INCH-POUND
MIL-W-12133D
17 JUNE 1994
SUPERSEDING
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MILITARY SPECIFICATION

WASHER, SPRING TENSION

GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers washers, spring tension, Belleville spring, wave and curved.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1. Specifications, standards and handbooks. Unless otherwise specified, issues of referenced documents are those in effect at the time of solicitation. Information regarding the latest issue of government documents and adopted non-government documents can be obtained from the Department of Defense Index of Specification and Standards..

SPECIFICATIONS

FEDERAL

QQ-P-416 - Plating, Cadmium (Electrodeposited)

MILITARY

MIL-S-5059 - Steel, Corrosion-Resistant (18-8) Plate, Sheet and Strip
MIL-S-25042 - Steel Plate, Sheet and Strip, 17-7 PH, Corrosion-Resistant, Precipitation Hardening
MIL-P-47158 - Penetrant Inspection, Soundness Requirements for Materials, Parts and Weldments
MIL-C-81562 - Coatings, Cadmium, Tin-Cadmium and Zinc, (Mechanically Deposited)

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to : Commander, Defense Industrial Supply Center (DISC), 700 Robbins Ave, Phila., PA 19111-5096, ATTN: DISC-EFA, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5310

STANDARDS

MILITARY

MIL-STD-13126 - Fasteners, Test Method 6, Hardness

(Copies of specifications, standards, handbooks, drawings and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other Publications. Unless otherwise specified, issues of referenced documents are those in effect at the time of solicitation . Information regarding the latest issue of non-government documents not adopted by the government can be obtained from the organization responsible for thier publication.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ASME B46.1 - Surface Texture (Surface Roughness, Waviness and Lay)
ASME/ANSI B18.18.2 - Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners

(Applications for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ANSI/ASTM A380 - Cleaning and Descaling Stainless Steel Parts, Equipment and Systems, Standard Recommended Practice for
ASTM B194 - Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip and Rolled Bar
ANSI/ASTM E384 - Standard Test Method for Microhardness of Materials
ASTM B633 - Electrodeposited Coatings of Zinc on Iron and Steel, Standard Specification for
ASTM A684/A684M - Steel, High-Carbon, Strip, Cold-Rolled Soft, Standard Specification for
ASTM E1444 - Magnetic Particle Inspection, Standard Practice for
ASTM F1470 - Guide for Fastener Sampling for Specified Mechanical Properties in Performance Inspection
ASTM D3951 - Commercial Packing, Standard Practices for

(Applications for copies should be addressed to the American Society of Testing and Materials, 1916 Race Street, Phila., PA 19103.)

SOCIETY OF AUTOMOTIVE ENGINEERS, INC. (SAE)

AMS 5519 - Steel, Corrosion Resistant, Sheet and Strip 18Cr - 8Ni (SAE 30301), Cold Rolled, 185 ksi (1276 Mpa) Tensile Strength
AMS 5906 - Steel Sheet and Strip, Corrosion Resistant, 18Cr - 9.0Ni (SAE 30302), Cold Rolled. 185 ki (1276 Mpa) Tensile Strength
AMS 5913 - Steel Sheet and Strip, Corrosion Resistant, 19Cr - 9.2Ni (SAE 30304), Cold Rolled, 185ki (1276 Mpa) Tensile Strength

(Applications for copies should be addressed to the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references, other than specification sheets, cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between requirements of this specification and the specification sheet, the latter shall govern (See 6.2).

3.2 Material. Recycled and reclaimed materials (see 3.1) shall be used to the maximum extent practicable.

3.2.1 Spring steel. Spring steel shall conform to any of the steel Grades 1070 thru 1095, (UNS 10700 thru UNS 10950), as specified in ASTM A684/A684M.

3.2.2 Corrosion resistant steel (austenitic). Austenitic corrosion resistant steel shall conform to Type 301 (UNS S30100) or Type 302 (UNS S30200) per AMS 5906, or Type 17-7 PH (UNS S17700 or S17780), temper TH1050, per MIL-S-25043.

3.2.3 Copper-Beryllium. Copper-beryllium shall conform to copper alloy Number 172 (UNS C17200) TD02 Temper as specified in ASTM B194.

3.3 Hardness.

3.3.1 Spring steel. Spring steel washers shall be heat treated to a surface hardness of 45-52 HRC.

3.3.2 Copper-beryllium. Copper-beryllium washers shall be heat treated to a surface hardness of 350-380HV 0.5

3.4 Protective coating and surface treatment. The protective coating and surface treatment of the washers when specified in the applicable specification sheet shall be as follows (see 4.4.3.2).

3.4.1 Cadmium plate. When specified, washers shall be cadmium plated in accordance with QQ-P-416, Type II, Class 2 or MIL-C-81562, Type II, Class 2 for electrodeposition or merchanical deposition , respectively.

3.4.2 Zinc. When specified, washers shall be zinc plated in accordance with MIL-C-81562, Type II, Class 2 or in accordance with ASTM B633, Fe/Zn 13, Type II for mechanical desposition or electrodeposition, respectively.

3.4.3. Cleaning, descaling and passivation. Corrosion resistant steel washers shall be cleaned, descaled and passivated in accordance with ASTM A380.

3.4.4 Plain. Unless otherwise specified washers shall be furnished with a natural (as fabricated) finish, unplated or uncoated, with a light film of oil or rust inhibitor.

3.5 Dimensions. Dimensions and tolerances shall be in accordance with the applicable specification sheet and shall apply after protective coating.

3.5.1 Concentricity. The outside diameter (OD) of the washers shall be concentric with the inside diameter within the following limits:

OD (inches)		CONCENTRICITY 1/
Over	To	
.250	.500	.005
.500	.750	.007
.750	1.500	.010
1.500	2.500	.015

1/ Concentricity dimensions apply to flat spring washers before being formed.

3.6 Edges and burrs. All edges shall be broken and free of burrs.

3.7 Surface roughness. Washers shall have a maximum surface roughness of 125 microinches, determined in accordance with ANSI/ASME B46.1.

3.8 Decarburization. Spring steel washers shall be free of decarburization.

3.9 Cracks. Washers shall be free of cracks, flaws and pits in any location. A crack is a clean crystalline fracture passing through or across the grain boundaries without inclusion of foreign elements.

3.10 Performance.

3.10.1 Load-deflection. Washers shall meet the compression load and deflection requirements set forth on the applicable specification sheet (see 3.1).

3.10.2 Permanent set.

3.10.2.1 Belleville and curved spring washers. After one deflection to flat, Belleville and curved spring washers shall return to their original free height within the tolerances of the original free height.

3.10.2.2 Wave spring washers. After one deflection to flat, the wave spring washer overall height shall not be less than twice the sectional thickness.

3.10.3 Repeated loading.

3.10.3.1 Belleville spring washers. The Belleville spring washers shall withstand the repeated loading test specified in 4.4.3.7.1, without indication of permanent set in excess of 10 percent of the original free height and without cracking or breaking.

3.10.3.2 Curved spring washers. The curved spring washers shall withstand the repeated loading test specified in 4.4.3.7.1, without indication of permanent set in excess of 20 percent of the original free height and without cracking or breaking.

3.10.3.3 Wave spring washer. The wave spring washer shall withstand the repeated loading test of 4.4.3.7.3, without indication of permanent set such that the overall height shall not have reduced to less than 1.7 times the sectional thickness.

3.11 Workmanship. Spring tension washers shall be free from surface contamination, tool marks and other imperfections which may adversely affect serviceability.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor 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 inspections are deemed necessary to assure supplies and services conform to prescribe requirements.

4.2 Quality conformance inspection.

4.2.1 Inspection of product for delivery. Inspection of product shall be in accordance with the requirements of ASME/ANSI B18.18.2M. Final inspection shall consist of Groups A and B inspection as specified in this document.

4.2.1.1 Inspection lot. An inspection lot shall consist of all spring tension washers covered by a single specification sheet, produced under essentially the same conditions, and offered for inspection at any one time.

4.2.1.2 Group A inspection. Group A inspection shall consist of the inspection specified in Table I.

4.2.1.2.1 Sampling plan. Statistical sampling and inspection for Subgroup 1 shall be in accordance with the criteria called out in ASTM F1470. Major and minor defects shall be as defined in Table II. Sampling and inspection for Subgroup 2 shall be in accordance with the criteria called out in ASTM F1470.

4.2.1.2.1.1 Rejected lots (Subgroup 1). Rejected inspection lots may be resubmitted for Government acceptance only if the manufacturer performs 100 percent inspection on the washers of the lot for those characteristics which were defective and resulted in rejection of the lot and remove all defective units and resubmits the lot for quality conformance inspection. Resubmitted lots shall be kept separate from new lots and shall be clearly identified as resubmitted lots. Resubmitted lots shall be inspected using the reinspection criteria specified in ASTM F1470, paragraph 7.3 and shall not thereafter be tendered for acceptance unless the former rejection or requirement of correction is disclosed.

4.2.1.2.1.2 Rejected lots (Subgroup 2). If an inspection lot is rejected, the manufacturer may rework it to correct creen out the defective units, and resubmit for reinspection. Resubmitted lots shall be inspected using the reinspection criteria specified in ASTM F1470, paragraph 7.3 and shall not thereafter be tendered for acceptance unless the former rejection or requirement of correction is disclosed. Such lots shall be separate from new lots nd shall be clearly identified as reinspected lots.

TABLE I. GROUP A INSPECTION

INSPECTION	REQUIREMENT PARAGRAPH	TEST METHOD PARAGRAPH	SAMPLING PROCEDURE
Subgroup 1			
Protective coating and surface treatment	3.4	4.4.3.2	
Dimensions	3.5	4.4.1	As specified
Surface roughness	3.7	4.4.1	per ASTM F1470
Subgroup 2			
Cracks	3.9	4.4.3.3	

4.2.1.2.2 Disposition of sample units. Sample units which have passed all the Group A inspections may be delivered on the contract or purchase order.

TABLE II. CLASSIFICATION OF DEFECTS.

CATEGORY	DEFECT	INSPECTION METHOD
Critical	None defined	
Major		
101	Inside diameter, not as specified (see 3.5)	SIE 1/
102	Outside diameter, not as specified (see 3.5)	SIE 1/
103	Evidence of cracks or pits (see 3.9)	Visual
104	Thickness, not as specified (see 3.5)	SIE 1/
105	Free height, not as specified (see 3.5)	SIE 1/
Minor		
201	Protective coating and surface treatment, missing or incomplete (see 3.4)	Visual
202	Other dimensions, not as specified (see 3.5)	SIE 1/
203	Surface Roughness, not as specified (see 3.7)	SIE 1/
204	Workmanship, (see 3.11)	Visual

1/ Standard Inspection Equipment

4.2.1.3 Group B inspection. Group B inspection shall consist of the tests specified in Table III in the order shown.

TABLE III. GROUP B INSPECTION.

INSPECTION	REQUIREMENT PARAGRAPH	TEST METHOD PARAGRAPH
Hardness	3.3	4.4.3.1
Decarburization	3.8	4.4.3.4
Load deflection	3.10.1	4.4.3.5
Permanent set	3.10.2	4.4.3.6
Repeated loading	3.10.3	4.4.3.7

4.2.1.3.1 Sampling Plan. The sampling plan shall be in accordance with ASTM F1470.

4.2.1.3.2 Defectives. If the number of defects exceed the number allowed in the specified sampling plan, the sample shall be considered to have failed.

4.2.1.3.3 Disposition of samples. Sample units which have been submitted to Group B inspection shall not be delivered on the contract or purchase order.

4.2.1.3.4 Noncompliance. If a sample fails to pass the specified inspection plan, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which are manufactured under essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action acceptable to the qualifying activity has been taken. After the corrective action has been taken, Group B inspection shall be repeated on additional sample units (all tests and examinations, or the test which the original sample failed, at the option of the qualifying activity). Group A inspection may be reinstituted; however, final acceptance and shipment shall be withheld until the Group B inspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.3 Inspection of packaging. The sampling and inspection of the preservation-packaging, packing and container marking shall be in accordance with the requirements of ASTM D3951.

4.4 Methods of inspection.

4.4.1 Visual and dimensional. The washers shall be examined to verify that physical dimensions, surface roughness and workmanship are in accordance with the applicable requirements of 3.5, 3.7 and 3.11.

4.4.2 Material inspection. Material inspection shall consist of certification supported by certifying data that the materials used in fabricating the washers are in accordance with the requirements of 3.2, or the requirements as defined in the applicable slash sheet..

4.4.3 Hardness and finish inspection.

4.4.3.1 Hardness inspection. Samples taken as specified in 4.2.1.3 (GROUP B) shall be tested for surface hardness in accordance with MIL-STD-1312-6 and ASTM E384, and the requirements referenced in 3.3.1 and 3.3.2.

4.4.3.2 Protective coating and surface treatment inspection. Samples taken as specified in 4.2.1.2 (GROUP A) shall be inspected for adequacy of plating in accordance with applicable specification of 3.4.

4.4.3.3 Magnetic particle (cracks) inspection. Spring steel washer samples taken as specified in 4.2.1.2 shall be subjected to magnetic particle inspection in accordance with ASTM E1444. CRES, Type 302 (UNS S30200) and Type 17-7 (UNS 17700 or UNS 17780), and copper-beryllium washer samples taken as specified in 4.2.1.2 shall be subjected to penetrant inspection in accordance with MIL-P-47158. There shall be no evidence of cracks or pits as specified in 3.9.

4.4.3.4 Decarburization. Samples taken as specified in 4.2.1.3 shall be microscopically examined at a magnification of 100 diameters. There shall be no evidence of decarburization. The etchant shall be 5 percent nital.

4.4.3.5 Load-deflection.

4.4..3.5.1 Belleville spring washers. Belleville spring washer samples, taken as specified in 4.2.1.3, shall be deflected to the test height listed on the applicable specification sheet. The resulting load shall be measured to verify conformance with the load and tolerances referenced therein.

4.4.3.5.2 Curved spring washers. Curved spring washer samples, taken as specified in 4.2.1.3, shall be deflected to the test height listed on the applicable specification sheet. The resulting load shall be measured to verify conformance with the load and tolerances referenced therein.

4.4.3.6 Permanent set.

4.4.3.6.1 Belleville and curved spring washers. Belleville and curved spring washer samples, taken as specified in 4.2.1.3, shall be deflected one time to flat, to determine compliance with 3.10.2.1.

4.4.3.6.2 Wave spring washers. Wave spring washers taken as specified in 4.2.1.3, shall be deflected to flat, to determine compliance with 3.10.2.2.

4.4.3.7 Repeated loading.

4.4.3.7.1 Belleville spring washers. Belleville spring washer samples, taken as specified in 4.2.1.3, shall be deflected 10 times from free height to within .003 to .005 inch of solid height to determine conformance with 3.10.3.1. The deflection shall then be measured to determine conformance with 3.10.1.

4.4.3.7.2 Curved spring washers. Curved spring washers, taken as specified in 4.2.1.3, shall be deflected 10 times from free height to flat to determine compliance with 3.10.3.2. The deflection shall then be measured to determine conformance with 3.10.1.

4.4.3.7.3 Wave spring washers. Wave spring washer samples, taken as specified in 4.2.1.3, shall be deflected 20 times from free height to flat to determine compliance with 3.10.3.3.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with ASTM D3951 (see 6.2).

6. NOTES

6.1 Intended use. Intended use of the washers is as follows:

a. Belleville washers are intended for use as compression springs where high loads in limited spaces are required. These washers can be used to maintain load or tension in bolted assemblies and to assure proper positioning and tension of ball bearings.

b. Curved spring washers are intended to exert relatively light thrust loads and to take up end play.

c. Wave spring washers are used in thrust loading applications where the allowable amount of axial space is limited.

6.2 Ordering data. Acquisition documents should specify the following:

a. Title, number and date of this specification and the applicable specification sheet.

b. Applicable specification sheet numbers (see 3.1).

c. Level (degree) of protection in accordance with ASTM D3951 ordering data (see 5.1).

6.3 Changes from previous issues. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

6.4 Key words:

Belleville
Corrosion
Curved
Spring
Wave

Custodians:
Army - AR
Navy - OS
Air Force - 99

Review Activities:
Army - AV, AT, ME, MI
Navy - AS, MC, YD
Air Force - 11, 82

Preparing Activity:
DLA - IS

(Project 5310-1890)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constutite or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-W-12133D	2. DOCUMENT DATE(YYMMDD) 94 JUNE 17

3. DOCUMENT TITLE WASHER, SPRING TENSION

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach sheets if needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY DLA-IS

a. NAME E. DENNIS/E. ALTOMARI	b. TELEPHONE (Include Area Code) (1) Commercial (215) 697-3964/6827 (2) AUTOVON 442-3964/6827
c. ADDRESS (Include Zip Code) DEFENSE INDUSTRIAL SUPPLY CENTER 700 ROBBINS AVENUE, BLDG. 3 (CODE DISC-EEP) PHILADELPHIA, PA 19111 5096	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041- Telephone (703) 756-2340 AUTOVON 289-2340