AMERICAN NATIONAL STANDARD

# Metric Plain Washers

ANSI B18.22M - 1981

Government Key Words:
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**REAFFIRMED 2017**

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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

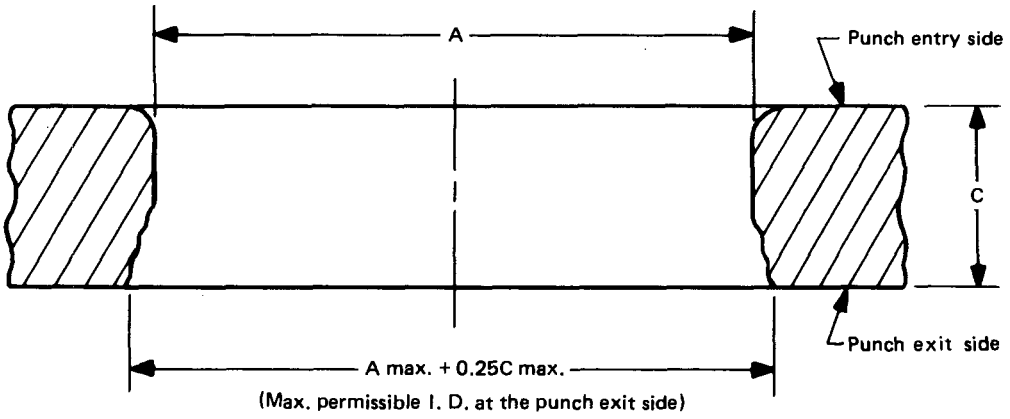


FIG. 1 WASHER INSIDE PROFILE

**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.