/16 (0.3125) | 0.322 | 0.314 | 0.593 | 0.097 | 0.130 | 0.091 |
| 3/8 (0.375) | 0.385 | 0.377 | 0.688 | 0.115 | 0.145 | 0.101 |
| 7/16 (0.4375) | 0.450 | 0.440 | 0.784 | 0.133 | 0.160 | 0.112 |
| 1/2 (0.500) | 0.512 | 0.502 | 0.879 | 0.151 | 0.176 | 0.123 |
| 9/16 (0.5625) | 0.574 | 0.564 | 0.975 | 0.170 | 0.193 | 0.135 |
| 5/8 (0.625) | 0.641 | 0.628 | 1.087 | 0.189 | 0.210 | 0.147 |
| 11/16 (0.6875) | 0.704 | 0.691 | 1.186 | 0.207 | 0.227 | 0.159 |
| 3/4 (0.750) | 0.766 | 0.753 | 1.285 | 0.226 | 0.244 | 0.171 |
| 13/16 (0.8125) | 0.832 | 0.816 | 1.387 | 0.246 | 0.262 | 0.183 |
| 7/8 (0.875) | 0.894 | 0.878 | 1.489 | 0.266 | 0.281 | 0.197 |
| 15/16 (0.9375) | 0.958 | 0.941 | 1.590 | 0.284 | 0.298 | 0.209 |
| 1 (1.000) | 1.024 | 1.003 | 1.700 | 0.306 | 0.319 | 0.223 |
| 1 1/16 (1.0625) | 1.087 | 1.066 | 1.803 | 0.326 | 0.338 | 0.237 |
| 1 1/8 (1.125) | 1.153 | 1.129 | 1.903 | 0.345 | 0.356 | 0.249 |
| 1 3/16 (1.1875) | 1.217 | 1.192 | 2.001 | 0.364 | 0.373 | 0.261 |
| 1 1/4 (1.250) | 1.280 | 1.254 | 2.104 | 0.384 | 0.393 | 0.275 |
| 1 5/16 (1.3125) | 1.344 | 1.317 | 2.203 | 0.403 | 0.410 | 0.287 |
| 1 3/8 (1.375) | 1.408 | 1.379 | 2.301 | 0.422 | 0.427 | 0.299 |
| 1 7/16 (1.4375) | 1.472 | 1.442 | 2.396 | 0.440 | 0.442 | 0.309 |
| 1 1/2 (1.500) | 1.534 | 1.504 | 2.491 | 0.458 | 0.458 | 0.321 |
| 1 5/8 (1.625) | 1.663 | 1.633 | 2.694 | 0.458 | 0.491 | 0.344 |
| 1 3/4 (1.750) | 1.789 | 1.758 | 2.820 | 0.458 | 0.491 | 0.344 |
| 1 7/8 (1.875) | 1.914 | 1.883 | 2.945 | 0.458 | 0.491 | 0.344 |
| 2 (2.000) | 2.039 | 2.008 | 3.144 | 0.496 | 0.526 | 0.368 |
| 2 1/4 (2.250) | 2.293 | 2.262 | 3.398 | 0.496 | 0.526 | 0.368 |
| 2 1/2 (2.500) | 2.543 | 2.512 | 3.648 | 0.496 | 0.526 | 0.368 |
| 2 3/4 (2.750) | 2.793 | 2.762 | 3.910 | 0.526 | 0.532 | 0.372 |
| 3 (3.000) | 3.043 | 3.012 | 4.160 | 0.526 | 0.532 | 0.372 |

GENERAL NOTES:
(a) For additional requirements, refer to section 2.
(b) Dimensions are in inches.



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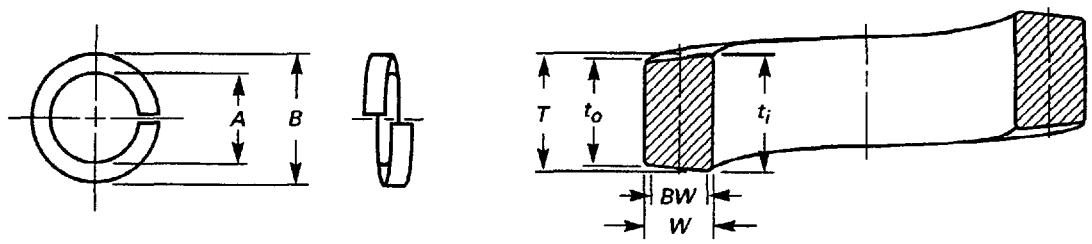
## TABLE 3 DIMENSIONS OF EXTRA-DUTY HELICAL SPRING-LOCK WASHERS

| Nominal Washer Size | Inside Diameter, *A* | | Outside Diameter, *B* | Mean Section Thickness $(t_i + t_o)/2$, *T* | Section Width, *W* | Bearing Width, *BW* |
|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Min. | Min. |
| No. 2 (0.086) | 0.094 | 0.088 | 0.208 | 0.027 | 0.053 | 0.037 |
| No. 3 (0.099) | 0.107 | 0.101 | 0.239 | 0.034 | 0.062 | 0.043 |
| No. 4 (0.112) | 0.120 | 0.114 | 0.253 | 0.034 | 0.062 | 0.043 |
| No. 5 (0.125) | 0.133 | 0.127 | 0.300 | 0.045 | 0.079 | 0.055 |
| No. 6 (0.138) | 0.148 | 0.141 | 0.314 | 0.045 | 0.079 | 0.055 |
| No. 8 (0.164) | 0.174 | 0.167 | 0.375 | 0.057 | 0.096 | 0.067 |
| No. 10 (0.190) | 0.200 | 0.193 | 0.434 | 0.068 | 0.112 | 0.078 |
| No. 12 (0.216) | 0.227 | 0.220 | 0.497 | 0.080 | 0.130 | 0.091 |
| 1/4 (0.250) | 0.260 | 0.252 | 0.533 | 0.084 | 0.132 | 0.092 |
| 5/16 (0.3125) | 0.322 | 0.314 | 0.619 | 0.108 | 0.143 | 0.100 |
| 3/8 (0.375) | 0.385 | 0.377 | 0.738 | 0.123 | 0.170 | 0.119 |
| 7/16 (0.4375) | 0.450 | 0.440 | 0.836 | 0.143 | 0.186 | 0.130 |
| 1/2 (0.500) | 0.512 | 0.502 | 0.935 | 0.162 | 0.204 | 0.143 |
| 9/16 (0.5625) | 0.574 | 0.564 | 1.035 | 0.182 | 0.223 | 0.156 |
| 5/8 (0.625) | 0.641 | 0.628 | 1.151 | 0.202 | 0.242 | 0.169 |
| 11/16 (0.6875) | 0.704 | 0.691 | 1.252 | 0.221 | 0.260 | 0.182 |
| 3/4 (0.750) | 0.766 | 0.753 | 1.355 | 0.241 | 0.279 | 0.195 |
| 13/16 (0.8125) | 0.832 | 0.816 | 1.458 | 0.261 | 0.298 | 0.209 |
| 7/8 (0.875) | 0.894 | 0.878 | 1.571 | 0.285 | 0.322 | 0.225 |
| 15/16 (0.9375) | 0.958 | 0.941 | 1.684 | 0.308 | 0.345 | 0.241 |
| 1 (1.000) | 1.024 | 1.003 | 1.794 | 0.330 | 0.366 | 0.256 |
| 1 1/16 (1.0625) | 1.087 | 1.066 | 1.905 | 0.352 | 0.389 | 0.272 |
| 1 1/8 (1.125) | 1.153 | 1.129 | 2.013 | 0.375 | 0.411 | 0.288 |
| 1 3/16 (1.1875) | 1.217 | 1.192 | 2.107 | 0.396 | 0.431 | 0.302 |
| 1 1/4 (1.250) | 1.280 | 1.254 | 2.222 | 0.417 | 0.452 | 0.316 |
| 1 5/16 (1.3125) | 1.344 | 1.317 | 2.327 | 0.438 | 0.472 | 0.330 |
| 1 3/8 (1.375) | 1.408 | 1.379 | 2.429 | 0.458 | 0.491 | 0.344 |
| 1 7/16 (1.4375) | 1.472 | 1.442 | 2.530 | 0.478 | 0.509 | 0.356 |
| 1 1/2 (1.500) | 1.534 | 1.504 | 2.627 | 0.496 | 0.526 | 0.368 |
| 1 5/8 (1.625) | 1.663 | 1.633 | 2.784 | 0.496 | 0.526 | 0.368 |
| 1 3/4 (1.750) | 1.789 | 1.758 | 2.902 | 0.526 | 0.532 | 0.372 |
| 1 7/8 (1.875) | 1.914 | 1.883 | 3.027 | 0.526 | 0.532 | 0.372 |
| 2 (2.000) | 2.039 | 2.008 | 3.156 | 0.526 | 0.532 | 0.372 |

GENERAL NOTES:
(a) For additional requirements, refer to section 2.
(b) Dimensions are in inches.



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**TABLE 4 DIMENSIONS OF HIGH-COLLAR HELICAL SPRING-LOCK WASHERS**

| Nominal Washer Size | Inside Diameter, A | | Outside Diameter, B | Mean Section Thickness $(t_i + t_o)/2$, T | Section Width, W | Bearing Width, BW |
|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Min. | Min. |
| No. 4 (0.112) | 0.120 | 0.114 | 0.173 | 0.022 | 0.022 | 0.015 |
| No. 5 (0.125) | 0.133 | 0.127 | 0.202 | 0.030 | 0.030 | 0.021 |
| No. 6 (0.138) | 0.148 | 0.141 | 0.216 | 0.030 | 0.030 | 0.021 |
| No. 8 (0.164) | 0.174 | 0.167 | 0.267 | 0.047 | 0.042 | 0.029 |
| No. 10 (0.190) | 0.200 | 0.193 | 0.294 | 0.047 | 0.042 | 0.029 |
| 1/4 (0.250) | 0.260 | 0.252 | 0.363 | 0.078 | 0.047 | 0.033 |
| 5/16 (0.3125) | 0.322 | 0.314 | 0.457 | 0.093 | 0.062 | 0.043 |
| 3/8 (0.375) | 0.385 | 0.377 | 0.550 | 0.125 | 0.076 | 0.053 |
| 7/16 (0.4375) | 0.450 | 0.440 | 0.644 | 0.140 | 0.090 | 0.063 |
| 1/2 (0.500) | 0.512 | 0.502 | 0.733 | 0.172 | 0.103 | 0.072 |
| 5/8 (0.625) | 0.641 | 0.628 | 0.917 | 0.203 | 0.125 | 0.087 |
| 3/4 (0.750) | 0.766 | 0.753 | 1.105 | 0.218 | 0.154 | 0.108 |
| 7/8 (0.875) | 0.894 | 0.878 | 1.291 | 0.234 | 0.182 | 0.127 |
| 1 (1.000) | 1.024 | 1.003 | 1.478 | 0.250 | 0.208 | 0.146 |
| 1 1/8 (1.125) | 1.153 | 1.129 | 1.663 | 0.313 | 0.236 | 0.165 |
| 1 1/4 (1.250) | 1.280 | 1.254 | 1.790 | 0.313 | 0.236 | 0.165 |
| 1 3/8 (1.375) | 1.408 | 1.379 | 2.031 | 0.375 | 0.292 | 0.204 |
| 1 1/2 (1.500) | 1.534 | 1.504 | 2.159 | 0.375 | 0.292 | 0.204 |
| 1 3/4 (1.750) | 1.789 | 1.758 | 2.596 | 0.469 | 0.383 | 0.268 |
| 2 (2.000) | 2.039 | 2.008 | 2.846 | 0.469 | 0.383 | 0.268 |
| 2 1/4 (2.250) | 2.293 | 2.262 | 3.345 | 0.508 | 0.508 | 0.356 |
| 2 1/2 (2.500) | 2.543 | 2.512 | 3.595 | 0.508 | 0.508 | 0.356 |
| 2 3/4 (2.750) | 2.793 | 2.762 | 4.095 | 0.633 | 0.633 | 0.443 |
| 3 (3.000) | 3.043 | 3.012 | 4.345 | 0.633 | 0.633 | 0.443 |

GENERAL NOTES:
(a) For additional requirements, refer to section 2.
(b) Dimensions are in inches.

## 2.4 Designation

Normal washer sizes are intended for use with comparable nominal screw or nut sizes. Fasteners conforming to this Standard shall be designated by the following data and sequence shown, or optionally by the ASME B18.24.3 PIN Code. See examples below:

*(a)* product name and style, where applicable
*(b)* ASME document number
*(c)* nominal size
*(d)* series
*(e)* material
*(f)* surface protective finish, if necessary

EXAMPLES:

(1) Helical Spring-Lock Washer, ASME B18.21.1, 3/8 in., Extra Duty, Carbon Steel, Phosphate Coated. PIN Code: W211NAC0037NN155NNNF1.



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**TABLE 5 DECARBURIZATION LIMITS**

| Diameters of Round Wire or Sections of Equivalent Area | Maximum Depth of Free Ferrite | Maximum Total Affected Depth (Free Ferrite Plus Partial Decarburization) |
|---|---|---|
| Up to 0.140, incl. | 0.002 | 0.006 |
| Over 0.140 to 0.250, incl. | 0.003 | 0.008 |
| Over 0.250 to 0.375, incl. | 0.004 | 0.010 |
| Over 0.375 to 0.500, incl. | 0.006 | 0.015 |

GENERAL NOTE: Dimensions are in inches.

(2) Helical Spring-Lock Washer, ASME B18.21.1, ½ in., High-Collar, Stainless Steel. PIN Code: W211NAD0050NN421NNAB1.

## 2.5 Washer Section

The section of finished washers shall be slightly trapezoidal with thickness at the inner periphery greater than the thickness at the outer periphery by a minimum of 0.0005 in. to a maximum of 0.001 in. per 0.0156 in. of the section width. The minimum section thickness specified in the dimensional tables represents the nominal mean thickness, $T$, of the trapezoid. Reduced to formulas, the increase in thickness from the outer periphery to inner periphery is $t_i$ minus $t_o$ or $0.032W$ (min.) to $0.064W$ (max.). The tolerance on the nominal mean thickness of the trapezoid shall be subject to a plus tolerance equal to the following:

| Size | Tolerance, +, in. |
|---|---|
| No. 12 and smaller | 0.006 |
| ¼ to 13/16 in. | 0.010 |
| ⅞ to 1½ in. | 0.020 |
| 1⅝ to 3 in. | 0.030 |

The corners at the inner and outer peripheries of the washers shall be slightly rounded. However, the extent of the rounding shall be such that the bearing width of the washer section is not reduced to less than the $BW$ values shown in Tables 1, 2, 3, and 4. It is recommended that conformance to this limitation be determined by presetting a suitable caliper measuring device to the tabulated minimum bearing width dimension and comparing the setting to the flat bearing face on each side of the washer as shown in Fig. 1.

## 2.6 Coiling

Washers shall be coiled so that the free height is approximately equivalent to twice the thickness of the washer section. The gap and relationship of the severed ends shall be such as to prevent washers from tangling and to ensure that washers compress flatly.

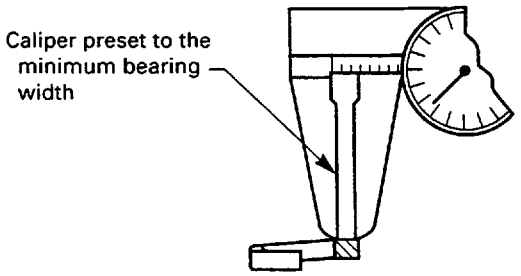



**FIG. 1 VERIFYING MINIMUM BEARING WIDTH**

## 2.7 Processing

**2.7.1 Finishes.** Unless otherwise specified by the purchaser, lock washers shall be supplied with a plain (as processed) finish, not plated or coated. Where corrosion preventative treatment is required, washers shall be plated or coated as specified by the purchaser. When helical spring-lock washers are to be furnished with coatings over 0.0005 in. thick and are to be used with bolts or screws also having thicker coatings, they are to be coiled to limits of 0.020 in. in excess of those specified in Tables 1 through 4 for minimum inside diameter and maximum outside diameter. Heavy coating of washers under ¼ in. nominal size is not recommended.

**2.7.2 Embrittlement.** Carbon and boron steel-lock washers that are electroplated or coated may be subject to embrittlement and shall be suitably treated to minimize such embrittlement. Plated washers shall not fracture after having been compressed flat for a minimum of 48 hr.

## 2.8 Workmanship

The flat surfaces (faces) of helical spring-lock washers shall be free from such surface imperfections as knurling, serrations, die marks, deep scratches, loose scale, burrs, or other irregularities that would affect serviceability. Moderate feed roll marks shall be permissible on the outer periphery.

## 2.9 Twist Tests

The washer shall be gripped in vise jaws. The ends of the washer shall be free, and an axis passing through the slot shall be parallel to and slightly above the top of the vise so less than 50% of the washer is gripped. A 90 deg maximum segment of the free end of the



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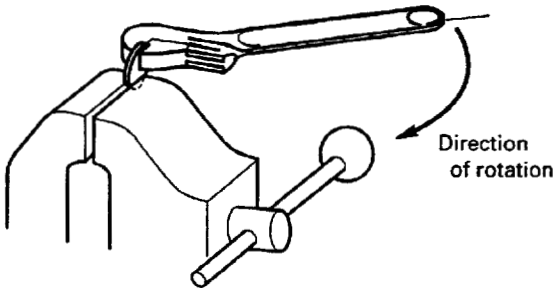



**FIG. 2 WASHER TWIST TEST**

washer shall be gripped in wrench jaws so at least 25% of the washer is exposed when twisting, as shown in Fig. 2. Edges of the wrench jaws shall be in a plane parallel to the vise. Movement of the wrench that increases the free height of the spring-lock washer shall twist carbon steel, boron steel, and alloy steel washers through an angle approximating 90 deg, and corrosion resistant steel and nonferrous washers through an angle approximating 45 deg with no sign of fracture.

## 3 GENERAL DATA FOR TOOTH-LOCK WASHERS

### 3.1 Application

The tooth-lock washers covered in this Standard are intended for general application. The tooth-lock washers serve to increase the friction between the screw and the assembly. Internal tooth-lock washers are preferred where it is desirable to provide a smooth periphery.

### 3.2 Tooth Design

The Type A and Type B tooth designs shall be optional.

### 3.3 Dimensions

Dimensions of internal tooth-lock washers, heavy internal tooth-lock washers, external tooth-lock washers, and internal/external tooth lock washers shall be as specified in Tables 6 through 10.

### 3.4 Material and Hardness

**3.4.1 Material Composition.** Washers shall be made from material meeting the chemical composition requirements of one of the following standards:

*(a) Carbon Steel.* SAE J403 1050–1065 or equivalent (UNS G10500–G10650).

*(b) Stainless Steel.* SAE J405 301–305 (UNS S30100–S30500) or SAE J405 316 (UNS S31600).

*(c) Stainless Steel.* SAE J405 410 (UNS S41000).

*(d) Copper Alloy.* ASTM B 591 Type 425 (UNS C42500).

Other materials and grades shall be as agreed upon by the manufacturer and purchaser.

**3.4.2 Hardness.** Washers that are manufactured from carbon steel that show evidence of decarburization, or parts that were plated, shall have these surface layers removed before checking. During this operation, care shall be exercised to prevent the surface temperature of the washer from exceeding 250°F. It is recommended that the lighter, more sensitive depth reading HRA scale be used in lieu of HRC when testing washers of a thin section. Hardness requirements applicable to washers of the respective materials shall be as follows. Refer to ASTM E 140 for hardness conversions.

*(a) Carbon Steel.* 40 to 50 HRC, 392 to 513 HV.

*(b) Stainless Steel 301–305.* Annealed 88 minimum. HRB, ¼ hard through full hard 20 to 45 HRC, 198 to 448 HV.

*(c) Stainless Steel 410.* 40 to 50 HRC, 392 to 513 HV.

*(d) Copper Alloy.* Temper H06 minimum.

### 3.5 Designation

Nominal washer sizes are intended for use with comparable screw or nut sizes. Fasteners conforming to this Standard shall be designated by the following data, in the sequence shown:

*(a)* product name and style where applicable

*(b)* ASME document number

*(c)* nominal size (number, fraction, or decimal equivalent)

*(d)* maximum washer outside diameter (internal/external tooth washers only)

*(e)* type

*(f)* material

*(g)* surface protective finish, if necessary

EXAMPLES:

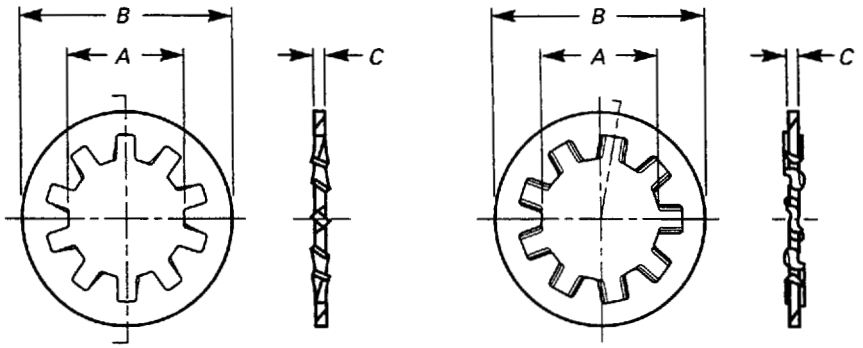
(1) Internal Tooth-Lock Washer, ASME B18.21.1, ¼ in., Type A, Stainless Steel.

(2) External Tooth-Lock Washer, ASME B18.21.1, .562 in., Type B, Carbon Steel, Phosphate Coated.

(3) Internal/External Tooth-Lock Washer, ASME B18.21.1, No. 12 (.900 O.D.), Type A, Carbon Steel, Zinc Plated.



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Type A Type B

**TABLE 6 DIMENSIONS OF INTERNAL TOOTH-LOCK WASHERS**

| Nominal Washer Size | Inside Diameter, *A* | | Outside Diameter, *B* | | Thickness, *C* | |
|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Max. | Min. |
| No. 2 (0.086) | 0.095 | 0.089 | 0.200 | 0.175 | 0.016 | 0.010 |
| No. 3 (0.099) | 0.109 | 0.102 | 0.232 | 0.215 | 0.016 | 0.010 |
| No. 4 (0.112) | 0.123 | 0.115 | 0.270 | 0.245 | 0.018 | 0.012 |
| No. 5 (0.125) | 0.136 | 0.129 | 0.280 | 0.255 | 0.020 | 0.014 |
| No. 6 (0.138) | 0.150 | 0.141 | 0.295 | 0.275 | 0.022 | 0.016 |
| No. 8 (0.164) | 0.176 | 0.168 | 0.340 | 0.325 | 0.023 | 0.018 |
| No. 10 (0.190) | 0.204 | 0.195 | 0.381 | 0.365 | 0.024 | 0.018 |
| No. 12 (0.216) | 0.231 | 0.221 | 0.410 | 0.394 | 0.027 | 0.020 |
| 1/4 (0.250) | 0.267 | 0.256 | 0.478 | 0.460 | 0.028 | 0.023 |
| 5/16 (0.3125) | 0.332 | 0.320 | 0.610 | 0.594 | 0.034 | 0.028 |
| 3/8 (0.375) | 0.398 | 0.384 | 0.692 | 0.670 | 0.040 | 0.032 |
| 7/16 (0.4375) | 0.464 | 0.448 | 0.789 | 0.740 | 0.040 | 0.032 |
| 1/2 (0.500) | 0.530 | 0.512 | 0.900 | 0.867 | 0.045 | 0.037 |
| 9/16 (0.5625) | 0.596 | 0.576 | 0.985 | 0.957 | 0.045 | 0.037 |
| 5/8 (0.625) | 0.663 | 0.640 | 1.071 | 1.045 | 0.050 | 0.042 |
| 11/16 (0.6875) | 0.728 | 0.704 | 1.166 | 1.130 | 0.050 | 0.042 |
| 3/4 (0.750) | 0.795 | 0.769 | 1.245 | 1.220 | 0.055 | 0.047 |
| 13/16 (0.8125) | 0.861 | 0.832 | 1.315 | 1.290 | 0.055 | 0.047 |
| 7/8 (0.875) | 0.927 | 0.894 | 1.410 | 1.364 | 0.060 | 0.052 |
| 1 (1.000) | 1.060 | 1.019 | 1.637 | 1.590 | 0.067 | 0.059 |
| 1 1/8 (1.125) | 1.192 | 1.144 | 1.830 | 1.799 | 0.067 | 0.059 |
| 1 1/4 (1.250) | 1.325 | 1.275 | 1.975 | 1.921 | 0.067 | 0.059 |

GENERAL NOTES:
(a) For additional requirements, refer to section 3.
(b) Dimensions are in inches.

### 3.6 Manufacturing Detail

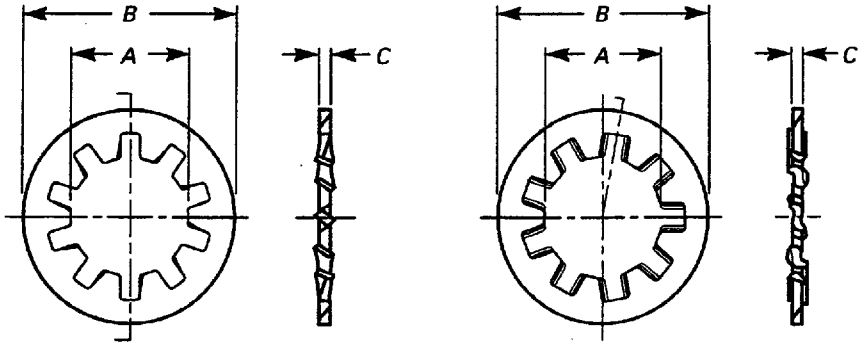
The number of teeth, the length of the teeth, the width of the rim, and the thickness of the washer over the teeth (free height) shall be optional with the manufacturer, with the provision, however, that the projection of the teeth on both sides of the washer shall be relatively uniform, but the teeth on the side with the minimum projection must be at least 50% of the side with the maximum projection.

### 3.7 Processing

**3.7.1 Finishes.** Unless otherwise specified by the purchaser, lock washers shall be supplied with a plain (as processed) finish, not plated or coated. Where



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Type A Type B

**TABLE 7 DIMENSIONS OF HEAVY INTERNAL TOOTH-LOCK WASHERS**

| Nominal Washer Size | Inside Diameter, *A* | | Outside Diameter, *B* | | Thickness, *C* | |
|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Max. | Min. |
| 1/4 (0.250) | 0.267 | 0.256 | 0.536 | 0.500 | 0.045 | 0.035 |
| 5/16 (0.3125) | 0.332 | 0.320 | 0.607 | 0.590 | 0.050 | 0.040 |
| 3/8 (0.375) | 0.398 | 0.384 | 0.748 | 0.700 | 0.050 | 0.042 |
| 7/16 (0.4375) | 0.464 | 0.448 | 0.858 | 0.800 | 0.067 | 0.050 |
| 1/2 (0.500) | 0.530 | 0.512 | 0.924 | 0.880 | 0.067 | 0.055 |
| 9/16 (0.5625) | 0.596 | 0.576 | 1.034 | 0.990 | 0.067 | 0.055 |
| 5/8 (0.625) | 0.663 | 0.640 | 1.135 | 1.100 | 0.067 | 0.059 |
| 3/4 (0.750) | 0.795 | 0.768 | 1.265 | 1.240 | 0.084 | 0.070 |
| 7/8 (0.875) | 0.927 | 0.894 | 1.447 | 1.400 | 0.084 | 0.075 |

GENERAL NOTES:
(a) For additional requirements, refer to section 3.
(b) Dimensions are in inches.

corrosion preventative treatment is required, washers shall be plated or coated as specified by the purchaser.

**3.7.2 Embrittlement.** Carbon steel-lock washers that are electroplated or coated may be subject to embrittlement and shall be suitably treated to minimize such embrittlement. Plated washers shall not fracture after having been compressed to a height equal to the actual material thickness for a minimum of 48 hr. Compression shall be accomplished between parallel flat surfaces for flat varieties of tooth washers, and between mating countersunk holes and cones for countersunk tooth washers.

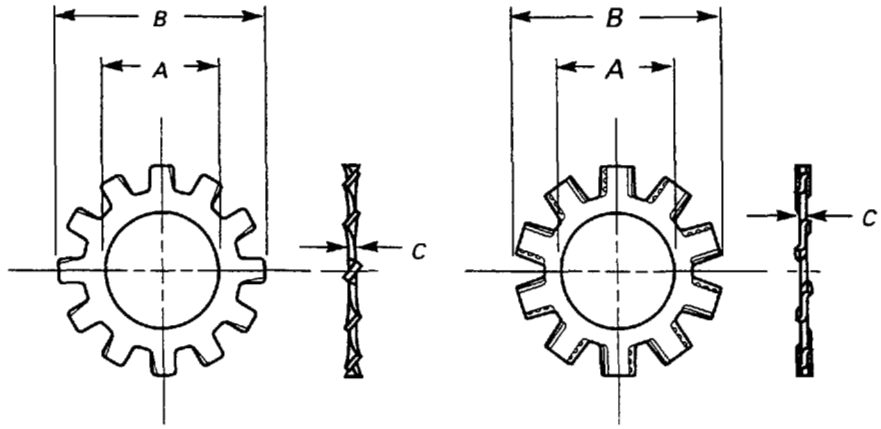
**3.7.3 Compression Test.** Washers, after being compressed to a height equal to the actual material thickness and then released, shall have a free height greater than the compressed height. Compression shall be accomplished between parallel flat surfaces for flat varieties of tooth washers, and between mating countersunk holes and cones for countersunk tooth washers.

## 3.8 Workmanship

Washers shall be symmetrical in shape and free from rust, loose scale, and defects that might affect their serviceability.



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Type A Type B

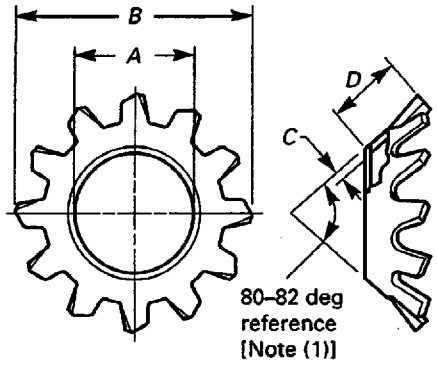
## TABLE 8 DIMENSIONS OF EXTERNAL TOOTH-LOCK WASHERS

| Nominal Washer Size | Inside Diameter, A | | Outside Diameter, B | | Thickness, C | |
|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Max. | Min. |
| No. 3 (0.099) | 0.109 | 0.102 | 0.235 | 0.220 | 0.016 | 0.010 |
| No. 4 (0.112) | 0.123 | 0.115 | 0.260 | 0.245 | 0.018 | 0.012 |
| No. 5 (0.125) | 0.136 | 0.129 | 0.285 | 0.270 | 0.020 | 0.014 |
| No. 6 (0.138) | 0.150 | 0.141 | 0.320 | 0.305 | 0.022 | 0.016 |
| No. 8 (0.164) | 0.176 | 0.168 | 0.381 | 0.365 | 0.023 | 0.018 |
| No. 10 (0.190) | 0.204 | 0.195 | 0.410 | 0.395 | 0.024 | 0.018 |
| No. 12 (0.216) | 0.231 | 0.221 | 0.475 | 0.460 | 0.027 | 0.020 |
| 1/4 (0.250) | 0.267 | 0.256 | 0.510 | 0.494 | 0.028 | 0.023 |
| 5/16 (0.3125) | 0.332 | 0.320 | 0.610 | 0.588 | 0.034 | 0.028 |
| 3/8 (0.375) | 0.398 | 0.384 | 0.694 | 0.670 | 0.040 | 0.032 |
| 7/16 (0.4375) | 0.464 | 0.448 | 0.760 | 0.740 | 0.040 | 0.032 |
| 1/2 (0.500) | 0.530 | 0.513 | 0.900 | 0.880 | 0.045 | 0.037 |
| 9/16 (0.5625) | 0.596 | 0.576 | 0.985 | 0.960 | 0.045 | 0.037 |
| 5/8 (0.625) | 0.663 | 0.641 | 1.070 | 1.045 | 0.050 | 0.042 |
| 11/16 (0.6875) | 0.728 | 0.704 | 1.155 | 1.130 | 0.050 | 0.042 |
| 3/4 (0.750) | 0.795 | 0.768 | 1.260 | 1.220 | 0.055 | 0.047 |
| 13/16 (0.8125) | 0.861 | 0.833 | 1.315 | 1.290 | 0.055 | 0.047 |
| 7/8 (0.875) | 0.927 | 0.897 | 1.410 | 1.380 | 0.060 | 0.052 |
| 1 (1.000) | 1.060 | 1.025 | 1.620 | 1.590 | 0.067 | 0.059 |

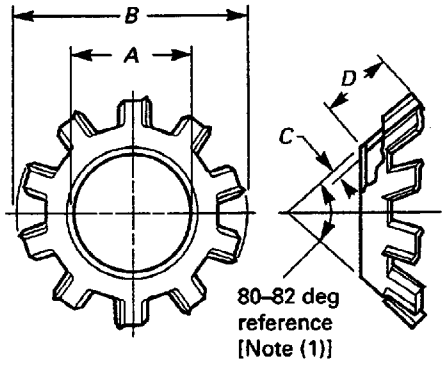
GENERAL NOTES:
(a) For additional requirements, refer to section 3.
(b) Dimensions are in inches.



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Type A




Type B

## TABLE 9 DIMENSIONS OF COUNTERSUNK EXTERNAL TOOTH-LOCK WASHERS

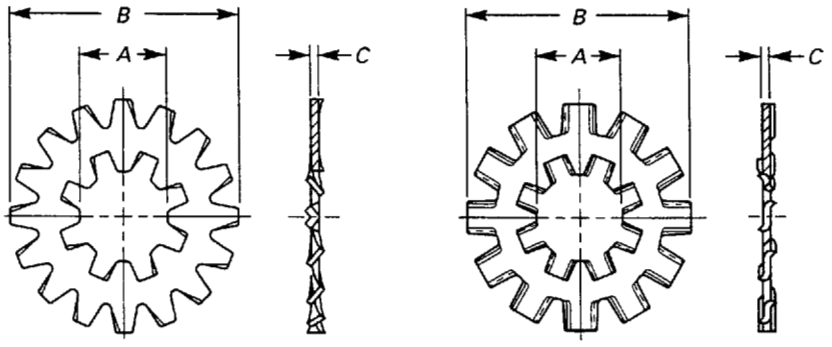
| Nominal Washer Size [Note (2)] | Inside Diameter, *A* | | Outside Diameter, *B* [Note (3)] | Thickness, *C* | | Length, *D* | |
|---|---|---|---|---|---|---|---|
| | Max. | Min. | Reference | Max. | Min. | Max. | Min. |
| No. 4 (0.112) | 0.123 | 0.113 | 0.213 | 0.019 | 0.015 | 0.065 | 0.050 |
| No. 6 (0.138) | 0.150 | 0.140 | 0.289 | 0.021 | 0.017 | 0.092 | 0.082 |
| No. 8 (0.164) | 0.177 | 0.167 | 0.322 | 0.021 | 0.017 | 0.099 | 0.083 |
| No. 10 (0.190) | 0.205 | 0.195 | 0.354 | 0.025 | 0.020 | 0.105 | 0.088 |
| No. 12 (0.216) | 0.231 | 0.220 | 0.421 | 0.025 | 0.020 | 0.128 | 0.118 |
| 1/4 (0.250) | 0.267 | 0.255 | 0.454 | 0.025 | 0.020 | 0.128 | 0.113 |
| No. 16 (0.268) | 0.287 | 0.273 | 0.505 | 0.028 | 0.023 | 0.147 | 0.137 |
| 5/16 (0.3125) | 0.333 | 0.318 | 0.599 | 0.028 | 0.023 | 0.192 | 0.165 |
| 3/8 (0.375) | 0.398 | 0.383 | 0.765 | 0.034 | 0.028 | 0.255 | 0.242 |
| 7/16 (0.4375) | 0.463 | 0.448 | 0.867 | 0.045 | 0.037 | 0.270 | 0.260 |
| 1/2 (0.500) | 0.529 | 0.512 | 0.976 | 0.045 | 0.037 | 0.304 | 0.294 |

GENERAL NOTES:
(a) For additional requirements, refer to section 3.
(b) Dimensions are in inches.

NOTES:
(1) Suggested angle or mating component is 80–82 deg.
(2) Washer sizes are intended for use with comparable nominal screw sizes.
(3) For reference purposes only; not subject to inspection.



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Type A Type B

## TABLE 10 DIMENSIONS OF INTERNAL/EXTERNAL TOOTH-LOCK WASHERS

| Nominal Washer Size | Inside Diameter, A | | Outside Diameter, B | | Thickness, C | | Nominal Washer Size | Inside Diameter, A | | Outside Diameter, B | | Thickness, C | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Max. | Min. | | Max. | Min. | Max. | Min. | Max. | Min. |
| No. 4 (0.112) | 0.123 | 0.115 | 0.475 | 0.460 | 0.021 | 0.016 | 5/16 (0.312) | 0.332 | 0.320 | 0.900 | 0.865 | 0.040 | 0.032 |
| | | | 0.510 | 0.495 | 0.021 | 0.017 | | | | 0.985 | 0.965 | 0.045 | 0.037 |
| | | | 0.610 | 0.580 | 0.021 | 0.017 | | | | 1.070 | 1.045 | 0.050 | 0.042 |
| | | | | | | | | | | 1.155 | 1.130 | 0.050 | 0.042 |
| No. 6 (0.138) | 0.150 | 0.141 | 0.510 | 0.495 | 0.028 | 0.023 | 3/8 (0.375) | 0.398 | 0.384 | 0.985 | 0.965 | 0.045 | 0.037 |
| | | | 0.610 | 0.580 | 0.028 | 0.023 | | | | 1.070 | 1.045 | 0.050 | 0.042 |
| | | | 0.690 | 0.670 | 0.028 | 0.023 | | | | 1.155 | 1.130 | 0.050 | 0.042 |
| | | | | | | | | | | 1.260 | 1.220 | 0.050 | 0.042 |
| No. 8 (0.164) | 0.176 | 0.168 | 0.610 | 0.580 | 0.034 | 0.028 | 7/16 (0.438) | 0.464 | 0.448 | 1.070 | 1.045 | 0.050 | 0.042 |
| | | | 0.690 | 0.670 | 0.034 | 0.028 | | | | 1.155 | 1.130 | 0.050 | 0.042 |
| | | | 0.760 | 0.740 | 0.034 | 0.028 | | | | 1.260 | 1.220 | 0.055 | 0.047 |
| | | | | | | | | | | 1.315 | 1.290 | 0.055 | 0.047 |
| No. 10 (0.190) | 0.204 | 0.195 | 0.610 | 0.580 | 0.034 | 0.028 | 1/2 (0.500) | 0.530 | 0.512 | 1.260 | 1.220 | 0.055 | 0.047 |
| | | | 0.690 | 0.670 | 0.040 | 0.032 | | | | 1.315 | 1.290 | 0.055 | 0.047 |
| | | | 0.760 | 0.740 | 0.040 | 0.032 | | | | 1.410 | 1.380 | 0.060 | 0.052 |
| | | | 0.900 | 0.880 | 0.040 | 0.032 | | | | 1.620 | 1.590 | 0.067 | 0.059 |
| No. 12 (0.216) | 0.231 | 0.221 | 0.690 | 0.670 | 0.040 | 0.032 | 9/16 (0.562) | 0.596 | 0.576 | 1.315 | 1.290 | 0.055 | 0.047 |
| | | | 0.760 | 0.725 | 0.040 | 0.032 | | | | 1.430 | 1.380 | 0.060 | 0.052 |
| | | | 0.900 | 0.880 | 0.040 | 0.032 | | | | 1.620 | 1.590 | 0.067 | 0.059 |
| | | | 0.985 | 0.965 | 0.045 | 0.037 | | | | 1.830 | 1.797 | 0.067 | 0.059 |
| 1/4 (0.250) | 0.267 | 0.256 | 0.760 | 0.725 | 0.040 | 0.032 | 5/8 (0.625) | 0.663 | 0.640 | 1.410 | 1.380 | 0.060 | 0.052 |
| | | | 0.900 | 0.880 | 0.040 | 0.032 | | | | 1.620 | 1.590 | 0.067 | 0.059 |
| | | | 0.985 | 0.965 | 0.045 | 0.037 | | | | 1.830 | 1.797 | 0.067 | 0.059 |
| | | | 1.070 | 1.045 | 0.045 | 0.037 | | | | 1.975 | 1.935 | 0.067 | 0.059 |

GENERAL NOTES:
(a) For additional requirements, refer to section 3.
(b) Dimensions are in inches.



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## AMERICAN NATIONAL STANDARDS FOR BOLTS, NUTS, RIVETS, SCREWS WASHERS, AND SIMILAR FASTENERS


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Large Rivets ..... B18.1.2-1972(R1995)
Metric Small Solid Rivets ..... B18.1.3M-1983(R1995)
Square and Hex Bolts and Screws (Inch Series) ..... B18.2.1-1996
Square and Hex Nuts (Inch Series) ..... B18.2.2-1987(R1999)
Metric Hex Cap Screws ..... B18.2.3.1M-1999
Metric Formed Hex Screws ..... B18.2.3.2M-1979(R1995)
Metric Heavy Hex Screws ..... B18.2.3.3M-1979(R1995)
Metric Hex Flange Screws ..... B18.2.3.4M-1984(R1995)
Metric Hex Bolts ..... B18.2.3.5M-1979(R1995)
Metric Heavy Hex Bolts ..... B18.2.3.6M-1979(R1995)
Metric Heavy Hex Structural Bolts ..... B18.2.3.7M-1979(R1995)
Metric Hex Lag Screws ..... B18.2.3.8M-1981(R1999)
Metric Heavy Hex Flange Screws ..... B18.2.3.9M-1984(R1995)
Square Head Bolts (Metric Series) ..... B18.2.3.10M-1996
Metric Hex Nuts, Style 1 ..... B18.2.4.1M-1996
Metric Hex Nuts, Style 2 ..... B18.2.4.2M-1979(R1995)
Metric Slotted Hex Nuts ..... B18.2.4.3M-1979(R1995)
Metric Hex Flange Nuts ..... B18.2.4.4M-1982(R1999)
Metric Hex Jam Nuts ..... B18.2.4.5M-1979(R1998)
Metric Heavy Hex Nuts ..... B18.2.4.6M-1979(R1998)
Fasteners for Use in Structural Applications ..... B18.2.6-1996
Socket Cap, Shoulder, and Set Screws, Hex and Spline Keys (Inch Series) ..... B18.3-1998
Socket Head Cap Screws (Metric Series) ..... B18.3.1M-1986(R1993)
Metric Series Hexagon Keys and Bits ..... B18.3.2M-1979(R1998)
Hexagon Socket Head Shoulder Screws (Metric Series) ..... B18.3.3M-1986(R1993)
Hexagon Socket Button Head Cap Screws (Metric Series) ..... B18.3.4M-1986(R1993)
Hexagon Socket Flat Countersunk Head Cap Screws (Metric Series) ..... B18.3.5M-1986(R1993)
Metric Series Socket Set Screws ..... B18.3.6M-1986(R1993)
Round Head Bolts (Inch Series) ..... B18.5-1990(R1998)
Metric Round Head Short Square Neck Bolts ..... B18.5.2.1M-1996
Metric Round Head Square Neck Bolts ..... B18.5.2.2M-1982(R1993)
Round Head Square Neck Bolts With Large Head (Metric Series) ..... B18.5.2.3M-1990(R1998)
Wood Screws (Inch Series) ..... B18.6.1-1981(R1997)
Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws ..... B18.6.2-1998
Machine Screws and Machine Screw Nuts ..... B18.6.3-1998
Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch Series) ..... B18.6.4-1981(R1997)
Metric Thread Forming and Thread Cutting Tapping Screws ..... B18.6.5M-1986(R1993)
Metric Machine Screws ..... B18.6.7M-1985(R1993)
General Purpose Semi-Tubular Rivets, Full Tubular Rivets, Split Rivets and Rivet Caps ..... B18.7-1972(R1992)
Metric General Purpose Semi-Tubular Rivets ..... B18.7.1M-1984(R1992)
Clevis Pins and Cotter Pins (Inch Series) ..... B18.8.1-1994
Taper Pins, Dowel Pins, Straight Pins, Grooved Pins, and Spring Pins (Inch Series) ..... B18.8.2-1995
Spring Pins — Coiled Type (Metric Series) ..... B18.8.3M-1995
Spring Pins — Slotted (Metric Series) ..... B18.8.4M-1994
Machine Dowel Pins — Hardened Ground (Metric Series) ..... B18.8.5M-1994
Cotter Pins (Metric Series) ..... B18.8.6M-1995
Headless Clevis Pins (Metric Series) ..... B18.8.7M-1994
Headed Clevis Pins (Metric Series) ..... B18.8.8M-1994
Grooved Pins (Metric Series) ..... B18.8.9M-1998
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Glossary of Terms for Mechanical Fasteners ..... B18.12-1962(R1991)
Screw and Washer Assemblies — Sems (Inch Series) ..... B18.13-1996
Screw and Washer Assemblies: Sems (Metric Series) ..... B18.13.1M-1998
Forged Eyebolts ..... B18.15-1985(R1995)
Metric Lifting Eyes ..... B18.15M-1998
Mechanical and Performance Requirements for Prevailing-Torque Type Steel Metric Hex Nuts and Hex Flange Nuts ..... B18.16.1M-1979(R1995)
Torque-Tension Test Requirements for Prevailing-Torque Type Steel Metric Hex Nuts and Hex Flange Nuts ..... B18.16.2M-1979(R1995)
Dimensional Requirements for Prevailing-Torque Type Steel Metric Hex Nuts and Hex Flange Nuts ..... B18.16.3M-1998
Inspection and Quality Assurance for General Purpose Fasteners ..... B18.18.1M-1987(R1999)
Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners ..... B18.18.2M-1987(R1999)
Inspection and Quality Assurance for Special Purpose Fasteners ..... B18.18.3M-1987(R1999)
Inspection and Quality Assurance for Fasteners for Highly Specialized Engineered Applications ..... B18.18.4M-1987(R1999)
Inspection and Quality Assurance Plan Requiring In-Process Inspection and Controls ..... B18.18.5M-1998
Quality Assurance Plan for Fasteners Produced in a Third Party Accreditation System ..... B18.18.6M-1998
Quality Assurance Plan for Fasteners Produced in a Customer Approved Control Plan ..... B18.18.7M-1998
*Lock Washers (Inch Series)* ..... B18.21.1-1999
Lock Washers (Metric Series) ..... B18.21.2M-1999
Metric Plain Washers ..... B18.22M-1981(R1990)
Plain Washers ..... B18.22.1-1965(R1998)
Part Identifying Number (PIN) Code System Standard for B18 Externally Threaded Products ..... B18.24.1-1996
Part Identifying Number (PIN) Code System Standard for B18 Internally Threaded Products ..... B18.24.2-1998
Part Identifying Number (PIN) Code System Standard for B18 Nonthreaded Products ..... B18.24.3-1998
Square and Rectangular Keys and Keyways ..... B18.25.1M-1996
Woodruff Keys and Keyways ..... B18.25.2M-1996
Square and Rectangular Keys and Keyways: Width Tolerances and Deviations Greater Than Basic Size ..... B18.25.3M-1998
Tapered and Reduced Cross Section Retaining Rings (Inch Series) ..... B18.27-1998
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