

FF-W-100C

January 29, 1969

SUPERSEDING

Fed. Spec. FF-W-100B

April 21, 1965

(See Section 6)

FEDERAL SPECIFICATION

WASHER, LOCK, TOOTH

This specification was approved by the Commissioner, Federal Supply Services, General Services Administration, for the use of all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers tooth lockwashers for use in assemblies with bolts, studs and machine screws (see 6.1).

1.2 Classification.

1.2.1 Types, grades, styles and compositions. Tooth lockwashers shall be of the following types, grades, styles and compositions.

- Type I - Internal Tooth Flat.
 - Grade A - Regular.
 - Grade B - Heavy-Duty.
- Type II - External Tooth Flat.
- Type III - Internal-External Tooth Flat.
- Type IV - External Tooth Countersunk (80°-82°).
- Type V - External Tooth Countersunk (99°-101°).
 - Style 1 - Twisted Teeth.
 - Style 2 - Teeth with up-and-down bent edges.
 - Composition 1 - Carbon Steel.
 - Composition 2 - Corrosion-resisting steel.
 - Composition 3 - Phosphor bronze.
 - Composition 4 - Tin brass.

2. APPLICABLE DOCUMENTS

2.1 Specifications and standards. The following specifications and standards, of the issues in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

FSC 5310

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Federal Specifications:

- QQ-B-750 - Bronze, Phosphor; Bar, Plate, Rod, Sheet, Strip, Flat Wire and Structural and Special Shaped Sections.
- QQ-P-35 - Passivation Treatment for Austenitic, Ferritic and Martensitic Corrosion-resisting Steel.
- QQ-P-416 - Plating, Cadmium (Electrodeposited).
- QQ-Z-325 - Zinc Coating, Electrodeposited, Requirements for.

Federal Standards:

- Fed. Std. No. 66 - Steel: Chemical Composition and Hardenability.
- Fed. Std. No. 123 - Marking for Domestic Shipment (Civilian Agencies).
- Fed. Test Method Std. No. - 151 - Metals; Test Methods.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

(Single copies of this specification and other product specifications required by activities outside the Federal Government for bidding purposes are available without charge at the General Services Administration Regional Offices in Boston, New York, Washington, D.C., Atlanta, Chicago, Kansas City, Mo., Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, Wash.)

(Federal Government activities may obtain copies of Federal Specifications, Standards, Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

Military Specifications:

- MIL-H-3982 - Hardware (Fasteners and Related Items): Packaging and Packing for Shipment and Storage of.
- MIL-T-10727 - Tin Plating, Electrodeposited or Hot Dipped, for Ferrous and Non-Ferrous Metals.

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MIL-P-16232 - Phosphate Coatings, Heavy, Manganese or Zinc Base (For Ferrous Metals).

Military Standards:

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
- MIL-STD-129 - Marking for Shipment and Storage.
- MS35333 - Washer, Lock, Flat-Internal Tooth.
- MS35334 - Washer, Lock, Flat-Heavy, Internal Tooth.
- MS35335 - Washer, Lock, Flat-External Tooth.
- MS35336 - Washer, Lock, Countersunk 80°-82°, External Tooth.
- MS35790 - Washer, Lock-Countersunk, 100°, External Tooth.
- MS45904 - Washer, Lock, Internal and External Tooth.

(Copies of Military Specifications, Standards and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the Contracting Officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

United States of America Standard Institute (USAS) Standard:
USAS B27.1 - Lock washers.

(Applications for copies should be addressed to United States of America Standards Institute, 10 East 40th Street, New York, New York 10016.)

Copper Development Association Inc:
Alloy No. 425

(Application for copies should be addressed to Copper Development Association Inc., 405 Lexington Avenue, New York, New York 10017.)

(Technical society and technical associations specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and Federal agencies.)

3. REQUIREMENTS

3.1 Material. Tooth lockwashers shall be of carbon steel, corrosion-resisting steel, phosphor-bronze or tin brass, as specified herein.

3.1.1 Composition 1. Carbon steel washers shall be of composition 1050 to 1064 as specified in Fed. Std. No. 66.

3.1.2 Composition 2. Corrosion-resisting steel washers shall be of composition 410 as specified in Fed. Std. No. 66.

3.1.3 Composition 3. Phosphor bronze washers shall be of composition A as specified in QQ-B-750.

3.1.4 Composition 4. Tin brass washers shall be Copper Development Association Inc. alloy number 425.

3.2 Construction. The number of teeth, length of teeth, width of rim, and the free height (thickness of the washer over the teeth) shall be optional with the manufacturer. The teeth shall be uniform and symmetrical with respect to size, shape and angle of twist or of bent edges. The uniformity of the projections of the canted teeth of Style 1 washers and of bent-teeth edges of Style 2 washers, with respect to the washer rim, shall be within a tolerance of one-half the projection on a side. The teeth shall not have sharp corners at the junction with the rim.

3.3 Hardness. Compositions 1 and 2 washers shall have a hardness of Rockwell C40-50. Decarburization shall be removed prior to the hardness test. Composition 3 washers shall have a hardness of Rockwell E85-95. The hardness of composition 4 washers shall be as specified in table I.

TABLE I.

Types of washers	Material thickness	Rockwell hardness
I and II	0.039 inch and under	B89-94
	.040 and over	B92-97
IV and V	.039 inch and under	B86-92
	.040 and over	B88-94

3.4 Dimensions. Unless otherwise specified (see 6.2), the dimensions shall be as specified on the applicable Military Standards specified in table II, or as specified in USAS B27.1, as applicable.

TABLE II.

Types of washers	Publications	
I		
Grade A	MS35333	USAS B27.1
Grade B	MS35334	USAS B27.1
II	MS35335	USAS B27.1
III	MS45904	USAS B27.1
IV	MS35336	USAS B27.1
V	MS35790 (not covered by USAS B27.1)	

3.5 Compression. The washers shall withstand the test of 4.5.5 without evidence of fracture of either the rim or teeth.

3.6 Flattening resistance. The washers shall withstand the test of 4.5.5 without evidence of teeth being flattened with respect to the rim.

3.7 Spreadability. The washers shall withstand the spread test specified in 4.5.6 without fracture, when the ends are separated to a distance equal to the inside diameter of the washer.

3.8 Protective finish.

3.8.1 Carbon steel washers. Unless otherwise specified, carbon steel washers shall be uncoated (see 6.2).

3.8.1.1 Cadmium plating. When cadmium plating is specified it shall be in accordance with QQ-P-416, type II, class 3 (see 6.2).

3.8.1.2 Zinc coating. When zinc coating is specified it shall be in accordance with QQ-Z-325, type II, class 3 (see 6.2).

3.8.1.2.1 Hydrogen or acid embrittlement. Cadmium plated or zinc-coated washers shall be baked at a temperature of 350°-400°F for a period of four hours immediately after plating to relieve hydrogen or acid embrittlement.

3.8.1.3 Phosphate coating. When phosphate coating is specified it shall be in accordance with MIL-P-16232, type 4, class 2 (see 6.2).

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3.8.2 Corrosion-resisting steel washers. Corrosion-resisting steel washers shall be passivated in accordance with QQ-P-35, Type II or III.

3.8.3 Phosphor-Bronze washers. Unless otherwise specified, phosphor-bronze washers shall be furnished uncoated (see 6.2).

3.8.3.1 Tin plating. When specified (see 6.2), phosphor-bronze washers shall be tinned in accordance with MIL-T-10727.

3.8.4 Tin brass washers. Tin brass washers shall be uncoated.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspection are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Lot. A lot shall consist of all washers of one type, grade, style, composition and size on the same contract or order, produced by the same manufacturer under essentially the same conditions and submitted for inspection at the same time.

4.3 Sampling.

4.3.1 Sampling for visual and dimensional examination. Samples shall be taken in accordance with MIL-STD-105, inspection level II. The AQL shall be in accordance with table III.

4.3.2 Sampling for hardness test. Samples shall be taken in accordance with MIL-STD-105, inspection level S-4. The AQL shall be 2.5 percent.

4.3.3 Sampling for protective finish test. Samples shall be taken in accordance with the applicable finish specification (see 3.8).

4.3.4 Sampling for chemical analysis. Samples shall be taken in accordance with MIL-STD-105, Inspection level S-3. The AQL shall be 2.5 percent.

4.3.5 Sampling for compression and flattening test. Samples shall be taken in accordance with MIL-STD-105, inspection level S-3, with an AQL of 2.5 percent.

4.3.6 Sampling for spread test. Samples shall be taken in accordance with MIL-STD-105, inspection level S-3, with an AQL of 2.5 percent.

4.4 Examination.

4.4.1 Visual and dimensional. Each washer taken at random as specified in 4.3.1 shall be examined to verify conformance to requirements of this specification. Examination shall be in accordance with table III. Any washer containing one or more defects shall be rejected, and if the number of defective washers in the sample exceeds the acceptance number for that sample, the represented lot shall be rejected.

TABLE III.
Classification of defects

Categories	Defects	Inspection Method
Critical	None defined	
Major	AQL - 2.5 percent	
101	Inside diameter (see 3.4, types I-V)	Measure
102	Side length (see 3.4, type IV)	Measure
103	Material thickness (see 3.4 types I-V)	Measure
Minor	AQL - 6.5 percent	
201	Outside diameter (see 3.4, types I-V)	Measure
202	Uneven length of teeth (see 3.2)	Measure
203	Uneven width of teeth (see 3.2)	Measure
204	Variable number of teeth (see 3.2)	Visual

4.5 Tests.

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4.5.1 Chemical analysis. Unless otherwise specified by the procuring agency, the test procedure shall be in accordance with Fed. Test Method Std. No. 151. A certification of analysis from the mill supplier, kept available by the supplier of products specified herein, will be acceptable in lieu of chemical analysis (see 6.2).

4.5.2 Test for protective finish. Protective finishes shall meet the test requirements of the applicable specifications (see 3.8).

4.5.3 Hydrogen or acid embrittlement relief. The contractor shall furnish the Government certification that cadmium plated or zinc coated washers have been subjected to the hydrogen or acid embrittlement relief treatment of 3.8.1.2.1.

4.5.4 Hardness test. Hardness test shall be performed in accordance with Fed. Test Method Std. No. 151.

4.5.5 Compression and flattening test. Washers shall be placed between two cold rolled steel plates (types IV and V shall use conical mating surfaces) having a hardness of Rockwell B85-90. A coarse-threaded bolt (corresponding to size of washer under test) is passed through the plates and tightened until the washer is flat. The nut shall then be turned an additional $1/3$ of a turn and held for twelve hours. (Types IV and V up to No. 10, $3/8$ of a turn.) Upon release, the washer shall have a minimum height equal to 85 percent of the free height (see 3.2). There shall be no evidence of fracture of teeth or rim. The teeth shall not be flattered with respect to the rim.

4.5.6 Spread test. The rim of the lockwasher shall be cut or severed with a chisel or cutting pliers and the severed ends shall be gripped by pliers or vise and pliers. Separation of the ends in the form of a helix, to a distance equal to the inside diameter of the washer, shall not result in fracture.

4.6 Examination and tests of preparation for delivery. Preservation, packaging, packing and marking shall be inspected in accordance with MIL-H-3982.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, packing and marking. Cleaning, preservation, packaging, packing and marking shall be in accordance with MIL-H-3982, for the level of protection specified (see 6.2).

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5.1.1 When P-18 preservative is used, packages shall be closed so that there shall be no gas leakage (see 6.2).

5.2 Marking.

5.2.1 Civil agencies. In addition to markings required by the contract or order, the packages and shipping containers shall be marked in accordance with Federal Std. No. 123.

5.2.2 Military activities. In addition to markings required by the contract or order, the packages and shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The tooth lockwashers covered by this specification are intended for automotive, aircraft, and general industrial applications. These washers serve to lock fasteners to the component part of an assembly or increase the friction between the fasteners and the assembly. For aeronautical applications, see Design Limitation Standard AND10476.

6.2 Ordering data. Purchasers should exercise any desired options offered herein, and procurement documents should specify the following:

- (a) Title, number and date of this specification.
- (b) Type, grade, style and composition of tooth lockwashers required (1.2).
- (c) Dimensions (3.4).
- (d) Protective finish, if required (3.8).
- (e) Chemical analysis if required (4.5.1).
- (f) Level of protection required (5.1).
- (g) Method of closure when P-18 preservative is used (5.1.1).

6.2.1 Military procurement. Items procured under this specification for Military use are to be limited to the variety shown on the applicable Military Standards. Personnel of the military departments are requested to refer to these documents for guidance.

6.3 Cross reference data. Cross reference between types, grades, designs and classes of FF-W-CO100 (GSA-FSS), dated October 31, 1955, FF-W-100a dated August 15, 1962, FF-W-100b, dated April 21, 1965, and the types, grades, styles and compositions of this specification are as shown in Table IV.

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TABLE IV. Cross reference data

FF-W-00100 (GSA-FSS)	FF-W-100a	FF-W-100B and FF-W-100C
Type A	Type I	Type I
Grade 1	Grade A	Grade A
Grade 2	Grade B	Grade B
Type B	Type II	Type II
Type C	Type IV	Type IV
	Type III	Type III
Type E	Type V	Type V
Design 1	Style 1	Style 1
Design 2	Style 2	Style 2
Class 1	Composition 1	Composition 1
Class 2	Composition 2	Composition 2
Class 3	Composition 3	Composition 3
None	None	Composition 4

6.4 Supersession data. This specification includes the requirements of MIL-W-6986 dated October 29, 1959

Custodians:

Army - WC
Navy - AS
Air Force - 62

Review activities:

Army - AT, EL, ME, MI, MU
Navy - None
Air Force - 85
DSA - IS
NSA

User activities:

Army - CE, GL
Navy - SH
Air Force - None

Preparing activity:

Army - WC

CIVIL AGENCIES INTEREST:

DC
GSA
NBS
VA

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