

ASME-B18.21.2M

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ASME B18.21.2M-1994

(REVISION OF ASME B18.21.2M-1990)

Lock Washers (Metric Series)

AN AMERICAN NATIONAL STANDARD



The American Society of
Mechanical Engineers

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The American Society of
Mechanical Engineers

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FOREWORD

(This Foreword is not part of ASME B18.21.2M-1994.)

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 designated responsibility for standardization of washers and machine rings.

In May of 1928, the B27 Committee established two subcommittees to carry on development work, Subcommittee 1¹ on plain washers and Subcommittee 2¹ on lock washers. A tentative standard for helical spring lock washers circulated for industry comment in November 1931 failed to achieve acceptance and Committee activity became dormant for some years.

In 1940 the B27 Committee was reorganized and Subcommittee 2¹ 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, and in December of 1948 the B27 Committee accepted, in principle, expansion of the standard to cover helical spring lock washers made from materials other than carbon steel and inclusion of specifications for tooth lock washers, and both helical spring and tooth lock washer and machine screw assemblies. A draft proposal incorporating requirements applicable to corrosion resistant steel, phosphor bronze, silicon bronze, aluminum-zinc alloy, and K-monel helical spring lock washers and the other new products was completed by Subcommittee 2¹ 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.

During the years 1951 through 1958, Subcommittee 2¹ held five meetings, at which it was agreed to extend the light and heavy series helical spring lock washers to include sizes 1⁵/₈ 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.

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

Throughout the period 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 designation of medium series to regular series and extra-heavy series to extra-duty series, and the addition of the hi-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, then approved by the sponsors and the American Standards Association and officially granted recognition as an American Standard on September 20, 1965.

Continued studies conducted by the Helical Washer Institute resulted in this group submitting further recommendations for changes to the standard at a meeting of American National Standards Committee B27 in October 1969. Subcommittee 1 then undertook preparation of a proposal dated May 1970, incorporating changes to helical spring lock washers. These consisted of deleting coverage for the light series and Type 420 corrosion resistant steels, adding control on section corner radius, adjusting inside diameters, 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, conducted on August 11, 1970. Subsequent to the inclusion of additional editorial refinements, the proposal was found acceptable by the sponsor organizations and submitted to the American National Standards Institute for designation as an American National Standard. After approval of this revision by 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.

At the December 1986 American National Standards B18 main meeting, a request was made to have Subcommittee 21 draft an American National Standard for metric lock washers. On May 26, 1987, the first draft of the requested standard was completed. This draft was based on the inch series standard, which was being reviewed and revised at the time by Subcommittee 21. Dimensional data and types of lock washers to be included in the tables were gathered from industry standards. Both standards were then updated as required during the May and December 1987 subcommittee meetings. At the December 1987 meeting, a motion to ballot the standard was made, and by the December 1988, meeting all ballot comments were reviewed and editorial changes were made. At the May 1989 meeting, the completed draft dated May 6, 1989 was submitted for publication.

On December 9, 1992, a proposal to revise this Standard was made. This Standard hasn't been used with the dimensions in Table 2 or with the product listed in Table 3. This revision changes the dimensions in Table 2 to reflect active part dimensions and replaces Table 3, Metric Socket Head Helical Spring Lock Washers, with a new Table 3 for Metric Heavy Helical Spring Lock Washers. 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.

ASME STANDARDS COMMITTEE B18 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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CONTENTS

	Foreword	iii
	Standards Committee Roster	vii
1	Introductory Notes	1
2	General Data for Helical Spring Lock Washers	2
3	General Data for Metric Tooth Lock Washers	4
Figures		
1	Verifying Minimum Bearing Width	3
2	Washer Twist Test	4
Tables		
1	Decarburization Limits	4
2	Dimensions of Regular Metric Helical Spring Lock Washers	7
3	Dimensions of Heavy Metric Helical Spring Lock Washers	8
4	Dimensions of Internal Tooth Lock Washers	9
5	Dimensions of Heavy Internal Tooth Lock Washers	10
6	Dimensions of External Tooth Lock Washers	11
7	Dimensions of Countersunk External Tooth Lock Washers	12
8	Dimensions of External-Internal Tooth Lock Washers	13
Appendix		
A	Government Standard Items and Part Numbering System	15

LOCK WASHERS (METRIC 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.

1.1.3 Lock washers purchased for Government use shall conform to this Standard and additionally to the requirements of Appendix A.

1.2 Comparison with ISO

No comparable standard exist.

1.3 Types

1.3.1 Helical Spring Lock Washers. This Standard covers helical spring lock washers of the following sections: regular and heavy.

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

1.4 Dimensions

All dimensions in this Standard are given in millimeters, unless otherwise specified.

1.5 Responsibility

1.5.1 Performance. The party responsible for the performance of the product within the scope of this Standard is the organization that supplies the component to the final purchaser and certifies that the component was manufactured, assembled, tested, and inspected in accordance with this specification and meets all of its requirements.

1.5.2 Modification. The washer manufacturer 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 his control or direction.

1.6 Terminology

For definitions of terms relating to washers or features thereof used in this Standard, refer to ASA B18.12, Glossary of Terms for Mechanical Fasteners.

1.7 Referenced Standards

Copies of referenced ASTM standards may be obtained from The American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

Copies of referenced Federal or Military specifications may be obtained from DODSSP - Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.

Copies of referenced AISI standards may be obtained from the American Iron and Steel Institute, 1000 16th Street NW, Washington, DC 20036.

1.8 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.

1.9 Quality Assurance and Inspection

Unless otherwise specified, washers shall conform to the dimensions indicated in the respective tables by use of in-process control or other suitable means during manufacturing. Washers shall satisfy the inspection levels shown below, which are in accordance with ASME/ANSI B18.18.2M, Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners for designated characteristics. Should a nondesignated characteristic be determined to have a variance from norm, it should be inspected to B18.18.1M, and at that time it shall be deemed conforming to this Standard, if the user, who is the installer, accepts the variance based on fit, form, and function considerations.

1.9.1 Helical Spring Lock Washers

Characteristic	Inspection Level
Inside Diameter	A
Outside Diameter	C
Hardness	B

1.9.2 Tooth Lock Washers

Characteristic	Inspection Level
Inside Diameter	B
Hardness	A

Where verifiable in-process inspection is used in accordance with ASME/ANSI B18.18.3M or ASME/ANSI B18.18.4M, the inspection level sample size of those respective standards shall apply.

2 GENERAL DATA FOR HELICAL SPRING LOCK WASHERS

2.1 Application

The helical spring lock washers covered herein are intended for general applications. Helical spring lock

washers compensate for developed looseness between component parts of an assembly, distributing the load over a larger area for some head styles, and providing a hardened bearing surface.

2.2 Dimensions

The dimensions of helical spring lock washers shall be as specified in Tables 2 and 3. Selection should be made from the metric regular or metric socket head series in Tables 2 and 3, 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 1055 — 1065 or equivalent (UNS G10550 — G10650).

(b) *Boron Steel.* SAE 10B55 — 10B65 or equivalent.

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

(d) *Aluminum Alloy.* ASTM B 211, 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 (Monel K500).* Federal Specification QQ-N-286 (UNS N05500).

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

Other materials and grades shall be as agreed upon by 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 assure 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.

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

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

LOCK WASHERS (METRIC SERIES)

ASME B18.21.2M-1994

(c) *Austenitic Stainless*. 35 to 43 HRC, 345 to 423 HV, or equivalent.

(d) *Monel K500*. 33 to 40 HRC, 327 to 392 HV, or equivalent.

(e) *Aluminum Alloy*. 75 to 97 HRB, 137 to 222 HV, or equivalent.

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

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

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

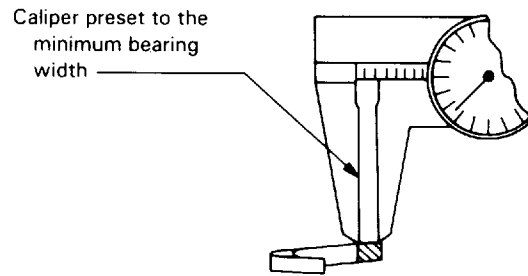


FIG. 1 VERIFYING MINIMUM BEARING WIDTH

2.4 Designation

Normal washer sizes are intended for use with comparable nominal screw or bolt sizes. Helical spring lock washers shall be designated by the following data, in the sequence shown: product name, nominal size, series, material, and protective finish if required.

EXAMPLES:

Metric Helical Spring Lock Washer, 5 mm Regular, Phosphor Bronze.

Metric Helical Spring Lock Washer, 14 mm Heavy, Plain Steel, Phosphate Coated.

The Government Part Numbering System for washers is given in Appendix A. This system may be adopted by any user needing a definitive part numbering system.

2.5 Washer Section

The section of finished washers shall be slightly trapezoidal in shape, with thickness at the inner periphery greater than the thickness at the outer periphery by an amount varying from a minimum of 0.02 mm to a maximum of 0.04 mm per 0.62 mm of the section width. The minimum section thickness specified in the dimensional tables represents the nominal mean thickness of the trapezoid. Reduced to formulas, the increase in thickness from the outer periphery to inner periphery is t_i minus t_o or $0.032 W$ (minimum) to $0.064 W$ (maximum). The tolerance on the nominal mean thickness of the trapezoid shall be subject to a plus tolerance equal to the following:

Size	Tolerance, +
5 mm and smaller	0.15 mm
6 mm to 20 mm	0.25 mm
24 mm to 36 mm	0.50 mm
42 mm to 72 mm	0.75 mm

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 2 and 3. 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 ensure that washers compress flat.

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

2.7.2 Embrittlement. Carbon steel lock washers that are electro-plated or coated may be subject to embrittlement; they shall be suitably treated to minimize such embrittlement. Plated washers shall not fracture after having been compressed flat for a period of 48 hr.

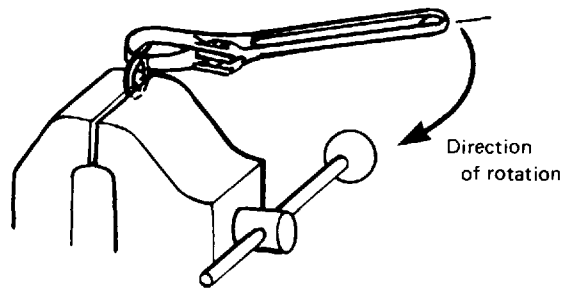


FIG. 2 WASHER TWIST TEST

2.7.3 Galvanized. When carbon steel helical spring lock washers are to be hot-dipped galvanized for use with hot-dipped galvanized bolts or screws, they shall be coiled to limits 0.5 mm in excess of those specified in Tables 2 and 3 for minimum inside diameter and maximum outside diameter. Galvanizing washers under 6 mm nominal size is not recommended.

2.8 Workmanship

The flat surfaces of washers shall be smooth and free from knurling, serrations, die marks, and deep scratches. Slight feed roll marks shall be permissible on the outer periphery. Washers shall be free from rust, pit marks, loose scale, excessive burrs and imperfections that might affect their serviceability.

2.9 Tests

2.9.1 Twist Test. 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 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. When the washer fractures at a greater degree of twist, the structure at

TABLE 1 DECARBURIZATION LIMITS

Diameters of Round Wire or Sections of Equivalent Area	Maximum Depth of Free Ferrite, mm	Maximum Total Affected Depth (Free Ferrite Plus Partial Decarburization), mm
Up to 4 mm, incl.	0.05	0.15
Over 4 mm to 6 mm, incl.	0.08	0.20
Over 6 mm to 10 mm, incl.	0.10	0.25
Over 10 mm to 12 mm, incl.	0.15	0.38

the point of fracture shall show a fine grain, and the washer up to the instant of fracture shall deliver a tough springy reaction.

2.9.2 Decarburization. Carbon steel, boron steel, and alloy steel lock washers shall meet the limits for decarburization shown in Table 1. Method for testing decarburization limits shall conform with SAE J419.

3 GENERAL DATA FOR METRIC TOOTH LOCK WASHERS

3.1 Application

The tooth lock washers covered herein are intended for general applications. 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 tooth design and the Type B tooth design shall be optional.

3.3 Dimensions

Dimensions of internal tooth lock washers, heavy internal tooth lock washers, external tooth lock washers, countersunk external tooth lock washers, and external-internal tooth lock washers shall be as specified in Tables 4 through 8.

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 1050 — 1065 or equivalent (UNS G10500 — G10650).

(b) *Stainless Steel.* SAE 301 — 305 (UNS S30100 — S30500) and SAE 316 (UNS S31600).

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

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

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

3.4.2 Hardness. Washers that are manufactured from carbon steel which show evidence of decarburization, or parts which 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.

(a) *Carbon Steel.* 40 to 50 *HRC*, 392 to 490 *HV*, or equivalent.

(b) *Stainless Steel 301 — 305.* Annealed 88 min. HRB, 1/4 hard through full hard 20 to 45 *HRC*, 198 to 448 *HV*, or equivalent.

(c) *Stainless Steel 410.* 40 to 50 *HRC*, 392 to 494 *HV*, or equivalent.

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

3.5 Designation

Nominal washer sizes are intended for use with comparable screw or nut sizes. Tooth lock washers shall be designated by the following data, in the sequence shown: product name, nominal size, maximum washer outside diameter (external-internal tooth washers only), type, material, and protective finish if required.

EXAMPLES:

Metric Internal Tooth Lock Washer, 6 mm, Type A, Plain Steel, Zinc Plated.

Metric External-Internal Tooth Lock Washer, 4 mm (19.30 O.D.), Type A, Plain Steel, Phosphate Coated.

The Government Part Numbering System for washers is given in Appendix A. This system may be

adopted by any user needing a definitive part numbering system.

3.6 Manufacturing Detail

The number of teeth, length of the teeth, width of the rim, and 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 uniform within a tolerance equal to one-half of the projection on one side.

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

3.7.2 Embrittlement. Carbon steel lock washers that are electro-plated or coated may be subject to embrittlement; they 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 plus 0.13 mm for a minimum period 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.

3.8 Workmanship

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

3.9 Tests

3.9.1 Twist Test. The rim of the lock washer shall be cut or severed with a cold chisel or cutting pliers, and the severed ends shall be gripped by pliers or vise and pliers. Separation of the ends in the form of a helix, to a distance equal to the inside diameter of the washer, shall not result in a fracture.

3.9.2 Temper Test. Washers, after being compressed to a height equal to the actual material thickness plus 0.13 mm, 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.

LOCK WASHERS (METRIC SERIES)

ASME B18.21.2M-1994

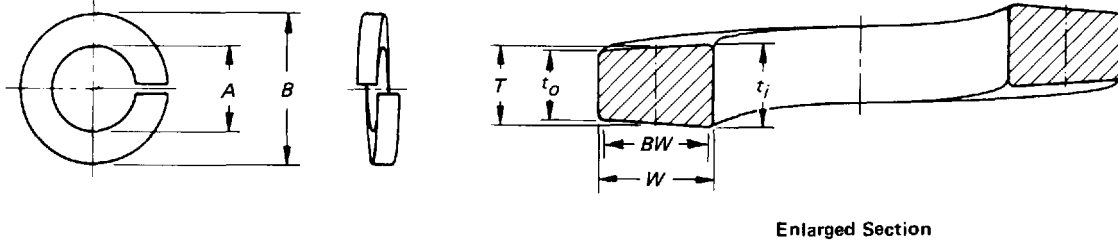
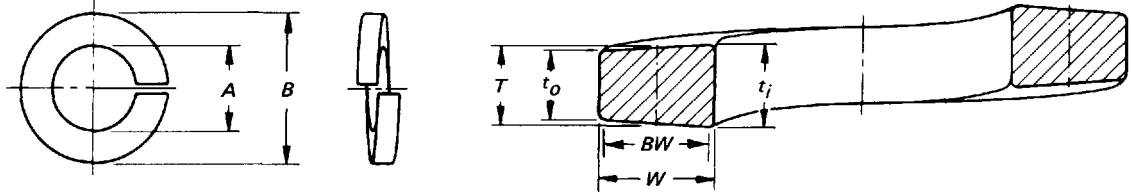


TABLE 2 DIMENSIONS OF REGULAR METRIC HELICAL SPRING LOCK WASHERS

Nominal Washer Size, mm	A		B	W	T	BW
	Inside Diameter		Outside Diameter	Section Width	Mean Section Thickness $(T_i + T_o)/2$	Bearing Width
	Max.	Min.	Max.	Min.	Min.	Min.
2	2.20	2.05	4.18	0.89	0.51	0.62
2.5	2.70	2.55	4.94	1.02	0.64	0.71
3	3.21	3.06	5.83	1.19	0.79	0.83
3.5	3.76	3.58	6.35	1.19	0.79	0.83
4	4.26	4.08	7.28	1.40	1.02	0.98
5	5.26	5.08	8.66	1.57	1.19	1.10
6	6.29	6.10	12.08	2.77	1.57	1.94
8	8.36	8.13	14.96	3.18	1.98	2.23
10	10.38	10.13	17.83	3.58	2.39	2.51
12	12.45	12.15	21.47	4.34	3.18	3.04
14	14.50	14.20	24.39	4.78	3.58	2.49
16	16.63	16.25	27.53	5.16	3.96	3.61
20	20.66	20.28	33.26	5.94	4.78	4.16
24	24.81	24.30	39.79	7.14	5.94	5.00
30	31.25	30.51	49.36	8.74	7.54	6.12
36	37.50	36.61	58.76	10.31	9.12	7.22

GENERAL NOTE: Dimensions in millimeters (mm).



Enlarged Section

TABLE 3 DIMENSIONS OF HEAVY METRIC HELICAL SPRING LOCK WASHERS

Nominal Washer Size, mm	A		B	W	T	BW
	Inside Diameter		Outside Diameter	Section Width	Mean Section Thickness $(T_i + T_o)/2$	Bearing Width
	Max.	Min.	Max.	Min.	Min.	Min.
2	2.20	2.05	4.44	1.02	0.64	0.71
2.5	2.70	2.55	5.29	1.19	0.79	0.83
3	3.21	3.06	6.24	1.40	1.02	0.98
3.5	3.76	3.58	6.76	1.40	1.02	0.98
4	4.26	4.08	7.64	1.57	1.19	1.10
5	5.26	5.08	9.07	1.78	1.42	1.25
6	6.29	6.10	12.12	2.79	1.96	1.95
8	8.36	8.13	15.22	3.30	2.46	2.31
10	10.38	10.13	18.03	3.68	2.92	2.58
12	12.45	12.15	21.73	4.47	3.84	3.13
14	14.50	14.20	24.64	4.90	4.32	3.43
16	16.63	16.25	27.88	5.33	4.80	3.73
20	20.66	20.28	33.77	6.20	5.74	4.34
24	24.81	24.30	40.66	7.57	7.21	5.30
30	31.25	30.51	50.81	9.47	9.25	6.63
36	37.50	36.61	60.60	11.23	11.18	7.86

GENERAL NOTE: Dimensions in millimeters (mm).

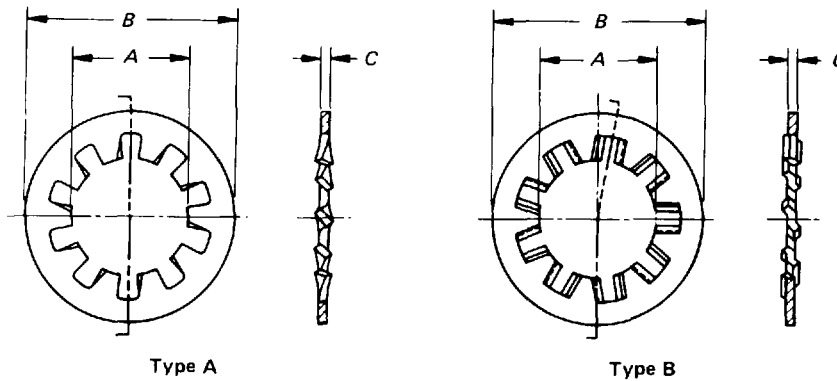


TABLE 4 DIMENSIONS OF INTERNAL TOOTH LOCK WASHERS

Nominal Washer Size [Note (1)]	A		B		C	
	Inside Diameter		Outside Diameter		Material Thickness	
	Max.	Min.	Max.	Min.	Max.	Min.
2.2*	2.40	2.25	4.70	4.40	0.35	0.25
2.5	2.80	2.65	5.85	5.45	0.35	0.25
2.9*	3.12	2.92	6.75	6.25	0.45	0.30
3	3.30	3.15	7.35	6.85	0.50	0.35
3.5	3.80	3.65	8.05	7.55	0.55	0.40
4	4.30	4.15	8.75	8.25	0.60	0.45
4.2*	4.47	4.27	8.75	8.25	0.60	0.45
4.8*	5.18	4.95	9.70	9.20	0.65	0.50
5	5.30	5.15	10.50	10.00	0.70	0.55
5.5*	5.87	5.61	10.50	10.00	0.70	0.55
6	6.50	6.20	12.95	12.20	0.70	0.55
6.3*	6.80	6.50	12.95	12.20	0.70	0.55
8	8.50	8.20	15.50	14.75	0.85	0.70
9.5*	10.11	9.75	17.60	16.85	1.00	0.80
10	10.60	10.20	17.60	16.85	1.00	0.80
12	12.70	12.30	20.25	19.50	1.00	0.80
14	14.80	14.30	22.90	21.90	1.15	0.95
16	17.00	16.40	27.20	26.20	1.25	1.05
20	21.20	20.50	32.00	31.00	1.40	1.20
24	25.30	24.50	35.30	34.50	1.50	1.30
30	31.40	30.60	46.30	45.10	1.70	1.50

GENERAL NOTE: For additional requirements refer to Section 3.

NOTE:

(1) Nominal washer sizes are intended for use with comparable nominal screw, bolt, or nut sizes. Washer sizes identified by an asterisk (*) are suited for use with spaced thread tapping screw Types AB, B, BF, and BT.

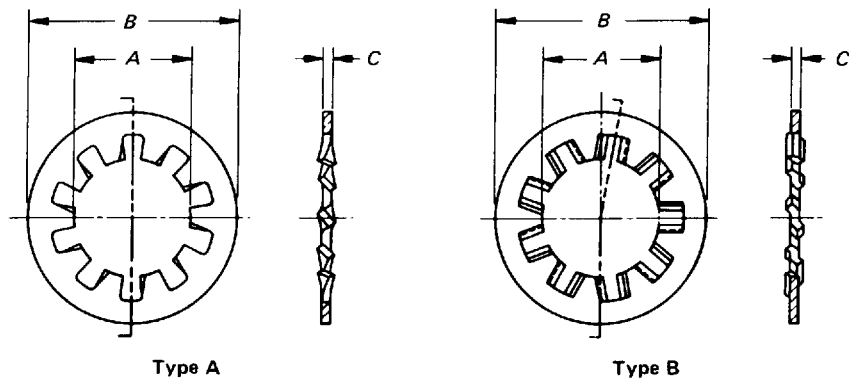


TABLE 5 DIMENSIONS OF HEAVY INTERNAL TOOTH LOCK WASHERS

Nominal Washer Size	A		B		C	
	Inside Diameter		Outside Diameter		Material Thickness	
	Max.	Min.	Max.	Min.	Max.	Min.
6	6.50	6.20	13.5	12.5	1.15	0.90
8	8.50	8.20	15.5	14.5	1.25	1.05
10	10.60	10.20	19.0	18.0	1.30	1.10
12	12.70	12.30	25.0	24.0	1.70	1.50
14	14.80	14.30	29.0	28.0	1.80	1.60
16	17.00	16.40	32.0	31.0	2.20	1.80
20	21.20	20.50	42.0	41.0	2.60	2.20

GENERAL NOTE: For additional requirements refer to Section 3.

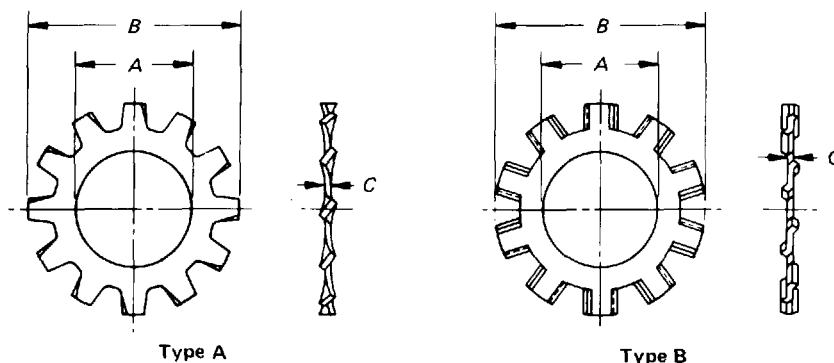


TABLE 6 DIMENSIONS OF EXTERNAL TOOTH LOCK WASHERS

Nominal Washer Size [Note (1)]	A		B		C	
	Inside Diameter		Outside Diameter		Material Thickness	
	Max.	Min.	Max.	Min.	Max.	Min.
2.2*	2.40	2.25	0.35	0.25
2.5	2.80	2.65	5.85	5.45	0.35	0.25
2.9*	3.12	2.92	6.60	6.20	0.45	0.30
3	3.30	3.15	7.35	6.85	0.50	0.35
3.5	3.80	3.65	8.05	7.55	0.55	0.40
4	4.30	4.15	9.00	8.50	0.60	0.45
4.2*	4.47	4.27	9.70	9.20	0.60	0.45
4.8*	5.18	4.95	10.30	9.80	0.65	0.50
5	5.35	5.15	10.50	10.00	0.65	0.50
5.5*	5.87	5.61	12.00	11.50	0.70	0.55
6	6.50	6.20	12.95	12.20	0.70	0.55
6.3*	6.80	6.50	12.95	12.20	0.70	0.55
8	8.50	8.20	15.50	14.75	0.85	0.70
9.5*	10.11	9.75	17.75	17.00	1.00	0.80
10	10.60	10.20	17.75	17.00	1.00	0.80
12	12.70	12.30	20.25	19.50	1.00	0.80
14	14.80	14.30	23.00	22.00	1.15	0.95
16	17.00	16.40	27.50	26.50	1.25	1.05
20	21.20	20.50	32.00	31.00	1.40	1.20
24	25.30	24.50	35.80	34.50	1.50	1.30
30	31.40	30.60	46.80	45.10	1.70	1.50

GENERAL NOTE: For additional requirements refer to Section 3.

NOTE:

(1) Nominal washer sizes are intended for use with comparable nominal screw, bolt, or nut sizes. Washer sizes identified by an asterisk (*) are suited for use with spaced thread tapping screw Types AB, B, BF, and BT.

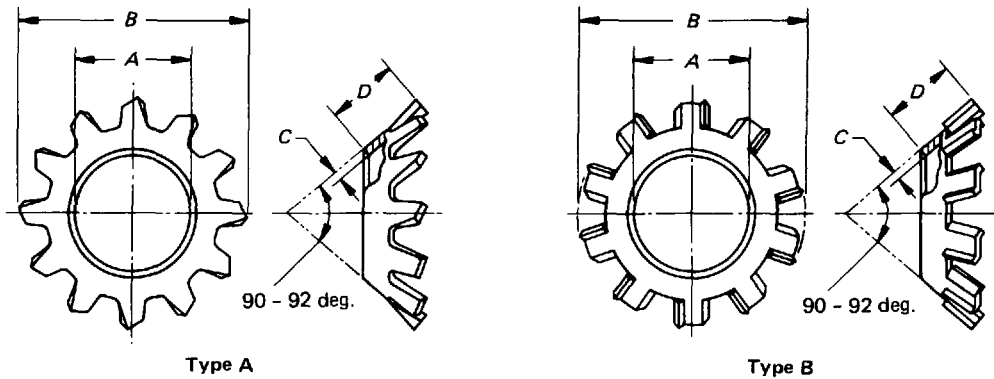


TABLE 7 DIMENSIONS OF COUNTERSUNK EXTERNAL TOOTH LOCK WASHERS

Nominal Washer Size [Note (1)]	A		B	C		D	
	Inside Diameter		Outside Diam.	Material Thickness		Length	
	Max.	Min.	Nominal	Max.	Min.	Max.	Min.
2 and 2.2*	2.40	2.25	3.75	0.25	0.17	1.05	0.75
2.5	2.80	2.65	4.50	0.25	0.17	1.70	1.30
3 and 2.9*	3.30	3.15	5.85	0.45	0.30	2.10	1.70
3.5	3.80	3.65	6.60	0.45	0.30	2.30	1.80
4 and 4.2*	4.47	4.27	7.50	0.55	0.40	2.40	1.80
5 and 4.8*	5.30	5.15	9.60	0.65	0.50	3.40	2.80
5.5*	5.87	5.61	10.90	0.65	0.50	3.90	3.30
6	6.50	6.20	12.00	0.65	0.50	4.20	3.40
6.3*	6.80	6.50	12.00	0.65	0.50	4.20	3.40
8	8.50	8.20	15.60	0.70	0.55	5.50	4.75
10 and 9.5*	10.60	10.20	19.50	0.85	0.70	6.80	5.80
12	12.70	12.30	23.00	1.00	0.80	7.80	6.80

GENERAL NOTE: For additional requirements refer to Section 3.

NOTE:

(1) Nominal washer sizes are intended for use with comparable nominal screw, bolt, or nut sizes. Washer sizes identified by an asterisk (*) are suited for use with spaced thread tapping screw Types AB, B, BF, and BT.

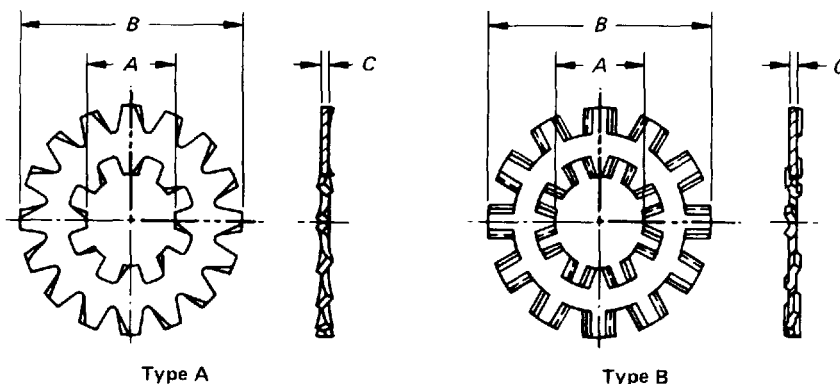


TABLE 8 DIMENSIONS OF EXTERNAL-INTERNAL TOOTH LOCK WASHERS

Nominal Washer Size [Note (1)]	A		B		C	
	Inside Diameter		Outside Diameter		Material Thickness	
	Max.	Min.	Max.	Min.	Max.	Min.
2.9*	3.12	2.92	12.10	11.35	0.50	0.35
			13.00	12.25	0.55	0.40
			15.50	14.75	0.55	0.40
3	3.30	3.15	12.10	11.35	0.50	0.35
			13.00	12.25	0.55	0.40
			15.50	14.75	0.55	0.40
3.5	3.80	3.65	12.90	12.15	0.70	0.55
			15.50	14.75	0.70	0.55
			17.55	16.80	0.70	0.55
4	4.30	4.15	15.25	14.50	0.85	0.70
			17.70	17.05	0.85	0.70
			19.30	18.55	0.85	0.70
4.2*	4.47	4.27	15.25	14.50	0.85	0.70
			17.70	17.05	0.85	0.70
			19.30	18.55	0.85	0.70
4.8*	5.18	4.95	15.25	14.50	0.85	0.70
			17.75	17.05	1.00	0.80
			19.30	18.55	1.00	0.80
			22.90	21.90	1.00	0.80
5	5.35	5.15	15.25	14.50	0.85	0.70
			17.75	17.05	1.00	0.80
			19.30	18.55	1.00	0.80
			22.90	21.90	1.00	0.80

TABLE 8 DIMENSIONS OF EXTERNAL-INTERNAL TOOTH LOCK WASHERS (CONT'D)

Nominal Washer Size [Note (1)]	A		B		C	
	Inside Diameter		Outside Diameter		Material Thickness	
	Max.	Min.	Max.	Min.	Max.	Min.
5.5*	5.87	5.61	17.75	17.00	1.00	0.80
			19.30	18.55	1.00	0.80
			22.90	21.90	1.00	0.80
			25.00	24.00	1.00	0.80
6	6.50	6.20	19.30	18.55	1.00	0.80
			22.90	21.90	1.00	0.80
			25.00	24.00	1.15	0.95
			27.20	26.20	1.15	0.95
6.3*	6.80	6.50	19.30	18.55	1.00	0.80
			22.90	21.90	1.00	0.80
			25.00	24.00	1.15	0.95
			27.20	26.20	1.15	0.95
8	8.50	8.20	22.90	21.90	1.00	0.80
			25.00	24.00	1.15	0.95
			27.20	26.20	1.25	1.05
			29.35	28.05	1.25	1.05
9.5*	10.11	9.75	25.00	24.00	1.15	0.95
			27.20	26.20	1.25	1.05
			29.35	28.35	1.25	1.05
			32.00	30.70	1.25	1.05
10	10.60	10.20	25.00	24.00	1.15	0.95
			27.20	26.20	1.25	1.05
			29.35	28.35	1.25	1.05
			32.00	30.70	1.25	1.05
12	12.70	12.30	32.00	30.70	1.40	1.20
			33.50	32.20	1.40	1.20
			36.00	34.30	1.50	1.30
			41.35	39.65	1.70	1.50
14	14.80	14.30	33.50	32.20	1.40	1.20
			36.00	34.30	1.50	1.30
			41.35	39.65	1.70	1.50
			46.50	45.30	1.70	1.50
16	17.00	16.40	36.00	34.30	1.50	1.30
			41.35	39.65	1.70	1.50
			46.50	45.30	1.70	1.50
			50.20	48.50	1.70	1.50

GENERAL NOTE: For additional requirements refer to Section 3.

NOTE:

(1) Nominal washer sizes are intended for use with comparable nominal screw, bolt, or nut sizes. Washer sizes identified by an asterisk (*) are suited for use with spaced thread tapping screw Types AB, B, BF, and BT.

APPENDIX A

GOVERNMENT STANDARD ITEMS AND PART NUMBERING SYSTEM

(This Appendix is not part of ASME B18.21.2M-1994, and is included here for information purposes only.)

NOTE: The Government encourages the general use of this Appendix to achieve maximum parts standardization.

This Appendix establishes the standard items for Government application, selected from the possible variations of items within the scope of the Standard, and provides a part numbering system for identification and application in engineering documents.

(a) *Variations.* The following variations shall be standard:

(1) nominal washer size in accordance with the applicable table in ASME B18.21.2M as follows:

Washer Type	Table
Helical spring — regular	2
Helical spring — heavy	3
Internal tooth — regular (Type A or B)	4
Internal tooth — heavy	5
External tooth — flat	6
External tooth — countersunk	7
External-internal tooth ²	8

(2) material (carbon steel, boron steel, austenitic corrosion-resistant steel, aluminum-zinc, phosphor bronze, silicon bronze, K-monel) as coded in Part Numbering System;

²Additional maximum washer outside dimension variation required.

(3) finish (black oxide; tin plated; phosphate; electro-deposited or mechanically-deposited cadmium; electro-deposited or mechanically-deposited zinc; cleaned, descaled, and passivated for austenitic corrosion-resistant steel; and not plated or coated) as coded in Part Numbering System;

(4) magnetic permeability — the magnetic permeability of austenitic corrosion-resistant steel washers shall not be greater than 2.0 [AIR = 1.257 μ H/m (microhenry per meter)] at a field strength of 16 kA/m (kiloamperes per meter) when tested in conformance with ASTM A 342.

(b) *Part Number.* The part number shall consist of the following element codes in the order shown:

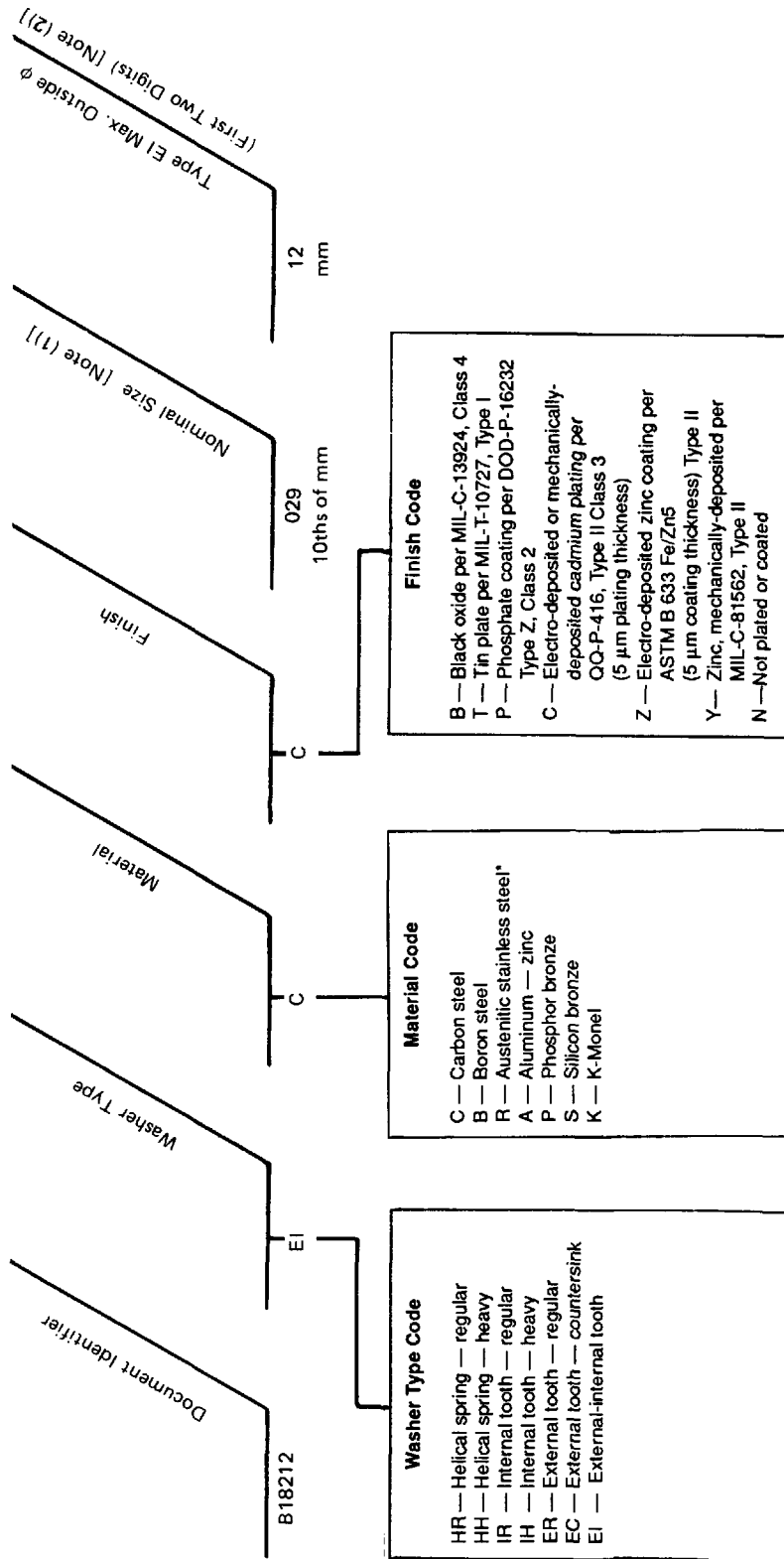
- (1) document identifier — ASME standard number less decimal points
- (2) washer type
- (3) material
- (4) finish
- (5) nominal size
- (6) maximum outside dimension (first two digits) for external-internal tooth type only

NOTE: The Part Numbering System may also be used for non-standard nominal size code combinations.

(c) *Packaging.* Packaging shall be in accordance with ASTM D 3951 and country of origin.

PART NUMBERING SYSTEM COVERING STANDARD ITEMS FOR GOVERNMENT USE

NOTE: THE GOVERNMENT ENCOURAGES THE GENERAL USE OF THIS SYSTEM TO ACHIEVE MAXIMUM PARTS STANDARDIZATION.



* Cleaned, descaled and passivated per QQ-P-35

EXAMPLE: B18212EICZ02912 indicates a washer, lock (metric), external-internal tooth type, made of carbon steel, electro-deposited zinc, 2.9 mm nominal washer size, 12.10 mm max. — 11.35 mm min. outside diameter.

NOTES:

- (1) See applicable table in ASME B18.21.2M.
- (2) For Type EI only, see Table 8 in ASME B18.21.2M.

METRIC LOCK WASHERS — STANDARD SIZES FOR GOVERNMENT USE

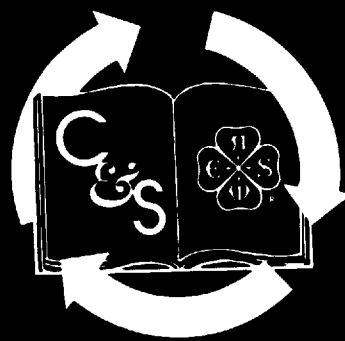
Tables 2 through 8 in ASME B18.21.2M are to be used for selection of standard sizes for Government use.

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

Small Solid Rivets	B18.1.1-1972(R1989)
Large Rivets	B18.1.2-1972(R1989)
Metric Small Solid Rivets	B18.1.3M-1983(R1989)
Square and Hex Bolts and Screws — Inch Series	B18.2.1-1981(R1992)
Square and Hex Nuts (Inch Series)	B18.2.2-1987(R1993)
Metric Hex Cap Screws	B18.2.3.1M-1979(R1989)
Metric Formed Hex Screws	B18.2.3.2M-1979(R1989)
Metric Heavy Hex Screws	B18.2.3.3M-1979(R1989)
Metric Hex Flange Screws	B18.2.3.4M-1984
Metric Hex Bolts	B18.2.3.5M-1979(R1989)
Metric Heavy Hex Bolts	B18.2.3.6M-1979(R1989)
Metric Heavy Hex Structural Bolts	B18.2.3.7M-1979(R1989)
Metric Hex Lag Screws	B18.2.3.8M-1981(R1991)
Metric Heavy Hex Flange Screws	B18.2.3.9M-1984
Metric Hex Nuts, Style 1	B18.2.4.1M-1979(R1989)
Metric Hex Nuts, Style 2	B18.2.4.2M-1979(R1989)
Metric Slotted Hex Nuts	B18.2.4.3M-1979(R1989)
Metric Hex Flange Nuts	B18.2.4.4M-1982
Metric Hex Jam Nuts	B18.2.4.5M-1979(R1990)
Metric Heavy Hex Nuts	B18.2.4.6M-1979(R1990)
Socket Cap, Shoulder and Set Screws — Inch Series	B18.3-1986
Socket Head Cap Screws (Metric Series)	B18.3.1M-1986(R1993)
Metric Series Hexagon Keys and Bits	B18.3.2M-1979(R1990)
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
Metric Round Head Short Square Neck Bolts	B18.5.2.1M-1981
Metric Round Head Square Neck Bolts	B18.5.2.2M-1982
Round Head Square Neck Bolts With Large Head (Metric Series)	B18.5.2.3M-1990
Wood Screws (Inch Series)	B18.6.1-1981(R1991)
Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws	B18.6.2-1972(R1993)
Machine Screws and Machine Screw Nuts	B18.6.3-1972(R1983)
Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch Series)	B18.6.4-1981(R1991)
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)	B18.8.2-1994
Spring Pins — Coiled Type (Metric Series)	B18.8.3M-1990
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-1994
Headless Clevis Pins (Metric Series)	B18.8.7M-1994
Headed Clevis Pins (Metric Series)	B18.8.8M-1994
Plow Bolts	B18.9-1958(R1989)
Track Bolts and Nuts	B18.10-1982(R1992)
Miniature Screws	B18.11-1961(R1992)
Glossary of Terms for Mechanical Fasteners	B18.12-1962(R1991)
Screw and Washer Assemblies — Sems (Inch Series)	B18.13-1987(R1993)
Screw and Washer Assemblies — Sems (Metric Series)	B18.13.1M-1991
Forged Eyebolts	B18.15-1985

Mechanical and Performance Requirements for Prevailing-Torque Type	
Steel Metric Hex Nuts and Hex Flange Nuts	B18.16.1M-1979(R1986)
Torque-Tension Test Requirements for Prevailing-Torque Type	
Steel Metric Hex Nuts and Hex Flange Nuts	B18.16.2M-1979(R1986)
Dimensional Requirements for Prevailing-Torque Type Steel	
Metric Hex Nuts and Hex Flange Nuts	B18.16.3M-1982(R1993)
Wing Nuts, Thumb Screws, and Wing Screws	B18.17-1968(R1983)
Inspection and Quality Assurance for General Purpose Fasteners	B18.18.1M-1987(R1993)
Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners	B18.18.2M-1987(R1993)
Inspection and Quality Assurance for Special Purpose Fasteners	B18.18.3M-1987(R1993)
Inspection and Quality Assurance for Fasteners for Highly Specialized	
Engineered Applications	B18.18.4M-1987(R1993)
Lock Washers (Inch Series)	B18.21.1-1994
Lock Washers (Metric Series)	B18.21.2M-1994
Metric Plain Washers	B18.22M-1981(R1990)
Plain Washers	B18.22.1-1965(R1990)
Helical Coil Screw Thread Inserts (Inch Series)	B18.29.1-1993

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