



Designation: F 436 – 07a

## Standard Specification for Hardened Steel Washers<sup>1</sup>

This standard is issued under the fixed designation F 436; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This specification covers the chemical, mechanical, and dimensional requirements for hardened steel washers for use with fasteners having nominal thread diameters of ¼ through 4 in. These washers are intended for general-purpose mechanical and structural use with bolts, nuts, studs, and other internally and externally threaded fasteners. These washers are suitable for use with fasteners covered in Specifications A 325, A 354, A 449, and A 490.

1.2 The washers are designated by *type* denoting the material and by *style* denoting the shape.

1.2.1 The types of washers covered are:

1.2.1.1 *Type 1*—Carbon steel.

1.2.1.2 *Type 3*—Weathering steel. Atmospheric corrosion resistance and weathering characteristics are comparable to that of steels covered in Specifications A 588/A 588M and A 709/A 709M. The atmospheric corrosion resistance of these steels is substantially better than that of carbon steel with or without copper addition. See 5.1. When properly exposed to the atmosphere, these steels can be used bare (uncoated) for many applications.

1.2.2 The styles of washers covered are:

1.2.2.1 *Circular*—Circular washers in nominal bolt sizes ¼ through 4 in. suitable for applications where sufficient space exists and angularity permits.

1.2.2.2 *Beveled*—Beveled washers are square or rectangular, in nominal sizes ½ through 1½ in., with a beveled 1 to 6 ratio surface for use with American standard beams and channels.

1.2.2.3 *Clipped*—Clipped washers are circular or beveled for use where space limitations necessitate that one side be clipped.

NOTE 1—A complete metric companion to Specification F 436 has been developed—Specification F 436M; therefore no metric equivalents are presented in this specification.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.02 on Steel Bolts, Nuts, Rivets and Washers.

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1.2.2.4 *Extra Thick*—Extra thick washers are circular washers in nominal sizes ½ through 1½ in., with a nominal thickness of 5/16 in. suitable for structural applications with oversized holes.

1.3 Terms used in this specification are defined in Terminology F 1789 unless otherwise defined herein.

### 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

A 325 Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A 354 Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

A 449 Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use

A 490 Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength

A 588/A 588M Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance

A 709/A 709M Specification for Structural Steel for Bridges

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

B 695 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

D 3951 Practice for Commercial Packaging

F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

F 1789 Terminology for F16 Mechanical Fasteners

F 2329 Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard.

**G 101** Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

**3. Ordering Information**

3.1 Orders for hardened steel washers under this specification shall include the following:

- 3.1.1 ASTM designation and year of issue,
- 3.1.2 Quantity (number of pieces by size),
- 3.1.3 Type and Style (see 1.2.1 and 1.2.2),
- 3.1.4 *Zinc Coating*—Specify the zinc coating process required, for example, hot-dip, mechanically deposited, or no preference (see 4.3),
- 3.1.5 Dimensions, nominal size, and other dimensions, if modified from those covered in this specification,
- 3.1.6 Specify if inspection at point of manufacture is required,
- 3.1.7 Specify if manufacturer’s certification or test reports, or both, are required, and
- 3.1.8 Special requirements.

**4. Materials and Manufacture**

4.1 Steel used in the manufacture of washers shall be produced by the open-hearth, basic-oxygen, or electric-furnace process.

4.2 Washers up to and including 1½ in. in bolt size shall be through hardened. Washers over 1½ in. may be either through hardened or carburized at the option of the manufacturer.

4.3 *Zinc Coatings, Hot-Dip and Mechanically Deposited:*

4.3.1 When zinc-coated washers are required, the purchaser shall specify the zinc coating process, for example, hot-dip, mechanically deposited, or no preference.

4.3.2 When hot-dip is specified the washers shall be zinc coated by the hot-dip process in accordance with the requirements of Specification **F 2329**.

4.3.3 When mechanically deposited is specified the washers shall be zinc coated by the mechanical-deposition process in accordance with the requirements of Class 55 of Specification **B 695**.

4.3.4 When no preference is specified, the supplier may furnish either a hot-dip zinc coating in accordance with Specification **F 2329**, or a mechanically deposited zinc coating in accordance with Specification **B 695**, Class 55. Threaded components (bolt and nuts) shall be coated by the same zinc-coating process and the supplier’s option is limited to one process per item with no mixed processes in a lot.

4.4 If washers are heat treated by a subcontractor, they shall be returned to the manufacturer for testing prior to shipment to the purchaser.

**5. Chemical Composition**

5.1 Type 1 and Type 3 washers shall conform to the chemical composition specified in **Table 1**. For Type 3 see Guide **G 101** for methods of estimating corrosion resistance of low alloy steels.

5.2 Product analysis may be made by the purchaser from finished material representing each lot of washers. The chemical composition shall conform to the requirements of 4.1 and 5.1.

**TABLE 1 Chemical Requirements**

Element	Composition, %	
	Type 1	Type 3 <sup>A</sup>
Phosphorus, max		
Heat analysis	0.040	0.040
Product analysis	0.050	0.045
Sulfur, max		
Heat analysis	0.050	0.050
Product analysis	0.060	0.055
Silicon		
Heat analysis	...	0.15–0.35
Product analysis	...	0.13–0.37
Chromium		
Heat analysis	...	0.45–0.65
Product analysis	...	0.42–0.68
Nickel		
Heat analysis	...	0.25–0.45
Product analysis	...	0.22–0.48
Copper		
Heat analysis	...	0.25–0.45
Product analysis	...	0.22–0.48

<sup>A</sup> Weathering steel washers may also be manufactured from any of the steels listed in Table 2 of Specification **A 325**.

5.3 Individual heats of steel are not identified in the finished product.

5.4 Chemical analyses shall be performed in accordance with Test Methods, Practices, and Terminology **A 751**.

**6. Mechanical Properties**

6.1 Through hardened washers shall have a hardness of 38 to 45 HRC, except when zinc-coated by the hot-dip process, in which case they shall have a hardness of 26 to 45 HRC.

6.2 Carburized washers shall be carburized to a minimum depth of 0.015 in. and shall have a surface hardness of 69 to 73 HRA or 79 to 83 HR15N, except when zinc-coated by the hot-dip process, in which case they shall have a hardness of 63 to 73 HRA or 73 to 83 HR15N.

6.3 Carburized and hardened washers shall have a minimum core hardness of 30 HRC or 65 HRA.

**7. Dimensions and Tolerances**

7.1 All circular and clipped circular washers shall conform to the dimensions shown in **Table 2** and **Table 3**.

7.2 All square beveled and clipped square beveled washers shall conform to the dimensions shown in **Table 3** and **Table 4**. In addition, rectangular beveled and clipped rectangular beveled washers shall conform to the dimensions shown in **Table 3** and **Table 4**, except that one side may be longer than shown for the “A” dimension.

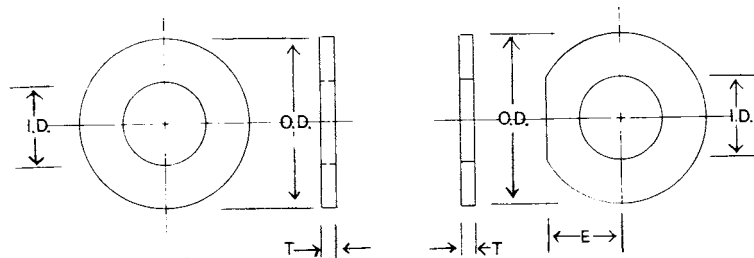
7.3 Unless otherwise stated in the inquiry or purchase order, plain (uncoated) hardened steel circular washers shall be furnished. Where corrosion-preventive treatment is required, washers shall be coated as agreed upon between the manufacturer and the purchaser.

**8. Workmanship, Finish, and Appearance**

8.1 Washers shall be free of excess mill scale, excess coatings and foreign material on bearing surfaces. Arc and gas cut washers shall be free of metal spatter.

**TABLE 2 Hardened Circular, Clipped Circular, and Extra-Thick Washers**

NOTE 1—Tolerances are as noted in table on washer dimension tolerances.



Nominal Size	Circular and Extra Thick		Circular and Clipped		Extra Thick		Clipped
	Circular, Clipped Circular, and Extra Thick		Circular and Clipped		Extra Thick		Clipped
	Nominal Outside Diameter (OD), in.	Nominal Inside Diameter (ID), in.	Thickness (T), in.				Minimum Edge Distance (E) <sup>A</sup> , in.
			min	max	min	max	
1/4	0.625	0.281	0.051	0.080	...	...	0.219
5/16	0.688	0.344	0.051	0.080	...	...	0.281
3/8	0.813	0.406	0.051	0.080	...	...	0.344
7/16	0.922	0.469	0.051	0.080	...	...	0.406
1/2	1.063	0.531	0.097	0.177	0.305	0.375	0.438
9/16	1.188	0.625	0.110	0.177	0.305	0.375	0.500
5/8	1.313	0.688	0.122	0.177	0.305	0.375	0.563
3/4	1.468	0.813	0.122	0.177	0.305	0.375	0.656
7/8	1.750	0.938	0.136	0.177	0.305	0.375	0.781
1	2.000	1.063	0.136	0.177	0.305	0.375	0.875
1 1/8	2.250	1.188	0.136	0.177	0.305	0.375	1.000
1 1/4	2.500	1.375	0.136	0.177	0.305	0.375	1.094
1 3/8	2.750	1.500	0.136	0.177	0.305	0.375	1.219
1 1/2	3.000	1.625	0.136	0.177	0.305	0.375	1.313
1 3/4	3.375	1.875	0.178 <sup>B</sup>	0.28 <sup>B</sup>	0.305	0.375	1.531
2	3.750	2.125	0.178 <sup>B</sup>	0.28 <sup>B</sup>	0.305	0.375	1.750
2 1/4	4.000	2.375	0.24 <sup>C</sup>	0.34 <sup>C</sup>	0.305	0.375	2.000
2 1/2	4.500	2.625	0.24 <sup>C</sup>	0.34 <sup>C</sup>	0.313	0.375	2.188
2 3/4	5.000	2.875	0.24 <sup>C</sup>	0.34 <sup>C</sup>	0.313	0.375	2.406
3	5.500	3.125	0.24 <sup>C</sup>	0.34 <sup>C</sup>	0.313	0.375	2.625
3 1/4	6.000	3.375	0.24 <sup>C</sup>	0.34 <sup>C</sup>	0.313	0.375	2.875
3 1/2	6.500	3.625	0.24 <sup>C</sup>	0.34 <sup>C</sup>	0.313	0.375	3.063
3 3/4	7.000	3.875	0.24 <sup>C</sup>	0.34 <sup>C</sup>	0.313	0.375	3.313
4	7.500	4.125	0.24 <sup>C</sup>	0.34 <sup>C</sup>	0.313	0.375	3.500

<sup>A</sup> Clipped edge E shall be not closer than 7/8 of the bolt diameter from the center of the washer.

<sup>B</sup> 3/16 in. nominal.

<sup>C</sup> 1/4 in. nominal.