



# Standard Specification for Hardened Steel Washers Inch and Metric Dimensions<sup>1</sup>

This standard is issued under the fixed designation F436/F436M; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 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. and M12 through M100. 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 [A354](#) and [F3125](#).

1.2 The washers are designated by *type* denoting the material, by *style* denoting the shape, and by inch or metric dimensions.

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.

1.2.1.3 This specification provides for furnishing Type 3 to chemical composition or a Corrosion Index (CRI) of 6 or higher at the suppliers option.

1.2.2 The styles of washers covered are:

1.2.2.1 *Circular*—Circular washers in nominal bolt sizes ¼ through 4 in. and M12 through M100 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., M12 through M16, 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 4 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 either inch-pound units for inch fasteners and SI units for metric fasteners and are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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*:<sup>2</sup>

[A354](#) Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners

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

[A751](#) Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

[B695](#) Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

[F606/F606M](#) Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

[F1136/F1136M](#) Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners

[F1470](#) Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

[F1789](#) Terminology for F16 Mechanical Fasteners

[F2329](#) Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

[F3125](#) Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150

<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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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

ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions

**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),
- 3.1.3.1 Material type of washer (that is, Type 1 or Type 3),
- 3.1.3.2 When the type is not specified, either Type 1 or Type 3 washers may be supplied when permitted by the purchaser.

3.1.4 When galvanized or zinc/aluminum washers are specified, specify, the type of galvanizing, such as hot-dip or mechanical (see 4.3),

3.1.4.1 When the type of galvanizing is not specified, the manufacturer, at his option, may furnish hot-dip or mechanically galvanized washers.

3.1.4.2 When atmospheric corrosion resistance is required, Type 3 washers shall be specified by the purchaser.

3.1.5 Dimensions, nominal size, and other dimensions, if modified from those covered in this specification,

3.1.5.1 Standard thickness shall be supplied unless extra thick is specified.

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.

3.1.9 Surface roughness control (See S1).

### 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. for inch fasteners and M36 for metric fasteners, shall be through hardened. Washers over 1½ in. for inch fasteners and M36 for metric fasteners, may be either through hardened or carburized at the option of the manufacturer.

4.3 *Zinc Coatings, Hot-Dip and Mechanically Deposited, Zinc/Aluminum 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/Aluminum 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/Aluminum Corrosion Protective Coating is specified, the washers shall be coated in accordance with the requirements of Grade 3 of Specification **F1136/F1136M**.

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/Aluminum Corrosion Protective Coating in accordance with Specification **F1136/F1136M**, 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 washers shall conform to the chemical composition specified in **Table 1**.

5.2 Type 3 washers shall conform to the heat analysis specified in **Table 1**. Alternatively, at the suppliers option, Type 3 washers having a Copper minimum Heat Analysis of 0.25%, Phosphorous and Sulfur conforming to **Table 1** and a Corrosion Index of 6 or higher as calculated from the Heat Analysis as described in Guide **G101** Predictive method based on the data of Larabee and Coburn shall be accepted.

5.3 For Type 1 and 3 furnished to the Chemical Compositions in **Table 1**, Product Analysis may be made by the purchaser on finished washers representing each lot. The Chemical Composition shall conform to the requirements in **Table 1**, Product Analysis.

5.4 Product Analysis are not applicable to Type 3 washers furnished to a CRI of 6 or higher calculated from the Heat Analysis.

**TABLE 1 Chemical Requirements<sup>A</sup>**

Element	Composition, %	
	Type 1	Type 3 <sup>B</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> When providing Weathering Steels to a calculated corrosion index use the Legault-Leckie formula from Guide **G101**. Link to online calculator: [http://www.astm.org/COMMIT/G01\\_G101Calcultr1100.xls](http://www.astm.org/COMMIT/G01_G101Calcultr1100.xls)

$$I = 26.01 (\% Cu) + 3.88 (\% Ni) + 1.20 (\% Cr) + 1.49 (\% Si) + 17.28 (\% P) - 7.29 (\% Cu) (\% Ni) - 9.10 (\% Ni) (\% P) - 33.39 (\% Cu)^2$$

<sup>B</sup> Weathering steel washers may also be manufactured from any of the steels listed in Table 2 of Specification **A588/A588M** and **F3125**.

5.5 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. (inch series) or 0.38 mm (metric series) 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 4** (inch washers) and **Table 5** and **Table 7** (metric washers).

7.2 All square beveled and clipped square beveled washers shall conform to the dimensions shown in **Table 3** and **Table 4** (inch washers) and **Table 6** and **Table 7** (metric washers). In addition, rectangular beveled and clipped rectangular beveled washers shall conform to the dimensions shown in the appropriate **Table 3** and **Table 4** (inch washers) or **Table 6** and **Table 7** (metric washers) except that one side may be longer than shown for the “A” dimension.

7.3 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, following which is a substantially parallel a burnished depth section, and finally at the exit side a tapered breakout may occur (see **Fig. 1**). The parallel sided burnished depth section of the washer inside diameter shall be within the limits specified in **Table 2**, however, the specified maximum inside diameter may be exceeded at the washer face on the breakout side by a maximum taper allowance of 25 % of the specified maximum washer thickness for each size.

7.4 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.

## 9. Sampling and Number of Tests

9.1 Each lot shall be tested by the manufacturer prior to shipment in accordance with the lot control as described in **9.4.1** and **9.4.2** and **Table 6**.

9.1.1 When supplied by a source other than the manufacturer or processed by an outside supplier, the responsible party

shall assure that all tests have been performed and the washers conform to this specification.

9.2 When specified in the purchase order, the manufacturer shall furnish a test report for the lot as defined in **9.4.1**.

9.3 When weathering steels are furnished to Corrosion Resistance Index, the CRI number shall be calculated for each heat.

9.4 When the purchaser requires that additional tests be performed by the manufacturer to determine that the properties of products in an individual shipment are within specified limits, the purchaser shall specify the testing requirements, including the sampling plan and basis of acceptance, in the inquiry and purchase order.

9.4.1 The lot, for purposes of selecting samples, shall consist of all washers offered for inspection and testing, at one time, that are the same type, style, nominal size, same raw material heat number, same nominal post treatment (heat treatment, coating or both) and surface finish.

9.4.2 Samples from each lot shall be selected at random and tested for each requirement in accordance to **Table 8**.

## 10. Test Methods

### 10.1 Hardness:

10.1.1 *Non-carburized Washers*—A minimum of two readings shall be taken 180° apart on at least one face at a minimum depth of 0.015 in. (inch series) or 0.38 mm (metric series).

10.1.2 *Carburized Washers*—A minimum of two readings shall be taken 180° apart on at least one face.

10.2 Hardness tests shall be performed in accordance with the Rockwell test method specified in Test Methods **F606/F606M**.

### 10.3 Corrosion Resistance Index:

10.3.1 The corrosion Resistance Index shall be calculated from the Heat Analysis in accordance with **G101** Prediction Method based on the data of Larabee and Coburn.

## 11. Inspection

11.1 The manufacturer shall afford the purchaser’s inspector all reasonable facilities necessary to satisfy him that the material is being produced and furnished in accordance with this specification. Mill inspection by the purchaser shall not interfere unnecessarily with the manufacturer’s operations. All tests and inspections shall be made at the place of manufacture, unless otherwise agreed to.

11.2 If other than the normal inspection for continuous mass production of parts as stipulated in **9.1** is required by the purchaser, it shall be specified in the inquiry and contract order.

## 12. Rejection and Rehearing

12.1 Disposition of nonconforming washers shall be in accordance with Guide **F1470** section titled “Disposition of Nonconforming Lots.”

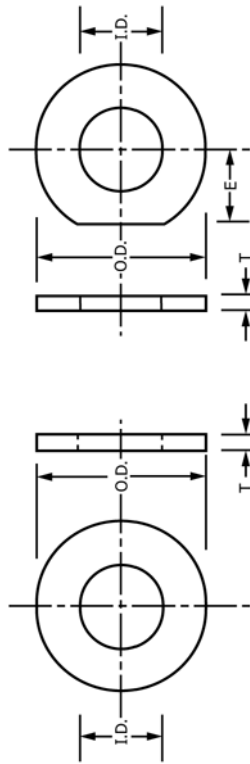
## 13. Certification and Test Report

13.1 When specified on the purchase order, a manufacturer’s certificate of conformance, or a test report, or both, that the



TABLE 2 Hardened Circular, Clipped Circular, and Extra (Inch Washers)

NOTE 1—Other tolerances are as noted in Table 4.



Nominal Washer <sup>D</sup> Size Inch	Clipped Circular		Outside Diameter (O.D.) Inch				Thickness Standard (T) Inch				Circular and Extra Thick		Clipped Minimum Edge Distance (E) <sup>A</sup>		
	Inside Diameter (I.D.) Inch		min		max		min		max		min			max	
	min	max	min	max	min	max	min	max	min	max	min	max		min	max
1/4	0.281	0.313	0.593	0.657	0.051	0.080	0.051	0.080	0.051	0.080	0.051	0.080	0.051	0.080	0.219
5/16	0.344	0.376	0.656	0.720	0.051	0.080	0.051	0.080	0.051	0.080	0.051	0.080	0.051	0.080	0.281
3/8	0.406	0.438	0.781	0.845	0.051	0.080	0.051	0.080	0.051	0.080	0.051	0.080	0.051	0.080	0.344
7/16	0.469	0.501	0.890	0.954	0.051	0.080	0.051	0.080	0.051	0.080	0.051	0.080	0.051	0.080	0.406
1/2	0.531	0.563	1.031	1.095	0.097	0.177	1.095	1.159	0.097	0.177	1.095	1.159	0.097	0.177	0.438
9/16	0.625	0.657	1.156	1.220	0.110	0.177	1.220	1.284	0.110	0.177	1.220	1.284	0.110	0.177	0.500
5/8	0.688	0.720	1.281	1.345	0.122	0.177	1.345	1.409	0.122	0.177	1.345	1.409	0.122	0.177	0.563
3/4	0.813	0.845	1.436	1.500	0.122	0.177	1.500	1.564	0.122	0.177	1.500	1.564	0.122	0.177	0.656
7/8	0.938	0.970	1.718	1.782	0.136	0.177	1.782	1.846	0.136	0.177	1.782	1.846	0.136	0.177	0.781
1	1.063	1.126	1.937	2.063	0.136	0.177	2.063	2.189	0.136	0.177	2.063	2.189	0.136	0.177	0.875
1 1/8	1.188	1.251	2.187	2.313	0.136	0.177	2.313	2.439	0.136	0.177	2.313	2.439	0.136	0.177	1.000
1 1/4	1.375	1.438	2.437	2.563	0.136	0.177	2.563	2.689	0.136	0.177	2.563	2.689	0.136	0.177	1.094
1 3/8	1.500	1.563	2.687	2.813	0.136	0.177	2.813	2.939	0.136	0.177	2.813	2.939	0.136	0.177	1.219
1 1/2	1.625	1.688	2.937	3.063	0.136	0.177	3.063	3.189	0.136	0.177	3.063	3.189	0.136	0.177	1.313
1 3/4	1.875	1.938	3.312	3.438	0.178 <sup>B</sup>	0.28 <sup>B</sup>	3.438	3.564	0.178 <sup>B</sup>	0.28 <sup>B</sup>	3.438	3.564	0.178 <sup>B</sup>	0.28 <sup>B</sup>	1.581
2	2.125	2.188	3.687	3.813	0.178 <sup>B</sup>	0.28 <sup>B</sup>	3.813	3.939	0.178 <sup>B</sup>	0.28 <sup>B</sup>	3.813	3.939	0.178 <sup>B</sup>	0.28 <sup>B</sup>	1.750
2 1/4	2.375	2.438	3.937	4.063	0.24 <sup>C</sup>	0.34 <sup>C</sup>	4.063	4.189	0.24 <sup>C</sup>	0.34 <sup>C</sup>	4.063	4.189	0.24 <sup>C</sup>	0.34 <sup>C</sup>	2.000
2 1/2	2.625	2.688	4.437	4.563	0.24 <sup>C</sup>	0.34 <sup>C</sup>	4.563	4.689	0.24 <sup>C</sup>	0.34 <sup>C</sup>	4.563	4.689	0.24 <sup>C</sup>	0.34 <sup>C</sup>	2.188
2 3/4	2.875	2.938	4.937	5.063	0.24 <sup>C</sup>	0.34 <sup>C</sup>	5.063	5.189	0.24 <sup>C</sup>	0.34 <sup>C</sup>	5.063	5.189	0.24 <sup>C</sup>	0.34 <sup>C</sup>	2.406
3	3.125	3.188	5.437	5.563	0.24 <sup>C</sup>	0.34 <sup>C</sup>	5.563	5.689	0.24 <sup>C</sup>	0.34 <sup>C</sup>	5.563	5.689	0.24 <sup>C</sup>	0.34 <sup>C</sup>	2.625
3 1/4	3.375	3.500	5.875	6.125	0.24 <sup>C</sup>	0.34 <sup>C</sup>	6.125	6.375	0.24 <sup>C</sup>	0.34 <sup>C</sup>	6.125	6.375	0.24 <sup>C</sup>	0.34 <sup>C</sup>	2.875
3 1/2	3.625	3.750	6.375	6.625	0.24 <sup>C</sup>	0.34 <sup>C</sup>	6.625	6.875	0.24 <sup>C</sup>	0.34 <sup>C</sup>	6.625	6.875	0.24 <sup>C</sup>	0.34 <sup>C</sup>	3.063
3 3/4	3.875	4.000	6.875	7.125	0.24 <sup>C</sup>	0.34 <sup>C</sup>	7.125	7.375	0.24 <sup>C</sup>	0.34 <sup>C</sup>	7.125	7.375	0.24 <sup>C</sup>	0.34 <sup>C</sup>	3.313
4	4.125	4.250	7.375	7.625	0.24 <sup>C</sup>	0.34 <sup>C</sup>	7.625	7.875	0.24 <sup>C</sup>	0.34 <sup>C</sup>	7.625	7.875	0.24 <sup>C</sup>	0.34 <sup>C</sup>	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.

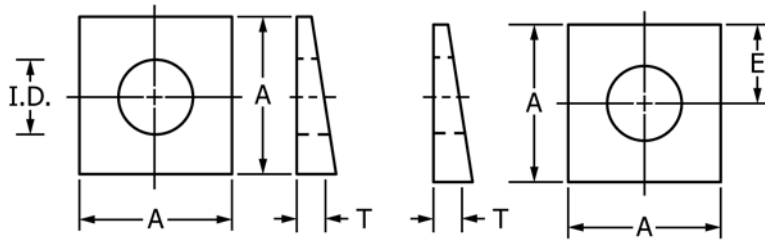
<sup>B</sup> 3/16 in. nominal.

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

<sup>D</sup> Nominal washer sizes are intended for use with fasteners of the same nominal thread size.

**TABLE 3 Hardened Beveled Washers (Inch Washers)**

NOTE 1—Tolerances are as noted in Table 4.



Bolt Size, in.	Square		Square Beveled and Clipped Square Beveled <sup>A</sup>		Mean Thickness (T), in.	Slope or Taper in Thickness	Clipped	
	Side Dimension (A), in.		Nominal Inside Diameter (I.D.), in.					Nominal Edge Distance (E), <sup>B</sup> in.
	min	max	min	max				
1/2	1.718	1.782	0.531	0.563	0.312	1:6	0.438	
5/8	1.718	1.782	0.688	0.720	0.312	1:6	0.562	
3/4	1.718	1.782	0.812	0.844	0.312	1:6	0.656	
7/8	1.718	1.782	0.938	0.970	0.312	1:6	0.781	
1	1.718	1.782	1.125	1.188	0.312	1:6	0.781	
1 1/8	2.187	2.313	1.250	1.313	0.312	1:6	0.875	
1 1/4	2.187	2.313	1.380	1.443	0.312	1:6	1.000	
1 3/8	2.187	2.313	1.500	1.563	0.312	1:6	1.094	
1 1/2	2.187	2.313	1.625	1.688	0.312	1:6	1.219	

<sup>A</sup> Rectangular beveled washers shall conform to the dimensions shown above, except that one side may be longer than that shown for the A dimension.

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

**TABLE 4 Washer Dimensional Tolerances (Inch washers)**

Dimensional Characteristics	<1 in. Nominal Size	1 through 1 1/2 in. Nominal Size	>1 1/2 through 3 in. Nominal Size	>3 in. Nominal Size
Flatness: max deviation from straightedge placed on cut side shall not exceed (in.)	0.010	0.015	0.020	0.032
Concentricity, in.: center of hole to outside diameter	0.030 FIR <sup>A</sup>	0.060 FIR <sup>A</sup>	0.090 FIR <sup>A</sup>	0.250 FIR <sup>A</sup>
Burr shall not project above immediately adjacent washer surface more than (in.)	0.010	0.015	0.020	0.025

<sup>A</sup> Full indicator reading.

material was manufactured and tested in accordance with this specification shall be furnished at the time of shipment.

13.2 Data contained in the test report shall include material grade, hardness tests, and calculated Corrosion Resistance Index when type 3 is furnished to a Corrosion Resistance Index.

**14. Responsibility**

14.1 The party responsible for the fastener shall be the organization that supplies the fastener to the purchaser.

**15. Product Marking**

15.1 Washers shall be marked with a symbol, or other distinguishing marks, to identify the manufacturer or private label distributor, as appropriate.

15.2 Additionally, washers shall be marked to identify their being metric size (metric series). Preferably, the metric marking shall be the symbol “M,” but may be of other distinguish-ing design as determined by the manufacturer.

15.3 Additionally, Type 3 weathering steel washers shall be identified with the symbol “3”.

15.4 Additional identification or distinguishing marks, or both, may be used by the manufacturer.

15.5 All marking symbols shall be depressed on one face of the washer.

15.6 Type and manufacturer’s or private label distributor’s identification shall be separate and distinct. The two identi-fications shall preferably be in different locations and, when on the same level, shall be separated by at least two spaces.

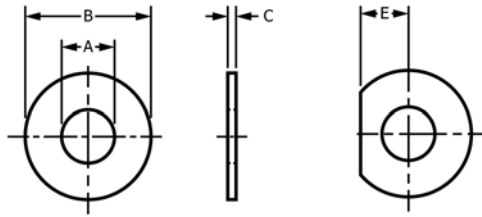
15.7 It is possible that during the clipping of circular washers the marking symbols may be removed. This is acceptable provided that the majority of washers in the lot still display the identification marks.

**16. Packaging and Package Marking**

16.1 *Packaging:*

**TABLE 5 Dimensions of Circular Washers (Metric Washers)**

NOTE 1—Other tolerances as noted in Table 7.

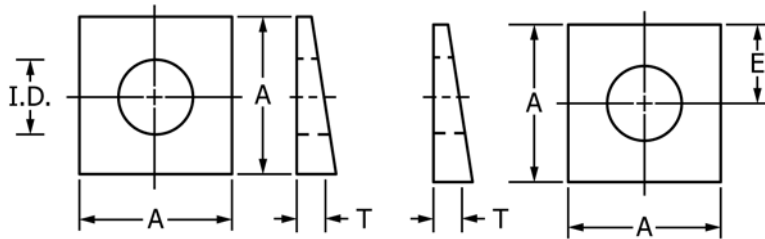


Metric Series							
Nominal Washer Size, mm <sup>A</sup>	Inside Diameter (A), mm		Outside Diameter (B), mm		Thickness (C), mm		Clipped Width (E), mm, min <sup>B</sup>
	max	max	min	max	min	max	
12	14.0	14.4	25.7	27.0	3.1	4.6	10.5
14	16.0	16.4	28.7	30.0	3.1	4.6	12.2
16	18.0	18.4	32.4	34.0	3.1	4.6	14.0
20	22.0	22.5	40.4	42.0	3.1	4.6	17.5
22	24.0	24.5	42.4	44.0	3.4	4.6	19.2
24	26.0	26.5	48.4	50.0	3.4	4.6	21.0
27	30.0	30.5	54.1	56.0	3.4	4.6	23.6
30	33.0	33.6	58.1	60.0	3.4	4.6	26.2
36	39.0	39.6	70.1	72.0	3.4	4.6	31.5
42	45.0	45.6	81.8	84.0	4.6	7.2	36.7
48	52.0	52.7	92.8	95.0	4.6	7.2	42.0
56	62.0	62.7	104.8	107.0	6.1	8.7	49.0
64	70.0	70.7	115.8	118.0	6.1	8.7	56.0
72	78.0	78.7	127.5	130.0	6.1	8.7	63.0
80	86.0	86.9	139.5	142.0	6.1	8.7	70.0
90	96.0	96.9	156.5	159.0	6.1	8.7	78.7
100	107.0	107.9	173.5	176.0	6.1	8.7	87.5

<sup>A</sup> Nominal washer sizes are intended for use with fasteners of the same nominal thread diameter.

<sup>B</sup> Washers may be clipped on one side not closer to the center of the washer than width E.

**TABLE 6 Hardened Beveled Washers (Metric Washers)**



Nominal Washer Size, mm <sup>A</sup>	Inside Diameter (I.D.), mm		Side Width (A), mm		Thickness (T), mm		Clipped Width (E), mm, min <sup>B</sup>
	min	max	min	max	min	max	
12	14.0	14.4	43.0	45.0	7.5	8.5	10.5
14	16.0	16.4	43.0	45.0	7.5	8.5	12.2
16	18.0	18.4	43.0	45.0	7.5	8.5	14.0
20	22.0	22.5	43.0	45.0	7.5	8.5	17.5
22	24.0	24.5	43.0	45.0	7.5	8.5	19.2
24	26.0	26.5	43.0	45.0	7.5	8.5	21.0
27	30.0	30.5	56.0	58.0	7.5	8.5	23.6
30	33.0	33.6	56.0	58.0	7.5	8.5	26.2
36	39.0	39.6	56.0	58.0	7.5	8.5	31.5

<sup>A</sup> Nominal washer sizes are intended for use with fasteners of the same nominal thread diameter.

<sup>B</sup> Washers may be clipped on one side not closer to the center of the was than width E

**TABLE 7 Washer Dimensional Tolerances (Metric Washers)**

Dimensional Characteristics	12mm through 16 mm	
	Nominal Size	>16 mm Nominal Size
Flatness: max deviation from straightedge placed on cut side shall not exceed	<sup>B</sup>	<sup>B</sup>
Concentricity, in.: center of hole to outside diameter	0.6 mm FIR <sup>A</sup>	0.9 mm FIR <sup>A</sup>
Burr shall not project above immediately adjacent washer surface more than (mm)	0.25 mm	0.25 mm

<sup>A</sup> Full indicator runoff.

<sup>B</sup> Flat within 0.01mm/mm of Outside Diameter

16.1.1 When special packaging requirements are specified, they shall be defined at the time of the inquiry or order, otherwise they will be packaged according to the supplier's normal practice.

### 16.2 Package Marking:

16.2.1 Each shipping unit shall include or be plainly marked with the following information:

16.2.1.1 ASTM designation and type,

16.2.1.2 Size,

16.2.1.3 Name and brand or trademark of the manufacturer,

16.2.1.4 Number of pieces,

16.2.1.5 Purchase order number, and

16.2.1.6 Country of origin.

## 17. Keywords

17.1 carbon steel; steel; washers; weathering steel

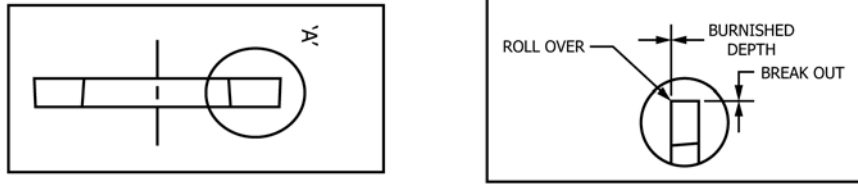


FIG. 1 Washer Inside Profile

TABLE 8 Sample Sizes and Acceptance Numbers for Mechanical Tests

Number of Pieces in Lot	Number of Tests	Acceptance Criteria	
		Acceptance Number	Rejection Number
800 and less	1	0	1
801 to 8000	2	0	1
8001 to 22 000	3	0	1
over 22 000	5	0	1

### SUPPLEMENTARY REQUIREMENTS

#### S1. Surface Roughness

S1.1 Washers shall have a multidirectional lay with a surface roughness not exceeding 750  $\mu$ in. (inch washers) or 19  $\mu$ m (metric washers) in height including any flaws in or on the surface.

S1.2 Burrs shall not exceed 0.01 in. (inch washers) or 0.25 mm (metric washers) in height.

### SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (F436–11) that may impact the use of this standard. (Approved September 1, 2016.)

- (1) Combined F436–11 and F436M–11 into one standard.
- (2) No content change or dimensionals changes were made. No metric dimensions were converted, all metric dimensions were taken from F436M. Some section wording that was previously updated in F436M was used in the combination. Some spelling corrections were made.
- (3) The figure and characteristic wording in 7.3 was updated to current practices.
- (4) Reformatted tables in Section 7, fractional dimensions were converted to decimals, added Table 6 for Hardened Beveled

- Washers (metric washers) back in. Added Table 7 Washer Dimensional Tolerances (metric washers).
- (5) Removed “certified” wording in Section 13.
- (6) Revised wording in 1.4 to clarify unit values to be used.
- (7) Updated Referenced documents in Section 2.
- (8) Revised Sampling and Number of tests in Section 9.
- (9) Revised Certification and Test Report in Section 10.

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