



# Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use<sup>1</sup>

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## 1. Scope

1.1 This specification covers round and miscellaneous shape steel plain (flat) washers furnished in an unhardened condition.

1.2 The washers are intended for general use bolt, nut, and stud applications to provide increased bearing surface, spacing, and to prevent galling.

1.3 Unless otherwise specified, the washers are furnished with dimensions conforming to B18.22.1, Type A, Tables 1A and Tables 1B.

1.4 Hardened washers for use with heat-treated structural bolts are covered by Specifications F436 and F436M.

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

## 2. Referenced Documents

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

A29/A29M Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought

A568/A568M Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

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

B633 Specification for Electrodeposited Coatings of Zinc on Iron and Steel

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

D3951 Practice for Commercial Packaging

F436 Specification for Hardened Steel Washers

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

F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

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

2.2 *ASME Standards*:<sup>3</sup>

B18.22.1 Plain Washers

B18.24 Part Identifying Number (PIN) Code System Standard for B18 Fastener Products

2.3 *Military Specification*:

DOD-P-16232 Phosphate Coating for Ferrous Metals<sup>4</sup>

2.4 *Federal Specification*:

QQ-P-416 Plating, Cadmium (Electrodeposited)<sup>4</sup>

## 3. Ordering Information

3.1 Orders for washers under this specification shall include:

3.1.1 Quantity (number of pieces of same item and size).

3.1.2 Name of item (steel plain washers).

3.1.3 Size (Nominal inside diameter and thickness. Include outside diameter, when required).

3.2 The following requirements are optional and may be specified when required:

3.2.1 Dimensions if other than B18.22.1, Type A.

3.2.2 Finish if other than oiled (see 4.3 through 4.3.6).

3.2.3 Chemical composition, if required (see 5.1.2).

3.2.4 Hardness, if required (see 6.2).

3.2.5 Shipment lot Testing, if required (see 9.2).

3.2.6 Test Reports, if required (see Section 12).

3.2.7 Marking, if required (see 14.1).

3.2.8 For establishment of a part identifying system, see ASME B18.24.

## 4. Materials and Manufacture

4.1 *Material*—The washers shall be punched from hot-rolled, hot-rolled and pickled, or cold-rolled steel; or shall be

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<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.

<sup>3</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

<sup>4</sup> Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, http://quicksearch.dla.mil/

machined from bar stock or tubing; or shall be forged at the manufacturer's option.

4.2 *Burr Removal*—The washers shall be tumbled, vibrated, or otherwise processed to minimize burrs.

4.3 *Protective Finishes:*

4.3.1 *Unprotected Washers*—Unless otherwise specified, the washer shall be furnished plain, with no protective finish other than oil to minimize rusting.

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

4.3.2.1 When zinc-coated washers are required, the purchaser shall specify the zinc-coating process, such as “hot dip,” “mechanically deposited,” or “no preference.”

4.3.2.2 When “hot-dip” is specified, the washers shall be zinc-coated by hot dipping in accordance with the requirements of Specification **F2329**.

4.3.2.3 When “mechanically deposited” is specified, the washers shall be zinc-coated by mechanical deposition in accordance with the requirements of Class 55 of Specification **B695**.

4.3.2.4 When “no preference” is specified, the supplier shall 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.

4.3.3 *Cadmium Plating*—Cadmium plated washers shall be cadmium plated by electrodeposition and yellow chromate treated in accordance with Federal Specification QQ-P-416, Type II, Class 3.

4.3.4 *Zinc Plating, Electroplated and Mechanically Deposited:*

4.3.4.1 When zinc plated washers are required, the purchaser shall specify the zinc plating process such as “electroplating” or “mechanical plating” or “no preference”.

4.3.4.2 When “electroplating” is specified, the washer shall be zinc plated by electrodeposition in accordance with Specification **B633**, Class Fe/Zn 5, Type II unless otherwise specified. See Specification **B633** for other thickness classes and finish types.

4.3.4.3 When “mechanical plating” is specified, the washer shall be zinc plated by mechanical deposition in accordance with Specification **B695**, Class 5, Type II unless otherwise specified. See Specification **B695** for other thickness classes and finish types.

4.3.4.4 When “no preference” is specified, the supplier, at his option, shall furnish either an electroplated finish in accordance with Specification **B633**, Class Fe/Zn 5, Type II, or a mechanically plated finish in accordance with Specification **B695**, Class 5, Type II.

4.3.5 *Phosphate Coating*—Phosphate coated washers shall be coated in accordance with Military Specification DOD-P-16232, Type Z, Class 2.

4.3.6 *Other Coatings*—Other protective coatings shall be as specified by the purchaser.

## 5. Chemical Composition

5.1 *Composition Limits:*

5.1.1 The washers shall be steel, and unless otherwise specified, shall have no specified chemical composition requirements.

5.1.2 When required, the washers shall be specified to conform to specific chemical requirements.

5.2 *Manufacturer's Analysis*—When specific chemical requirements have been specified and test reports are required, the manufacturer shall make individual analyses of randomly selected washers from the product to be shipped and report the results to the purchaser. In addition, if heat and lot identities have been maintained, the analysis of the raw material from which the fasteners have been manufactured shall, at the option of the manufacturer, be reported instead of product analysis.

5.3 *Product Analysis*—When specific chemical requirements have been specified, the purchaser reserves the right to conduct product analyses on the finished washers or request the manufacturer to conduct product analyses. The chemical composition thus determined shall conform to the specified requirements subject to the standard permissible variations for product analysis in Specification **A568/A568M** for washers punched from sheet; and Specification **A29/A29M** for washers machined from bar and tubing, or forged.

## 6. Mechanical Properties

6.1 Unless otherwise specified, the washers are not furnished to mechanical requirements.

6.2 When required and specified, the washers shall conform to the specified hardness.

## 7. Dimensions, Mass, and Permissible Variations

7.1 *Standard Dimensions*—Unless otherwise specified, the dimension shall be in accordance with B18.22.1, Tables 1A and Tables 1B for Type A washers. Where narrow (N) and wide (W) washers are provided for, the narrow type shall be furnished unless otherwise specified.

7.2 *Non-Standard Dimensions*—Other washers covered by this specification are generally referred to as US standard washers, SAE washers, light steel washers, riveting washers, fender washers, machinery bushing washers, machine screw washers, and similar designations. When specified, washers shall be furnished to these standards or shall be manufactured to the purchasers drawing requirements.

7.3 *Parallelism*—Washer faces shall be parallel within 0.005 in.

7.4 *Flatness:*

7.4.1 Washer faces shall be flat within the following requirements:

Outside Diameter, inches	Out of Flat, inches, maximum
0.500 and less	0.007
0.5625 through 1.250	0.010
over 1.250	0.015

7.4.2 Flatness shall be measured by laying a flat or concave side of the washer, if there is one, on a surface plate (so it rests on its outside diameter), and measuring the maximum difference in height of the other side above the surface plate. If both sides are convex, or if the washer is bent, both sides could be checked in the same manner, but:

7.4.2.1 A convex side will rest on the edge of the hole.

7.4.2.2 A bent (curved) washer shall be restrained to minimize the readings.

7.5 *Runout*—The runout of the outside diameter relative to the inside diameter shall not exceed a full indicator movement (FIM) equal to the inside diameter tolerance of B18.22.1.

## 8. Workmanship, Finish, and Appearance

8.1 Within the limits of good manufacturing practice, the washers shall be smooth, and free of burrs, loose scale, sharp edges, and other injurious imperfections.

8.2 Where protective finishes are specified, the requirements for the finish shall be in accordance with the requirements of the referenced specification.

## 9. Number of Tests and Retests

9.1 When mechanical requirements are specified, and for coating weight or thickness of coated products, the number of tests for each requirement specified shall be in accordance with Guide F1470, sampling level for the detection process; unless the purchaser and manufacturer have mutually agreed to use the prevention process. See Guide F1470 on Selection of Sampling Plans.

9.2 If the failure of a test specimen is due to improper preparation of the specimen or to incorrect testing technique, the specimen shall be discarded and another test specimen substituted.

## 10. Test Methods

10.1 *Chemical Analysis*—The chemical composition shall be determined by commercial test method. In the event of disagreement, chemical tests shall be made in accordance with Test Methods, Practices, and Terminology A751.

10.2 *Mechanical Tests*—Hardness tests, when required, shall be performed in accordance with Test Methods F606.

## 11. Inspection

11.1 The purchaser's representative representing the purchaser shall have free entry to all parts of the manufacturer's works that concern the manufacture of the material ordered. The manufacturer shall afford the purchaser's representative all reasonable facilities to satisfy that the material is being furnished in accordance with this specification. All tests and inspections required by the specification that are requested by the purchaser's representative shall be made prior to shipment,

and shall be conducted so as not to interfere unnecessarily with the operation of the works.

## 12. Certification

12.1 *Certificate of Compliance*—When specified in the contract or purchase order, the manufacturer shall furnish certification that the product was manufactured and tested in accordance with this specification and conforms to all specified requirements.

12.2 *Test Reports, Normal Inspection*—When test reports are specified on the purchase order for normal inspection as provided for by 9.1, the manufacturer shall furnish a test report certified to be the last complete set of mechanical tests for each stock size in each shipment.

12.3 *Test Reports, Individual Shipments*—When shipment lot testing in accordance with 9.2 is specified in the contract or purchase order, the manufacturer shall furnish a test report showing the results of the tests required for each lot shipped.

## 13. Responsibility

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

## 14. Product Marking

14.1 Individual washers are not required to be marked.

## 15. Packaging and Package Marking

15.1 *Packaging*:

15.1.1 Unless otherwise specified, packaging shall be in accordance with Practice D3951.

15.1.2 When special packaging requirements are required, they shall be defined at the time of the inquiry and order.

15.2 *Package Marking*:

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

15.2.1.1 ASTM designation,

15.2.1.2 Size,

15.2.1.3 Name and brand or trademark of the manufacturer,

15.2.1.4 Number of pieces,

15.2.1.5 Purchase order number, and

15.2.1.6 Country of origin.

## 16. Keywords

16.1 carbon steel; plain; steel; washers

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