Designation: F436 – 09

Standard Specification for Hardened Steel Washers[1]

This standard is issued under the fixed designation F436; 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 A325, A354, A449, and A490.

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 A588/A588M and A709/A709M. 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.

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 F1789 unless otherwise defined herein.

1.4 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

NOTE 1—A complete metric companion to Specification F436 has been developed—Specification F1136; therefore no metric equivalents are presented in this specification.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

A325 Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

A354 Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

A449 Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use

A490 Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength

A588/A588M Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance

A709/A709M Specification for Structural Steel for Bridges

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

B695 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

D3951 Practice for Commercial Packaging

F436M Specification for Hardened Steel Washers (Metric)

F606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

F1136 Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners

F1789 Terminology for F16 Mechanical Fasteners

[1] 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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[2] 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.**

F2329 Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
G101 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, Zinc/Aluminium Corrosion Protective Coating, 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, Zinc/Aluminium Corrosion Protective Coating*:

4.3.1 When zinc-coated washers are required, the purchaser shall specify the zinc coating process, for example, hot-dip, mechanically deposited, Zinc/Aluminium Corrosion Protective Coating, 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 F2329.

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 B695.

4.3.4 When Zinc/Aluminium Corrosion Protective Coating is specified, the washers shall be coated in accordance with the requirements of Grade 3 of Specification F1136.

4.3.5 When no preference is specified, the supplier may furnish either a hot-dip zinc coating in accordance with Specification F2329, or a mechanically deposited zinc coating in accordance with Specification B695, Class 55, or a Zinc/Aluminium Corrosion Protective Coating in accordance with Specification F1136, Grade 3. 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 G101 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.

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 A751.

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,

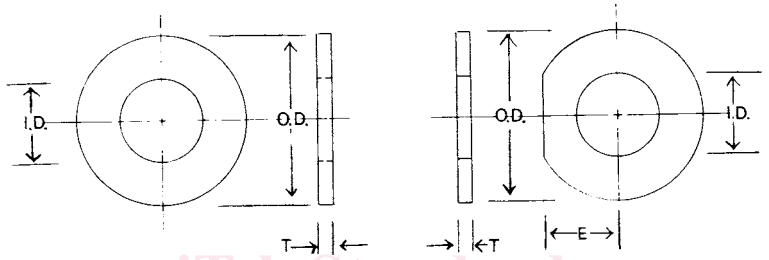
TABLE 1 Chemical Requirements

Element	Composition, %	
	Type 1	Type 3[A]
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

[A] Weathering steel washers may also be manufactured from any of the steels listed in Table 2 of Specification A325.

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

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



Circular and Extra Thick — Clipped Circular

Nominal Size	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. min	Thickness *(T)*, in. max	Thickness *(T)*, in. min	Thickness *(T)*, in. max	Minimum Edge Distance *(E)*[A], in.
¼	0.625	0.281	0.051	0.080	. . .	. . .	0.219
5/16	0.688	0.344	0.051	0.080	. . .	. . .	0.281
⅜	0.813	0.406	0.051	0.080	. . .	. . .	0.344
7/16	0.922	0.469	0.051	0.080	. . .	. . .	0.406
½	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
⅝	1.313	0.688	0.122	0.177	0.305	0.375	0.563
¾	1.468	0.813	0.122	0.177	0.305	0.375	0.656
⅞	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
1⅛	2.250	1.188	0.136	0.177	0.305	0.375	1.000
1¼	2.500	1.375	0.136	0.177	0.305	0.375	1.094
1⅜	2.750	1.500	0.136	0.177	0.305	0.375	1.219
1½	3.000	1.625	0.136	0.177	0.305	0.375	1.313
1¾	3.375	1.875	0.178[B]	0.28[B]	0.305	0.375	1.531
2	3.750	2.125	0.178[B]	0.28[B]	0.305	0.375	1.750
2¼	4.000	2.375	0.24[C]	0.34[C]	0.305	0.375	2.000
2½	4.500	2.625	0.24[C]	0.34[C]	0.313	0.375	2.188
2¾	5.000	2.875	0.24[C]	0.34[C]	0.313	0.375	2.406
3	5.500	3.125	0.24[C]	0.34[C]	0.313	0.375	2.625
3¼	6.000	3.375	0.24[C]	0.34[C]	0.313	0.375	2.875
3½	6.500	3.625	0.24[C]	0.34[C]	0.313	0.375	3.063
3¾	7.000	3.875	0.24[C]	0.34[C]	0.313	0.375	3.313
4	7.500	4.125	0.24[C]	0.34[C]	0.313	0.375	3.500

[A] Clipped edge *E* shall be not closer than ⅞ of the bolt diameter from the center of the washer.
[B] 3/16 in. nominal.
[C] ¼ in. nominal.