AMERICAN NATIONAL STANDARD

Metric Plain Washers

ANSI B18.22M - 1981

Government Key Words:
Washer, Flat, Plain – Metric

REAFFIRMED 2000

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SECRETARIAT

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FOREWORD

American National Standards Committee B18 for the standardization of bolts, screws, nuts, rivets, and similar fasteners was organized in March 1922 as Sectional Committee B18 under the aegis of the American Engineering Standards Committee (later the American Standards Association, then the United States of America Standards Institute and as of October 6, 1969, the American National Standards Institute, Incorporated), with the Society of Automotive Engineers and the American Society of Mechanical Engineers as joint sponsors. Subcommittee 22 was subsequently established and charged with the responsibility for technical content of standards covering flat washers.

In early 1976, the Subcommittee was directed to develop a new standard for metric general purpose flat washers. The first draft was based on work done by a 1975/76 SAE "ad hoc" washer task force. The SAE objective, and subsequently the Subcommittee 22 objective, was to provide a standard compatible with metric bolt standards and to avoid deficiencies of the existing inch standard which had historically fostered specialty washers. Improvements were to include closer ID to bolt shank clearance for maximum bearing area, least number of OD increments in rational proportion to ID, slightly increased thicknesses with minimum tolerance, and defined geometric form variability.

ISO general purpose flat washer standards and draft standards were carefully reviewed during the development of this Standard. However, due to differences in philosophy regarding flat washer manufacture and use, very few ISO recommended sizes could be accommodated.

This Standard was approved by letter ballot of Committee B18, with all negatives resolved at the B18 general meeting of May 20, 1981. It was subsequently approved by the secretariat and submitted to the American National Standards Institute for designation as an American National Standard. This designation was granted on September 21, 1981.

NOTE

The reprint of 5/98 incorporates corrections specified in an errata sheet issued previously (item number L0063E). Corrections are indicated by **5/98** in the margin.

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AMERICAN NATIONAL STANDARD

METRIC PLAIN WASHERS

1 SCOPE

This Standard covers general specifications and dimensions for flat, round hole washers, both soft (as fabricated) and hardened, intended for use in general purpose applications.

The inclusion of dimensional data in this Standard is not intended to imply that all sizes displayed are production stock items. Manufacturers should be contacted for current information on stock sizes.

2 COMPARISON WITH ISO

The washers described in this Standard are nominally similar to those contained in various ISO documents. Outside diameters were selected, where possible, from ISO/TC2/WG6/N47, General Plan for Plain Washers for Metric Bolts, Screws, and Nuts. The thicknesses shown in this Standard are similar to the nominal thicknesses shown in ISO documents. However, the tolerances on thicknesses shown in this document differ in that they permit the use of secondary material for washer manufacture. Inside diameters shown in this document differ from the inside diameters shown in ISO documents.

3 TYPES OF WASHERS

3.1 Soft. Soft (as fabricated) washers are generally available in nominal sizes 1.6 mm through 36 mm in a variety of materials. They are normally used in low strength applications to distribute bearing load, to provide a uniform bearing surface, and to prevent marring of the work surface.

3.2 Hardened. Hardened steel washers are normally available in sizes 6 mm through 36 mm in the narrow and regular series. They are intended primarily for use in high-strength joints to minimize embedment, to provide a uniform bearing surface, and to bridge large clearance holes and slots.

4 DIMENSIONS

Washer dimensions shall be in accordance with Table 1. All dimensions in this Standard are in millimeters, unless otherwise specified.

4.1 Inside Diameter. To maximize bearing area, minimum inside diameter is calculated as approximately 0.97 x bolt underhead fillet transition diameter.[1] Theoretically, the bolt fillet may contact the washer inside edge before full seating. However, actual contact will be minimal and minor metal deformation will occur so that full bolt bearing surface contact will be achieved at nominal clamp loads.

Inside diameters have been established assuming natural (as fabricated) finish on bolts and washers. Some closeness of fit may occur if products are galvanized or have some other heavy coating or plating.

4.2 Inside Profile. As a result of the punching process, the inside diameter of the washer generally consists of three distinct sections. On the punch entry side of the washer there is some drawing in of the material resulting in a rounded corner section, followed by a substantially parallel section, and finally at the exit side a tapered breakout occurs (see Fig. 1).

The parallel-sided section of the washer inside diameter must be within the tabulated limits. However, the specified maximum inside diameter may be exceeded at the washer face on the breakout side by a maximum taper allowance of 25 percent of the specified maximum washer thickness for each size.

[1] Per ANSI B18.2.3.1M-1979 Metric Hex Cap Screws

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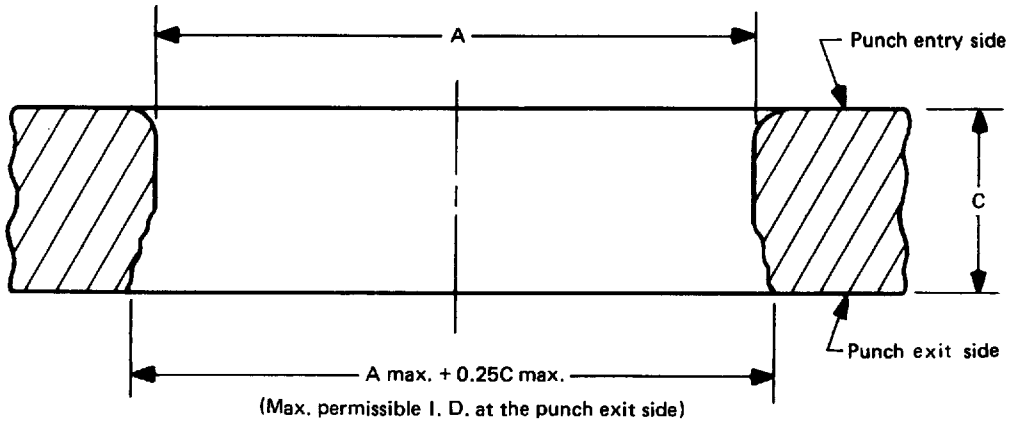


FIG. 1 WASHER INSIDE PROFILE

4.3 Dimensions After Plating. Unless otherwise specified, dimensions shall apply before plating or coating.

5 TOLERANCES[2]

The tolerances used to determine max/min dimensions are shown in Table 1.

5/98 **5.1 Inside Diameters.** For washers having a thickness of 4.0 mm or less, h13. For washers having a thickness over 4.0 mm, h14.

5/98 **5.2 Outside Diameters.** For washers having a thickness of 4.0 mm or less, h14. For washers having a thickness over 4.0 mm, h15.

5.3 Thickness. Tolerance on thickness is generally chosen to span the combined tolerance range of a first choice thickness[3] and the next larger second choice thickness plus an additional allowance for crown and for material frequently used in washer manufacture.

[2] ISO R286-1962 as shown in ANSI B4.2-1978, Preferred Metric Limits and Fits.

[3] ANSI B32.3-1977, Preferred Metric Thickness and Widths for Flat Metal Products.

6 TOTAL RUNOUT

The total runout of the outside diameter relative to the inside diameter shall be within the following tolerances:

Nominal Sizes	Full Indicator Movement (FIM)
1.6, 2	0.24
2.5, 3, 3.5	0.30
4, 5, 6	0.36
8, 10	0.42
12, 14, 16	0.50
20, 24	0.92
30, 36	1.40

7 FLATNESS

Washers shall be flat within 0.25 mm for sizes with maximum outside diameters up to and including 25.0 mm, and within 0.01 mm per millimeter of outside diameter for sizes with maximum outside diameters larger than 25.0 mm.

Variation from flat shall be measured by laying the part on a surface plate with the convex side up and measuring the maximum rise. Edge rounding and edge burrs are excluded from the flatness requirement.

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8 MATERIALS

8.1 Soft. Soft (as fabricated) washers shall be made of non-hardened steel unless otherwise specified by the purchaser.

8.2 Hardened. Hardened washers shall be made of steel, through-hardened and tempered to a hardness of 38 to 45 HRC (372-446 HV).

NOTE:
If hot-dip galvanized finish is specified, hardness shall be 26-45 HRC (272-446 HV).

9 FINISHES

Unless otherwise specified, washers shall be furnished with a natural (as fabricated) finish, unplated or uncoated, with a light film of oil or rust inhibitor.

When plating or coating is specified by the purchaser, plating or coating thickness shall be determined on the flat surface approximately midway between the inside and outside diameter.

Hardened washers, if plated or coated, shall be free from detrimental effects of hydrogen embrittlement.

10 TERMINOLOGY

For definitions of terms relating to fasteners or component features thereof used in this Standard, refer to American National Standard, Glossary of Terms for Mechanical Fasteners, ANSI B18.12.

11 WORKMANSHIP

11.1 Burrs. For nominal sizes 2.0 mm and smaller, burrs shall not exceed 13 μm. For nominal sizes 2.5 mm and larger, burrs shall not exceed two percent of the actual thickness.

11.2 General. Washers shall not contain an excess of surface imperfections which might affect their serviceability, such as sharp edges, loose scale, and other irregularities.

12 DESIGNATION

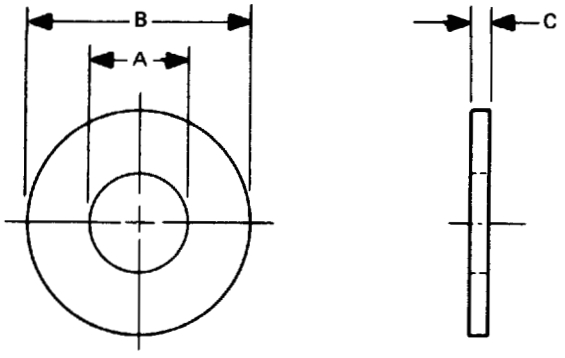
When specifying plain washers, the designation shall include the description; nominal washer size; series; material type; and finish, if required, in that order as shown in the following examples:

Plain washer, 6 mm, narrow, soft, steel, zinc plated.

Plain washer, 6 mm, regular, hardened steel.

The Government part numbering system for metric plain washers is given in Appendix I. This system may be used by any user needing a definitive part numbering system.

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TABLE 1 DIMENSIONS OF METRIC PLAIN WASHERS (GENERAL PURPOSE)

Nominal Washer Size(1)	Washer Series	A		B		C	
		Inside Diameter		Outside Diameter		Thickness	
		Max(2)	Min(3)	Max	Min	Max	Min
1.6	Narrow	2.09	1.95	4.00	3.70	0.70	0.50
	Regular	2.09	1.95	5.00	4.70	0.70	0.50
	Wide	2.09	1.95	6.00	5.70	0.90	0.60
2	Narrow	2.64	2.50	5.00	4.70	0.90	0.60
	Regular	2.64	2.50	6.00	5.70	0.90	0.60
	Wide	2.64	2.50	8.00	7.64	0.90	0.60
2.5	Narrow	3.14	3.00	6.00	5.70	0.90	0.60
	Regular	3.14	3.00	8.00	7.64	0.90	0.60
	Wide	3.14	3.00	10.00	9.64	1.20	0.80
3	Narrow	3.68	3.50	7.00	6.64	0.90	0.60
	Regular	3.68	3.50	10.00	9.64	1.20	0.80
	Wide	3.68	3.50	12.00	11.57	1.40	1.00
3.5	Narrow	4.18	4.00	9.00	8.64	1.20	0.80
	Regular	4.18	4.00	10.00	9.64	1.40	1.00
	Wide	4.18	4.00	15.00	14.57	1.75	1.20
4	Narrow	4.88	4.70	10.00	9.64	1.20	0.80
	Regular	4.88	4.70	12.00	11.57	1.40	1.00
	Wide	4.88	4.70	16.00	15.57	2.30	1.60
5	Narrow	5.78	5.60	11.00	10.57	1.40	1.00
	Regular	5.78	5.60	15.00	14.57	1.75	1.20
	Wide	5.78	5.60	20.00	19.48	2.30	1.60
6	Narrow	6.87	6.65	13.00	12.57	1.75	1.20
	Regular	6.87	6.65	18.80	18.28	1.75	1.20
	Wide	6.87	6.65	25.40	24.88	2.30	1.60
8	Narrow	9.12	8.90	18.80	18.28	2.30	1.60
	Regular	9.12	8.90	25.40	24.88	2.30	1.60
	Wide	9.12	8.90	32.00	31.38	2.80	2.00

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TABLE 1 (CONT'D) DIMENSIONS OF METRIC PLAIN WASHERS (GENERAL PURPOSE)

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Nominal Washer Size(1)	Washer Series	A		B		C	
		Inside Diameter		Outside Diameter		Thickness	
		Max(2)	Min(3)	Max	Min	Max	Min
10	Narrow	11.12	10.85	20.00	19.48	2.30	1.60
	Regular	11.12	10.85	28.00	27.48	2.80	2.00
	Wide	11.12	10.85	39.00	38.38	3.50	2.50
12	Narrow	13.57	13.30	25.40	24.88	2.80	2.00
	Regular	13.57	13.30	34.00	33.38	3.50	2.50
	Wide	13.57	13.30	44.00	43.38	3.50	2.50
14	Narrow	15.52	15.25	28.00	27.48	2.80	2.00
	Regular	15.52	15.25	39.00	38.38	3.50	2.50
	Wide	15.52	15.25	50.00	49.38	4.00	3.00
16	Narrow	17.52	17.25	32.00	31.38	3.50	2.50
	Regular	17.52	17.25	44.00	43.38	4.00	3.00
	Wide	17.68	17.25	56.00	54.80	4.60	3.50
20	Narrow	22.13	21.80	39.00	38.38	4.00	3.00
	Regular	22.32	21.80	50.00	49.00	4.60	3.50
	Wide	22.32	21.80	66.00	64.80	5.10	4.00
24	Narrow	26.12	25.60	44.00	43.00	4.60	3.50
	Regular	26.12	25.60	56.00	54.80	5.10	4.00
	Wide	26.12	25.60	72.00	70.80	5.60	4.50
30	Narrow	33.02	32.40	56.00	54.80	5.10	4.00
	Regular	33.02	32.40	72.00	70.80	5.60	4.50
	Wide	33.02	32.40	90.00	88.60	6.40	5.00
36	Narrow	38.92	38.30	66.00	64.80	5.60	4.50
	Regular	38.92	38.30	90.00	88.60	6.40	5.00
	Wide	38.92	38.30	110.00	108.60	8.50	7.00

NOTES.

(1) Nominal washer sizes are intended for use with comparable nominal screw or bolt sizes.

(2) See 4.2 for maximum permissible I.D. at the punch exit side.

(3) See 4.1 for closeness of fit with coated or plated products.

(4) The 18.80/18.28 and 25.40/24.88 mm outside diameters avoid washers which could be used in coin operated devices.

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APPENDIX I

PART NUMBERING SYSTEM COVERING STANDARD ITEMS FOR GOVERNMENT USE

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.

The following variations are standard:

a. Nominal Washer Size – as specified in Table 2.

b. Material–Steel-soft (non-hardened) or hardened as coded in Part Numbering System.

c. Finish–Cadmium plating, zinc plating or plain finish as coded in Part Numbering System.

d. Washer Series Code–narrow, regular or wide as coded in Part Numbering System.

The part number shall consist of the following element codes in the order shown:

a. Document Identifier – ANSI Standard Number less decimal points

b. Material and Finish

c. Washer Type

d. Nominal Size

e. Washer Series

Quality Assurance Provisions: Quality assurance provisions shall be in accordance with FF-W-92, Washer, Flat (Plain), except that for type H, a hardness test shall be made at a minimum of 2 locations 180 deg. apart on one face.

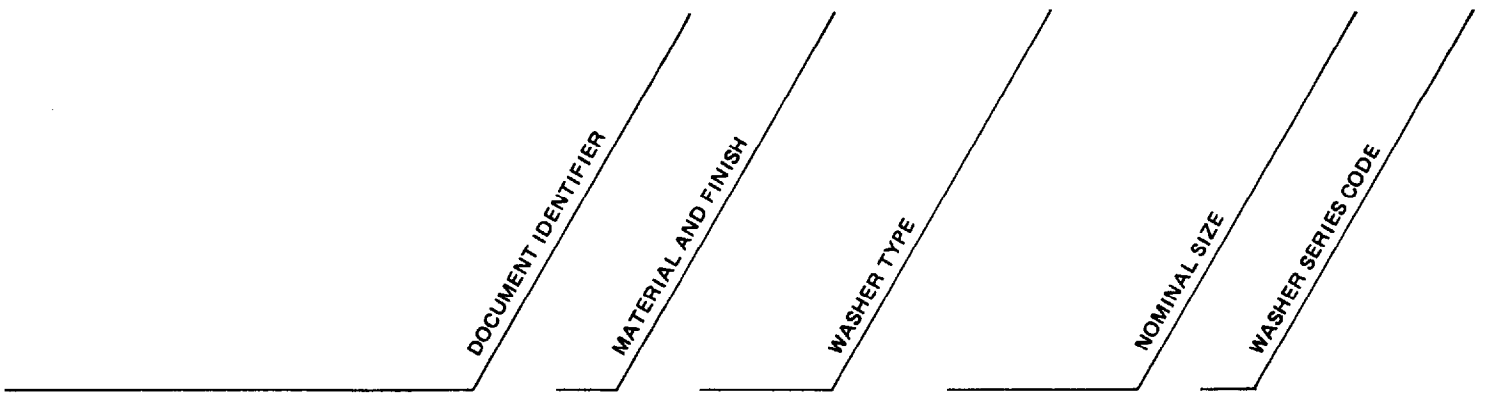
Packaging: Packaging shall be in accordance with PPP-H-1581, Hardware (Fasteners and Related Items), Packaging and Packing for Shipment and Storage of.

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APPENDIX I (CONT.) PART NUMBERING SYSTEM COVERING STANDARD ITEMS FOR GOVERNMENT USE

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



MATERIAL AND FINISH CODE

- A — Steel w/Cadmium Plating per QQ-P-416, Type II, Class 3 (5.1 μm Plating Thickness).
- B — Steel w/Zinc Plating per QQ-Z-325, Type II, Class 3 (5.1 μm Plating Thickness) for 6 mm size and smaller and Class 2 (13 μm Plating Thickness) for sizes larger than 6 mm.
- C — Steel w/Hot Dip Galvanized Coating per ASTM A153 Grade C.
- P — Steel, No Finish.

TYPE CODE

- S — Soft
- H — Hardened

WASHER SERIES CODE

- N — Narrow
- R — Regular
- W — Wide

EXAMPLE: B1822AS160R indicates a Washer, Flat, Plain-Metric, made of cadmium plated, non-hardened steel, 16 mm nominal size, regular series.

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TABLE 2 GOVERNMENT STANDARD ITEMS

Nominal Washer Size	Equivalent Part Number	Washer Series Per Table 1
1.6	016	N R* W
2	020	N R* W
2.5	025	N R* W
3	030	N R* W
3.5	035	N R* W
4	040	N R* W
5	050	N R* W
6	060	N R* W
8	080	N R* W
10	100	N R* W
12	120	N R* W
14	140	N R* W
16	160	N R* W
20	200	N R* W
24	240	N R* W
30	300	N R* W
36	360	N R* W

*R series preferred

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